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**Managing E-waste in The Kathmandu Metropolitan City: A Case of Ward
No. 22**

by

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ABSTRACT

The competitive electronic market and the growing consumer buying behavior are leading to the rapid obsolescence of electronic devices. The handling of e-waste at the end of its useful life after these devices are replaced or discarded for various reasons over time presents a challenging situation. The objective of this research is to understand the perspective of electronics consumers in managing their e-waste, taking the case of ward no.22 of Kathmandu Metropolitan City. Semi-structured questionnaires were developed using the variables identified in the literature. The questions were based on various grounds of information regarding demographic information, socioeconomic information, e-waste generation and disposal practice, awareness level, and consumer intentions toward e-waste disposal. Although consumers were aware of the problems of e-waste, the study's findings showed that there was a major lack of knowledge on its handling, including the existence of formal recycling centers. Furthermore, it was also found that most respondents were inclined to repair and selling their e-waste such as desktops and television to scrap dealers. But the scrap dealers do not follow scientific procedures of e-waste handling therefore, awareness efforts are essential to prevent the effects of inappropriate e-waste disposal. The research can help to create a guidance for creating long-term e-waste management plans in Nepal.

Keywords: E-waste generation, method of disposal, awareness level, e-waste management

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TABLE OF CONTENTS

COPYRIGHT	II
CERTIFICATE OF THESIS APPROVAL	III
DECLARATION	IV
ABSTRACT	V
ACKNOWLEDGEMENT	VI
TABLE OF CONTENTS	VII
LIST OF FIGURES	XI
LIST OF TABLES	XIII
LIST OF ABBREVIATIONS	XIV
1 CHAPTER ONE: INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Need of Research	4
1.4 Importance of Research.....	5
1.5 Research Objectives	6
1.6 Research Question.....	6
1.7 Scope and Limitations of Study	6
1.8 Expected Outputs	7
1.9 Research Area	7
1.9.1 Growth of technology	8
2 CHAPTER TWO: LITERATURE REVIEW	9
2.1 Operational Definitions of Important Key Terms	9
2.2 Composition of E-Waste	9
2.3 Categories of E-Waste.....	10
2.4 Effects of E-waste on Health and Environment	11

2.4.1	Human Health Aspect	11
2.4.2	Environmental Aspect.....	11
2.5	Socio Economic Benefits of Recycling.....	13
2.6	Theory of Planned Behaviour (TPB)	14
2.7	Household E-Waste Recycling Influences and Behavior	16
2.8	Types of E-Waste Generation in Different Land Use Zones	17
2.9	E-Waste Management Strategy	18
2.10	National Policy	20
2.10.1	Solid Waste Management Act, 2011	20
2.10.2	Solid Waste Management Rules, 2070 (2013)	21
2.10.3	Environment Protection Act, 2019	22
2.10.4	Kathmandu Metropolitan City Environment and Natural Resources Protection Act, 2073	22
2.10.5	15 th Five Year Plan	23
2.10.6	National Urban Development Strategy, 2017 NUDS	24
2.10.7	The Public Procurement Regulation, 2007	24
2.11	International Context.....	25
2.12	Contributions of E-Waste Management to Achieving SDG.....	27
2.13	International Convention.....	28
2.13.1	The Basel Convention.....	28
2.13.2	Vienna Convention and Montreal Protocol	29
2.13.3	Stockholm Convention on Persistent Organic Pollutants	29
2.13.4	Rotterdam Convention	30
2.13.5	Minamata Convention.....	30
2.13.6	The Durban Declaration.....	30

2.13.7	EU WEEE Directives & EU Restriction of Hazardous Substances Directive (RoHS).....	30
2.13.8	Solving the E-waste Problem (StEP).....	31
2.14	Case studies.....	31
2.14.1	E-Basura Programme, Argentina.....	31
2.14.2	Hewlett-Packard E-Waste Management in South Africa.....	33
2.14.3	Kitakyushu Eco Town Project.....	35
2.14.4	Chhatrapati Shivaji Maharaj International Airport.....	36
3	CHAPTER THREE: STUDY AREA.....	37
3.1	Study Area Selection.....	37
3.2	Waste Management in Kathmandu Metropolitan City.....	38
3.3	E-waste collection and disposal practices in Nepal.....	38
4	CHAPTER FOUR: CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY.....	41
4.1	Research Paradigm.....	41
4.2	Methods.....	43
4.2.1	Data and Document Collection.....	43
4.2.2	Case Studies and Literature Review.....	43
4.2.3	Field Visit for Observation.....	43
4.2.4	Interviews.....	43
4.2.5	Questionnaire survey.....	44
4.3	Framework for Data Collection.....	45
4.4	Data Points.....	46
5	CHAPTER FIVE: FINDINGS AND ANALYSIS.....	47
5.1	Results from Questionnaire survey.....	47
5.1.1	Socio-Demographic Information.....	47

5.2	Analysis of E-waste Generation Depending on Source	52
5.3	Analysis of E-waste Disposal Practice.....	53
5.4	Analysis of Awareness of level of people regarding the e-waste	55
5.4.1	Awareness of E-waste Problem	55
5.4.2	Awareness about E-waste Management	57
5.4.3	Willingness of people regarding E-waste Management	58
5.4.4	Relationship Between Education and Awareness Level.....	59
5.5	Analysis of Possible ways to reduce e-waste.....	63
6	CHAPTER SIX : DISCUSSION AND CONCLUSION	64
6.1	Discussion	64
6.2	Conclusion.....	65
7	CHAPTER SEVEN: RECOMMENDATION	67
7.1	Specific Recommendation.....	67
7.2	Policy Recommendation	67
7.3	Direction For Future Research	68
	REFERENCE.....	69
	ANNEX-I: QUESTIONNAIRES.....	76
	ANNEX II: KEY INFORMANT INTERVIEW	85
	ANNEX III: SITE PHOTOGRAPHS	89
	ANNEX IV:FINAL PRESENTATION COMMENTS	91
	ANNEX V:IOE GRADUATE CONFERENCE.....	92

LIST OF FIGURES

Figure 1: Projected e-waste generation worldwide.....	2
Figure 2: E-waste generation in tons from household waste of Kathmandu Valley	3
Figure 3: Blow Up Map of Kathmandu Metropolitan City	7
Figure 4: E-waste Composition by Percentage (Osibanjo & Nnorom, 2007)	10
Figure 5: Theory of planned behaviour (Cordano & Frieze, 2000).....	15
Figure 6: Circular Economy.....	18
Figure 7: E-waste management cocntributions to achieving SDG (Perina & Ratynski, 2019)	28
Figure 8: E-Basura Programme (ITU, 2018)	31
Figure 9: Training in PC assembly and repair (ITU, 2018).....	32
Figure 10: Waste to art product (ITU, 2018)	33
Figure 11: Kitakyushu Eco Town Project (Environment Bureu, 2019).	35
Figure 12: Wall art made from computer circuit boards (Singh, 2022).....	36
Figure 13: Study area	37
Figure 14: E-waste transported to India for recycling	40
Figure 15: Location of formal e-waste recycling company	40
Figure 16: Distribution of sample	44
Figure 17: Data Points	46
Figure 18: Chart showing age of respondents.....	47
Figure 19: Chart showing gender of respondents	48
Figure 20: Chart showing respondents education level	48
Figure 21: Chart showing education level of respondents.....	49
Figure 22: Chart showing total household monthly income of respondents	50
Figure 23: Chart showing building ownership.....	50
Figure 24: Chart showing family size of respondents	51
Figure 25: Chart showing building use in surveyed area.....	51
Figure 26: Chart showing percentage of unused electronics	52
Figure 27: Chart showing percentage of annual e-waste generation depending on source	53
Figure 28: Chart showing reason for discarding electrical equipment in percentage ..	54

Figure 29: Chart showing method of e-waste disposal in percentage	54
Figure 30: Open dumping of e-waste by repair shops	55
Figure 31: Chart showing awareness of e-waste problem	56
Figure 32: Chart showing awareness of e-waste management	57
Figure 33: Chart showing willingness of consumers regarding e-waste management	59
Figure 34: Chart showing Education Level and Awareness of electronic products that are not used are considered e-waste	59
Figure 35: Chart showing Education level and awareness of improper disposal of e-waste leads to health and environmental degradation.....	60
Figure 36: Chart Showing Education level and awareness of hazardous content in e-waste can enter food cycle through crops and plants.....	61
Figure 37: Chart showing Education level and awareness of unsafe manual dismantling of e-waste affects worker health	61
Figure 38: Chart Showing Education level and awareness of extended use of refurbished products.....	62
Figure 39: Chart showing Income level and Willingness to pay	63
Figure 40: Electronic waste stores at home with other waste	64
Figure 41: E-waste Section	88
Figure 42: Method of Disposal	88
Figure 43: Newroad	89
Figure 44: Pako Newroad	89
Figure 45: Dharmapath	89
Figure 46: Ranjana Galli	89
Figure 47: Ganabahal	90
Figure 48: Tebahal	90

LIST OF TABLES

Table 1:Waste composition of Kathmandu Mahanagarpalika (DOE, 2022).....	38
Table 2: Framework for Data Collection	45
Table 3: Final Presentation Comments	91

LIST OF ABBREVIATIONS

CBS- Central Bureau of Statistics

CRT- Cathode Ray Tube

DNA- Deoxyribose Nucleic Acid

ICT- Information and Communication Technology

KII - Key Informant Interview

KMC - Kathmandu Metropolitan City

LCD - Liquid Crystal Display

LED - Light Emitting Diode

NUDS - National Urban Development Strategy

PCBs - Printed circuit Boards

UNEP- United Nations Environment Programme

1 CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Electronic waste is also referred to as "e-waste" or "waste electronic and electrical equipment" (WEEE). In large cities in developing countries with rapid urbanization, it is the waste stream that is rising at the highest rate (Khatri, 2018.). Electronic waste is largely the outcome of the IT boom causing a serious threat to ecology. Britannica defines e-waste as, "Discarded or old electronic devices containing toxic substances such as lead, mercury, cadmium, and chromium, which demand proper processing before its scientific disposal".

The competitive electronic market and the growing consumer buying behavior are leading to the rapid obsolescence of electronic devices. Over a period, when these devices are replaced or discarded for various reasons, the end-of-life management of electronic waste (e-waste) becomes a complex challenge. Unlike other solid wastes, e-wastes cannot be treated easily as they contain several components including metals, non-metals, chemical compounds, plastics, and other hazardous substances. Hence, the treatment or recycling of electronic waste is extremely challenging (Shevchenko et al., 2019).

It has been banned to dump e-waste in developing countries after the Basel Convention in 1989. Since it became illegal to dump e-waste in many areas of the world. A new solution had to be developed to properly deal with electronic waste disposal. As a result, the practice of legally and safely recycling of used electronic equipment has emerged. The Step (Solving the E-Waste Problem) Initiative is an illustration of such a method. It was established in 2004 as a free-standing, multi-stakeholder platform to support the discovery of creative solutions to the world's e-waste concerns (Khatriwal & Kuehr, 2016.). Through this project, worn-out electronic equipment can be recycled legally and scientifically.

The Global E-waste Monitor (2020) estimates that up to 50 million metric tonnes of electronic waste are thrown away globally each year, with the majority of this waste being illegally transshipped into developing and underdeveloped nations. If this pattern holds, the yearly global production of e-waste will increase by almost 30% by 2030. The UN report also states that if we carry on consuming irresponsibly like this, it is

estimated that we could reach 120 million tons of electronic scrap by 2050. This highlights the growing need for e-waste management as only 20% of this waste is recycled.

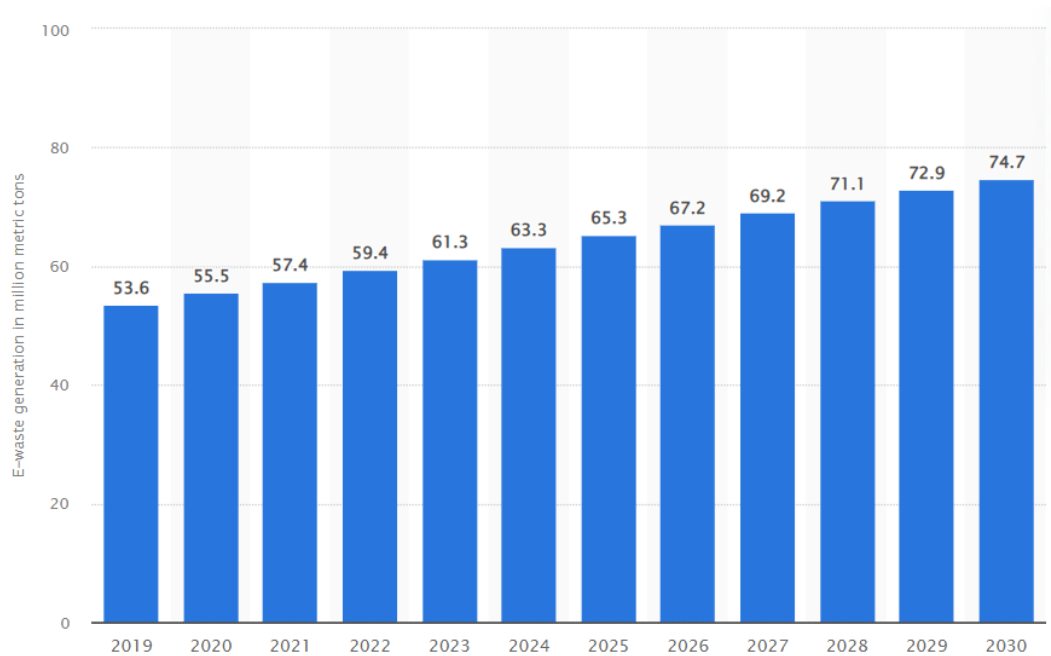


Figure 1: Projected e-waste generation worldwide

Nearly 20.62 million tons of electrical and electronic equipment were consumed in Asia in 2005, and that number rose to 26.69 million tons in 2012 (Khetriwal & Kuehr, 2016.). It has become a dumping ground for the world’s used and discarded electronics. Concerns regarding the feasibility of current waste infrastructure to handle the rising volume of e-waste in Asia are mounting, especially because electronics contain several ecologically harmful compounds such as mercury, lead, arsenic, and beryllium. When these end up in landfill, chemicals can leach into the soil, air, and nearby water.

The most serious problem with e-waste in Nepal is that the government lacks legislation or regulations about how to properly handle harmful e-waste. The Environment Protection Act of 2018 is the only legislation the government uses to address matters relating to the environment, and it makes no mention of e-waste management (MoEF, 2019). In 2017, Kathmandu dumped around 18,000 metric tons of e-waste (Nepali Times, 2018). According to a survey, households in Kathmandu are the main producers of waste electrical and electronic equipment due to the introduction of new technology

and consumers' frequent desire to purchase new products for a higher quality of life (Luitel, 2017). In 2017, the average amount of e-waste generated per KMC household was found to be 1.52 to 1.74 kg, accounting for 0.38-0.43% of total municipal waste generated by KMC households (Luitel, 2017). Although that may not seem like much, but much more is discarded without the knowledge of the municipality.

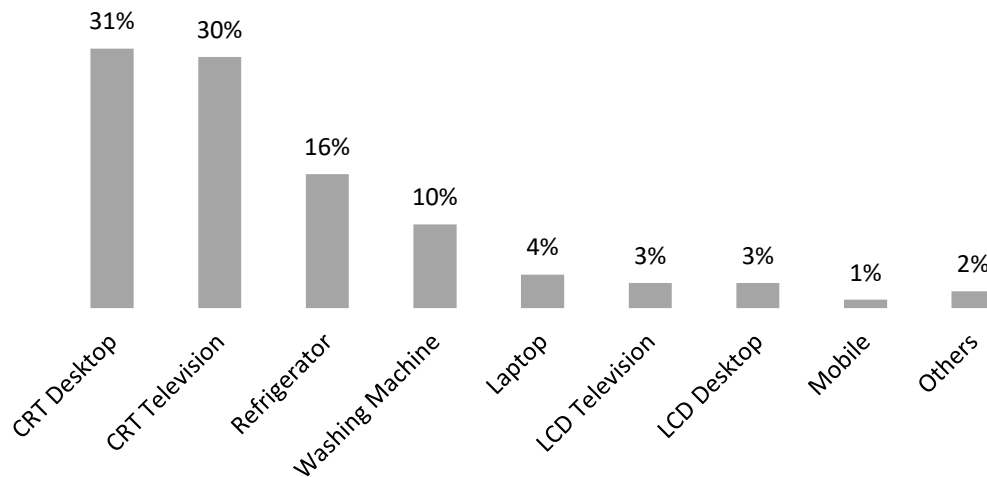


Figure 2: E-waste generation in tons from household waste of Kathmandu Valley

The highest category supporting e-waste generation, as shown by the bar chart, is CRT-based PCs. Other significant categories that support significant e-waste generation include televisions and refrigerators. CRT technology is on the verge of going extinct internationally due to technological advancements and the introduction of energy-efficient and lightweight LED/LCD devices. Such a trend also has an impact in the Kathmandu Valley. Mobile phones produce the least amount of electronic waste when measured in terms of weight due to their average weight of only 200 gm, despite the fact that they produce a lot of waste when measured in terms of quantity.

1.2 PROBLEM STATEMENT

The rapid growth of technology, its faster acceptance by the masses, and the urge to find newer product variants, are creating a global waste in the form of obsolete electronics. The need to obtain raw materials from the environment for the manufacture of electronic equipment, as well as the waste produced when electronics reach the end of their useful lives, place a heavy strain on mother earth and disrupt the sustainability of the environment. As e-waste damages both people and the environment, authorities are worried about its growth and the challenges associated with disposal. Many laws

and procedures have been put in place to lessen the risks associated with e-waste across nations, but there are still several issues that need to be resolved.

The Government of Nepal has not made many successful initiatives for the disposal of e-waste in the country as society lacks awareness or facilities for recycling and scientific disposal (Bhat & Savale, 2019). Due to the danger involved in managing this type of waste at dump sites, Nepal may experience difficulties in the near future. To stop unsafe dismantling, the extraction of valuable metals, and the disposal of hazardous waste in landfills that contaminate the soil, groundwater, and rivers, the government must implement an e-waste management policy.

According to a study by Bhutta et al. (2011), the average lifespan of electronic products, which is less than two years for computers and cell phones, is a significant contributor to the growing e-waste problem. According to Sanjay Golcha of Him Electronics, the Nepali culture of repair has been undermined by the rapid growth of e-waste generation, caused by increasing purchasing power, intentional obsolescence of electronic devices, and a lack of strict control on disposal (Nepali Times, 2018).

Since the recyclers of e-waste engage in crude practices like open burning, which could affect both the environment and human health if they are not made aware in time. To lessen the negative effects that the dangerous substances in e-waste have on the environment and people's health, this issue of improper waste management needs to be addressed.

1.3 NEED OF RESEARCH

A study by Parajuly et al. (2018) found that Nepal does not have an official system for the separate collection or treatment of e-waste stream. The majority of e-waste is collected by repair shops, which sell up to 50% of total e-waste collections to scrap merchants. Scavengers, scrap hawkers, and scrap dealers carry out the overall recycling process by separating the reusable pieces and illegally exporting them to another nation for proper recycling. Most of Nepal's electronic waste is sent to India, where it is chemically treated to remove valuable materials like gold and silver. It is necessary to expand our processing facility here in Nepal and turn waste into resources from the government level rather than selling what is a goldmine.

Most people are unaware of the potential negative effects that could arise from the rapidly growing use of computers, monitors, and televisions. Due to the hazardous materials they contain, when old electrical and electronic devices are disposed of in landfills or burned, they pose health risks like cancer and neurological and developmental disorders. Scrap dealers choose only the most valuable waste, which results in hazardous waste being dumped in landfills and unsafe dismantling for the extraction of useful metals, poisoning the soil, groundwater, and rivers. It is possible for unsafe disposed electronic waste to harm the environment.

There is also an absence of public awareness about the recycling concept in our society. Many people are unaware that formal recycling facilities exist in Nepal that are in charge of handling e-waste in a safe manner. Also, the Solid Waste Management Act, (2011) makes no mention of handling hazardous e-waste, a policy for its disposal is need for efficient management.

1.4 IMPORTANCE OF RESEARCH

Nowadays, the majority of consumers purchase electronic goods. The purchase of electronic equipment has increased due to rapidly developing technology. According to a Statista report, from 2013 to 2020, the number of units sold for intelligent devices increased and reached about 60 million units. Also, the coronavirus pandemic had a great impact on sales of consumer electronics due to online classes or being connected to friends and family. E-waste is being added to the solid waste stream as a result of consumers being forced by faster technological advancements to dispose of outdated electronics quicker. As a result, this research is essential to motivating customers to properly dispose of their e-waste and adopt sustainable consumption habits.

According to the 3Rs Principle, recycling decreases the amount of waste that needs to be disposed of permanently, conserves natural resources, and increases energy efficiency. If discarded electronic gadgets are restored, utilized, and donated to a good cause, they can be kept out of landfills. Refurbish outdated electronics and distribute them to those who would otherwise go without them. "Reuse" is a key part of preventing waste from entering the system.

Recycling valuable components can also help in reducing the demand for raw materials by recovering valuable elements from discarded items. It will contribute to the

preservation of vital natural resources. Utilizing recycled materials will also assist in lowering greenhouse gas emissions created during manufacturing and in keeping dangerous substances out of the environment.

Therefore, the study of managing e-waste in urban areas of Nepal is very important and can be done by developing new policies and strategies for e-waste management. In most cases, the household's electronic waste is stored inside the home. The research can help to generate different management ideas that will be useful at local as well as national levels.

1.5 RESEARCH OBJECTIVES

The main objective of this research is to study e-waste management in different landuse zones of ward number 22 in Kathmandu Metropolitan City. The specific objectives include:

- 1) To study the e-waste generation depending on the source.
- 2) To identify the disposal practice of e-waste in the study area.
- 3) To understand the level of awareness of the public regarding e-waste.
- 4) To find possible ways to reduce e-waste going to landfills.

1.6 RESEARCH QUESTION

- 1) How does the generation of e-waste differ depending on the source?
- 2) What are some of the general practices of disposal of e-waste?
- 3) What is the awareness level of people regarding the e-waste problems and e-waste management?
- 4) What are the possible ways to reduce e-waste going to landfills?

1.7 SCOPE AND LIMITATIONS OF STUDY

This study examines how different types of customers, including residential, commercial, and institutional ones, manage their e-waste in Kathmandu Metropolitan City's ward number 22. Different electronic product categories have been included in the survey to understand the current disposal practices followed by the consumers. Due to practical limitations to including all the electronic products, only selected products were considered in the study. Other limitations include

- 1) The research studied the point of view of electronic waste only. Future studies could be incorporated with the perspectives of other digital waste such as spam.
- 2) Some recycling companies were hesitant in permitting to visit their recycling center.

1.8 EXPECTED OUTPUTS

The management of e-waste is very important as people are buying electronics without being aware of their disposal. This study helps to understand the cause of the gap in the awareness of local communities in sustainable e-waste management. There are several solutions which can only be introduced with proper management and user education. If we want a healthy cities in future, we should promote recycling and reusing electronic products. Thus, the

- Identification of the current practice of e-waste management in ward no.22 of Kathmandu Metropolitan City.
- Identification of strategies for solving the problem of e-waste management in urban areas.

1.9 RESEARCH AREA

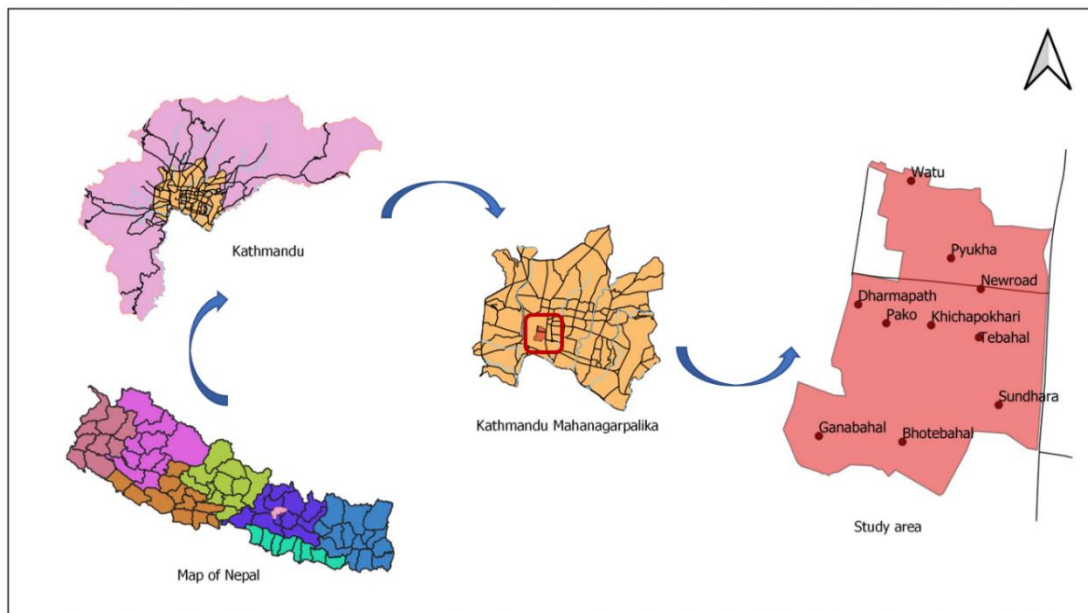


Figure 3: Blow Up Map of Kathmandu Metropolitan City

Kathmandu is the administrative and commercial center of Nepal and is one of the most ancient settlements in the world. Kathmandu metropolitan city is the largest metropolitan city in Nepal which is home to 845,767 inhabitants living in 105,649 households in 2021 (CBS, 2022). Kathmandu has been an important trading center over the centuries due to its location between India and China.

1.9.1 Growth of technology

Information and communications technology (ICT) is one of the fastest-growing industries in Kathmandu, and it has a lot of potentials to grow even more rapidly in the near future (GoN, 2017). The following subsectors and services are included in the ICT sector:

- **Communications Services** such as Internet, telephone and mobile communication
- **IT services** such as IT Enabled Services (ITES) and Business Process Outsourcing (BPO)

In comparison to other South Asian nations, Nepal generally has lower pricing for IT developers. In 2016, Nepal was able to enter the global market and establish itself as an alternative location for offshore outsourcing for Pakistan, India, and other Asian nations (GoN, 2017). For businesses looking to outsource from Europe and America, the Nepalese time zone is perfect. According to FNCCI, numerous businesses have expanded their operations in Nepal and created a niche market for their goods abroad. Every year, about 5,500 graduates from Nepal work in the IT industry. Additionally, the continued advancement of internet and telecommunications technologies is a factor in the rise in the use of electronic device.

The number of Internet users in Nepal has increased significantly over the past 20 years, rising from less than 50 users in 1995 to 14.3 million users in October 2016. The significant digital divide in Nepal offers chances for investors. As of October 2016, there are 23 active ISPs in the nation (GoN, 2017).

2 CHAPTER TWO: LITERATURE REVIEW

2.1 OPERATIONAL DEFINITIONS OF IMPORTANT KEY TERMS

E-Waste: Electrical and electronic devices that have been abandoned are referred to as "e-waste." For instance, radios, laptops, and mobile phones which are no longer in use for a various reasons. Used electronics that are destined for recycling, disposal, salvage, or resale are referred to as e-waste. Handing out electronic waste informally can have a harmful effect on human health and pollutes the environment. (Selvakani, 2021).

Planned obsolescence: The term "planned obsolescence" refers to the planning or design of a product with a finite lifespan. For example, if the components in a device are glued together, it is difficult to replace broken components. As a result, the product is replaced with a new one instead of being repaired (Pohjalainen et al., n.d.).

Awareness: Awareness is the condition or capacity to recognize, feel, or be mindful of things, events, or sensory patterns. In this study, the investigator measures the level of e-waste awareness of consumers on scientific disposal of electrical and electronic equipment (Selvakani, 2021)

Environmental Attitudes: An individual's care for the physical environment is referred to as their environmental attitudes. According to the attitude theory, environmental attitudes are viewed as being made up of beliefs and feelings regarding an object. It is challenging to identify the environment as an object, which has implications for research on broad environmental views (Selvakani, 2021).

2.2 COMPOSITION OF E-WASTE

E-waste normally contains more than 1000 different substances both hazardous and non-hazardous materials (Abdallah, 2020). The type of electronic device, the model, the manufacturer, the date of manufacture, and the age of the scrap all affect the composition of e-waste. Scrap from IT and telecom systems contains more precious metals than scrap from residential appliances (Chancerel et al., 2009). A distinct approach should be taken to avoid discarding rare and valuable materials from e-waste.

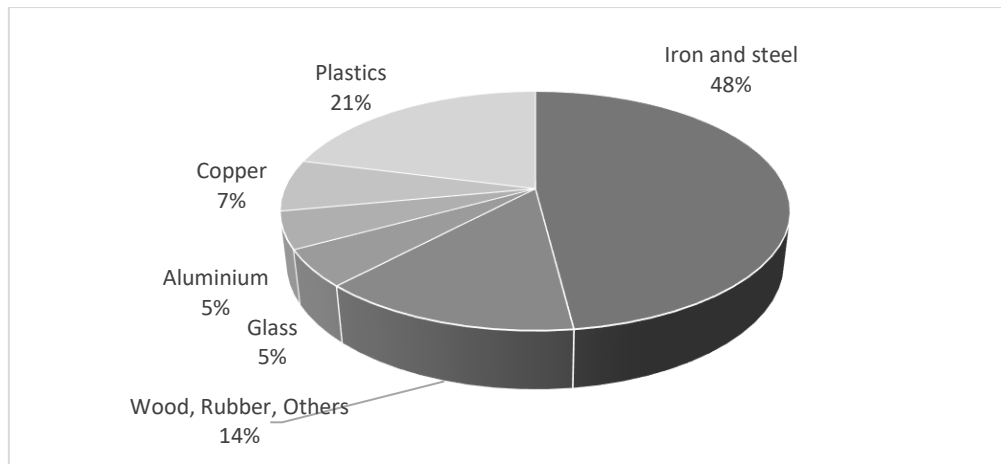


Figure 4: E-waste Composition by Percentage (Osibanjo & Nnorom, 2007)

Lead is the material of most concern in e-waste. Because of their toxic nature, cathode ray tubes are no longer allowed to be disposed of in landfills in the US, other industrialized nations in the EU, and Japan. Heavy metals like cadmium, chromium, mercury, antimony, polybrominated diphenyl ether (PBDE), and polybrominated biphenyls, as well as brominated flame retardants (BFRs), are among the other components of WEEE that raise environmental health concerns (PBB) (Osibanjo & Nnorom, 2007).

2.3 CATEGORIES OF E-WASTE

The Step Initiative defines WEEE/e-waste as all electrical and electronic equipment (EEE) and its components that have been thrown out as waste by their owner with no intention of being reused (UNEP, 2017). Electronic waste is essentially any appliance or commercial gadget with circuit or electrical components that need electricity or batteries. WEEE/e-waste can be categorized using the list below.

- 1) Temperature-Exchange Equipment: refrigerators, air conditioners, heat pumps, and freezers.
- 2) Screens, monitors: laptops, televisions, and monitors
- 3) Lamps: LED and high intensity discharge lamps
- 4) Large Equipment: photovoltaic panels, copy machines, and washing machines
- 5) Small Equipment: radios, scales, calculators, video cameras, vacuum cleaners, electric shavers
- 6) Small IT and Telecommunication Equipment: Smartphones, GPS units, routers, printers, and telephones

2.4 EFFECTS OF E-WASTE ON HEALTH AND ENVIRONMENT

2.4.1 Human Health Aspect

Electric lamps, audio equipment, batteries, personal computers, mobile phones, and other electronic devices all contain dangerous elements including mercury, lead, and cadmium, while printed circuit boards (PCBs) include nickel, beryllium, and zinc. The most hazardous material is lead due to its toxic nature. The study of (Bhutta et al., 2011) found that lead impairs behavior and learning in people, excessive copper intake damages the liver, and cadmium exposure increases the risk of lung cancer and kidney damage.

Lifetime cancer risks for inhabitants and workers due to presence of chromium, nickel, lead, and cadmium in electronic items was found (Fang et al., 2013). Women who are exposed to cadmium over their lifetime have increased risk of mortality, as well as a significantly higher relative risk of renal illnesses (Nogawa et al., 2018). Residents, especially youngsters living near to informal recycling sites are more likely to develop cancer than at formal recycling sites (Zhang et al., 2013).

The study of Guo et al. (2009) in China on the health consequences of newborns, kids, adults found that there are a number of detrimental impacts on the health of newborns when pregnant women are exposed to heavy metals from e-waste (Guo et al., 2009). These detrimental effects include an increase in stillbirths, preterm births, and spontaneous abortions. Because of their exposure to nickel, chromium, and manganese, children between the ages of 8 and 9 were also shown to have issues with their lung function (Zheng et al., 2013). Those exposed, including newborns and kids, have shown signs of thyroid malfunction and DNA damage (Li et al., 2008).

2.4.2 Environmental Aspect

Due to a lack of proper technologies, e-waste is handled by informal sectors in the majority of developing nations solely to recycle precious elements using crude processes. For instance, copper from discarded printed circuit boards (PCBs) is recycled using hydrogen peroxide as an oxidant in a sulfuric acid solution at room temperature (Yang et al., 2011). Another example given by Rao (2014) focused on the problems in Guiyu, Hong Kong, a region where illegal e-waste recycling is flourishing, which explains that river water in Guiyu is contaminated and facing a problem of water shortage.

The earth will become more acidic if waste acid and sludge from the melting of computer chips are thrown on it. During the recycling process, it has been claimed that waste materials such toxic metals and acid used in acid baths to remove valuable metals from circuit board components are dumped into the ground by digging pits or into nearby streams (B. H. Robinson, 2009). This shows that recycling plants are still using outdated technology, which is harmful to employee occupational health and the local environment.

The stages of the e-waste lifecycle, but especially the informal recycling techniques, which include burning, dismantling, and then repairing activities are the most harmful to the environment. Metal concentrations at e-waste recycling plants for some metals were 100–1000 times greater than at control sites (Ohajinwa et al., 2018). During informal recycling, the dismantling stage may result in unintentional leaks and spills of dangerous compounds (Premalatha et al., 2014).

Despite the fact that metals can contaminate the soil, water, air, sediments, plants, and marine life, this poses a major environmental risk (Ohajinwa et al., 2018). As a result, heavy metals can poison plants, causing phytotoxicity, which results in weak plant development, chlorosis, decreased nutrient uptake, a disruption in plant metabolism, and decreased nitrogen fixation in legume plants intended for human consumption (Guala et al., 2010). Consequently, exposure to humans and animals occurs through consumption of food, inhalation of air, ingestion of dust or dirt, and even skin contact (Li et al., 2011). Metals can dissolve in water and be easily absorbed by fish and other marine life, harming human health and the aquatic life and quality of the water (Ohajinwa et al., 2018).

Another potential source of dangerous metals in the environment, especially in areas without official treatment facilities, is batteries (Awasthi et al., 2005). Rechargeable lithium-based batteries are a common source of metals like copper, nickel, lead, cobalt, silver, and thallium in portable electronic gadgets. When the battery corrodes, these metals leak out and cause poisoning (Kang et al., 2013). If these metals and compounds are not appropriately handled, they could cause significant environmental harm. For instance, the battery of a single mobile phone has the potential to poison 600,000 liters of water (He et al., 2006).

2.5 SOCIO ECONOMIC BENEFITS OF RECYCLING

Since formal sites don't employ children and adhere to rules and regulations, they may have higher requirements for occupational health and safety (Ceballos & Dong, 2016). Furthermore, since employees only work for eight hours a day in formal recycling facilities, they would be exposed to less contaminated water, air, soil, and food (Julander et al., 2014). Additionally, formal recycling can assist in recovering about 99.9% of the mercury from lamps and switches and reuse more than 98% of plastics, metals, and wood (Kaya, 2016).

In Pakistan, where workers were not eligible for any social aid, it was discovered that working hours were over 72 hours a week (Umair et al., 2015). This is only one example of how informal recycling techniques typically have a detrimental societal impact. A large portion of recycling is carried out by disadvantaged individuals, frequently members of the same family who are unskilled laborers who work in close proximity to where they live, eat, and sleep (Premalatha et al., 2014). Despite its drawbacks, the informal recycling sector plays a critical role in economic growth and contributes to the fight against poverty (Lin et al., 2002).

McMahon et al. (2021) evaluated the employment potential of formal e-waste pre-treatment factories in Ireland and found that although 400 kg of mixed waste produces 1 full-time equivalent job, diverting e-waste from the scrap yard might provide 12- 14 jobs in the pre-treatment plant. The collection, recycling, and repair of e-waste employed between 20,300 and 33,600 people in Ghana in 2010, according to a calculation by Prakash & Manhart (2010). Furthermore, it was predicted that 144,000 more people were indirectly employed as a consequence of renovation operations, and 57,600 more people were indirectly employed that year as a result of collection and recycling.

With the revelation that urban mining is more affordable than virgin mining, e-waste management, specifically recycling of outdated electronic gadgets, is a modern economic potential. Urban mining is the recovery of metals from abandoned electronics, such as copper, gold, etc., whereas virgin mining is the extraction of materials straight from the ores (Zeng et al., 2018). Many researchers have emphasized the existence of precious metals as the main economic driver of the e-waste recycling

industry since e-waste may include metals in greater abundance than ores (Dong et al., 2007).

Obsolete discarded electronic devices are rich sources of rare and precious metals. A ton of cellphones, for instance, has 100 times more gold than a ton of the same weight of gold ore. Resources found in e-waste are estimated to be worth \$62.5 billion annually (Scharfglass, 2019). According to a report by the Environment Protection Agency (EPA) in India, recycling 1 million cell phones resulted in the production of up to 35,000 pounds, 772 pounds, 75 pounds, and 33 pounds, respectively, of metals like copper, silver, gold, and palladium (EPA, n.d.).

One of the economic aspects of e-waste management is the recovery of precious metals and other components from electronic waste. A ton of discarded cell phones (6000 units), according to a UNEP study, contain valuable metals with a market value of \$15,000. It also stated that recycling aluminum from e-waste rather than mining it from ores can save 90% of the energy. Reusing 10,000 computers would result in the creation of 296 additional jobs rather than their disposal in landfills or incinerators (UNEP, 2013).

2.6 THEORY OF PLANNED BEHAVIOUR (TPB)

Electronic waste management is an area that involves several stakeholders such as the manufacturers of products, users or consumers of the product including individual and bulk consumers, post-consumption scrap dealers such as waste collectors, middlemen and recyclers, and the government.

Frequently employed theories in this field include Intentions serving as the primary dependent variable in the Theory of Planned Behavior (TPB), which was developed by Icek Ajzen in 1985 (Ajzen, 1991). It is a model that seeks to explain how an individual's beliefs are linked to their actions. According to the theory, there are three constructs that influence behavioural intentions which includes attitude, subjective norms and perceived behavioural control.

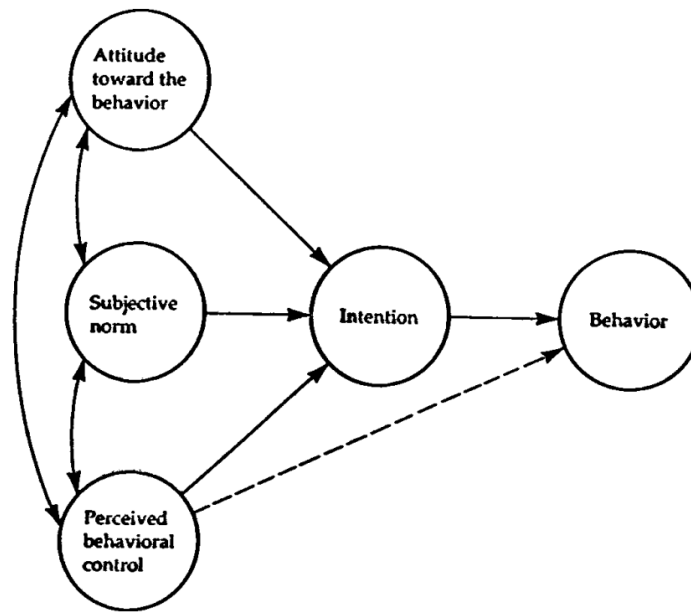


Figure 5: Theory of planned behaviour (Cordano & Frieze, 2000)

Attitude: The degree to which a person views a particular behavior favorably or unfavorably is referred to as their attitude toward that behavior (Ajzen, 1991). Attitude is influenced by behavioural belief regarding the performance of the behaviour (Ajzen, 1991).

Subjective norms: A subjective norm, or felt social pressure to do or not do something, is the second antecedent of a behavioral intention in the TPB model, emphasizing the effect of other individuals who are significant to or close to the actors, such as family, close friends, relatives, and coworkers. (Sari et al., 2021).

Perceived behavioural control: According to Ajzen and Madden (1986), perceived behavioral control refers to an individual's thoughts about the possibilities and resources available to carry out a particular behavior (Ajzen and Madden, 1986). The control beliefs are internal, such as knowledge, talents, or planning, and external, such as chance, circumstance, time, other people's cooperation, etc. In Beijing, China, it was found that there is a favorable correlation between waste sorting behavior in homes and perceived behavioral control (Yuan et al., 2016).

A study conducted among managers of electronic manufacturing units in Thailand Sanitnarathorn (2019) found that subjective norms influenced intentions for e-waste management among the manufacturers. Attitude represented mediating effect between

independent variables and the dependent e-waste management among manufacturers (Sanitnarathorn, 2019).

2.7 HOUSEHOLD E-WASTE RECYCLING INFLUENCES AND BEHAVIOR

Depending on the product type, homeowners commonly employ a range of methods to dispose of their electronic waste. For instance, Study of Darby and Obara in Devon, UK in 2005 found that tiny e-waste items like batteries and electric toothbrushes are regularly thrown out with typical household waste, whereas a home stereo may be given away or sold.

For a variety of reasons, including data security concerns and the need for a backup, homeowners may decide to keep their e-waste (Baxter et al., 2016). Households typically choose to keep outdated electronics rather than recycle them, especially old cell phones. Up to 60% of cell phones that are no longer in use are kept in cabinets and drawers, according to research by Ongondo & Williams (2011). Yet research indicates that stored e-waste is rarely used again (Baxter et al., 2016).

According to Baxter et al. (2016), if consumers were made aware of the drawbacks of stockpiling e-waste, such as the need for ongoing precious metals mining and subsequent environmental degradation, or low levels of recycled product entering the resource cycle reducing the recycling opportunities available to them, they might be persuaded to recycle more.

Although some consumers may be aware that certain e-waste contains valuable materials. Song et al. (2012) conducted a research in Macau and discovered that many of the locals they polled had no idea what e-waste was, and about 30% of respondents did not believe that e-waste had a negative impact on the environment. This highlights the need for “more general education and information about the broader issues underlying waste management” (Martin et al., 2006).

Customers views on recycling are initially influenced by the accessibility and familiarity of resources and services, followed by convenience, according to Tonglet et al. (2004). The value-action gap, sometimes referred to as the recycling intention-action gap (Blake, 1999), could be explained by elements including motivation, knowledge, awareness, values, attitudes, and priorities (Kollmuss & Agyeman, 2002). The value-action gap considers the idea that, even while consumers may be aware of and believe,

for instance, that recycling is good for the environment, this may not necessarily translate into real recycling activity. Cost can have a significant influence on how pro-environmental behavior is displayed. These findings show that in order to encourage households to join in recycling programs, they must be useful, economical (or even free), and easy to use.

2.8 TYPES OF E-WASTE GENERATION IN DIFFERENT LAND USE ZONES

Households, institutions, and businesses that pollute our environment are the major sources of e-waste generation. People use electronic devices to get their work done in shorter time. Due to this, households have been compelled to switch to more modern devices, which has increased generation of waste (Borthakur & Singh, 2022). For instance, phones are being upgraded at an accelerated rate, it is more likely that outdated phones will be discarded.

Due to the introduction of new technologies and consumers ongoing desire to purchase new appliances for a better lifestyle, households are today the primary supplier of electrical and electronic equipment. As a result, the outdated or defective equipment is thrown away. For instance, every month, the computer industry introduces new goods and updates to the market. Due to new software being insufficient for or incompatible with older hardware, the usable life of a personal computer has shortened from five to two years. As a result, customers are pressured to purchase new PCs (DOE, 2017).s

Household e-waste can be separated into two distinct categories. White goods, or household appliances, make up the first section. Each home at least has standard appliances like refrigerators and washing machines. Most of the weight in e-waste is made up of these huge white products. Computers, televisions, and mobile phones fall within the second group of products, which is known as "brown goods." The vast majority of these products are small and medium in size (Darby and Obara, 2005).

Electronic products including computers, printers, copiers, and other devices are widely used by small and large businesses, institutions, and government organizations. To ensure compatibility with the newest software, large corporations frequently upgrade the computers used by their employees. For instance, the largest computer software

company, Microsoft Corporation, which employs over 50,000 people globally, updates each machine every three years (Kunacheva, 2006).

Since it is illegal for users to dispose of their computers in landfills, their electronic waste is instead sold on the resale, refurbishing, recycling, and export markets. Some major firms rent their computers from rental companies or manufacturers, like Hewlett Packard and IBM, who pick up functional and malfunctioning equipment at the completion of contracts. When rental companies remove hundreds or even thousands of computers all at once, e-waste is produced. The number of rental computers is huge compared to new computer sales to enterprises. Even the national government and institutions now prefer renting computers than buying them (IBM, 2006).

2.9 E-WASTE MANAGEMENT STRATEGY

Circular Economy

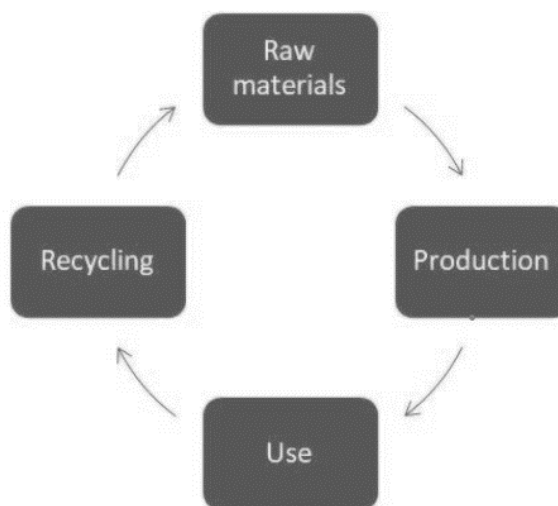


Figure 6: Circular Economy

The linear economy of today can be contrasted with the circular economy. Products in a linear economy are made to be manufactured, used, and then thrown away as waste. In a circular economy, resources and goods are reused throughout their useful lives before being recycled to make new items. E-waste can therefore be viewed as a resource or a waste, depending on the perspective. The objective is to decrease both the use of raw materials and the generation of waste. Basically, this is how nature works. The gold, silver, and bronze medals for the 2020 Tokyo Olympics manufactured from the

millions of abandoned cellphones and other consumer electronics is one of the example of circular economy.

The transition from a linear to a circular economy requires that items be designed sustainably. This means that items must be made to be long-lasting, repairable, and ultimately easily recyclable. For example: A company that creates and distributes modular phones, Fair Phone, is an illustration of a sustainable design. Longer lifespans are made possible since customers can change damaged parts on their own (Pohjalainen et al., n.d.).

Extended Producer Responsibility (EPR)

Extended Producer Responsibility is a producer's duty for a product is extended through the post-consumer stage of its life, including its eventual disposal, under the responsible approach to environmental policy (Singh, 2016). EPR regulation encourages companies to change their designs in a way that reduces waste, serving as a tool for sustainable development (Kiebert, 2004).

EPR may include one or more of the following:

- i. **Prolong product life:** Manufacturers must design durable products that may be utilized for a long time before becoming out of style. Several electrical chain retailers are actively extending the life of their products by offering extended warranty agreements for goods bought from their stores. For instance: Seng Heng will repair electrical equipment purchased from their outlets within the warranty period, which lasts up to five years. If the product is beyond repair, the retailer will replace and throw away the defective products without charge throughout the specified guarantee period.
- ii. **Modular design to ease upgrading, disassembly and recycling:** To make maintenance and the repair of faulty or broken parts easy, product engineers and designers must create products with modular design.
- iii. **Take back programme (TBP) incentives/ Buy Back Method:** Producers have drop-off or collection locations for e-waste. TBP's primary goal is to prevent electronic waste from ending up in landfills. Consumers' unwanted electronic waste can be returned. Lowering production costs, enhancing brand awareness, adapting to changing customer expectations, and protecting aftermarkets are

some of TBP's goals (Toffel, 2004). Takeback system can be divided into store retailer take back and producer take back. Either the store retailers or producers taking back the product recycle the materials, which reduces the burden of taking new materials from ores or they create new products by restoring older products.

- iv. **Substitute the used materials with new ones:** Producers need to do more research to develop new raw materials that provide little to no negative risk throughout operations for recovery, reuse, recycling, or disposal. Some companies, including LG, Sony Ericsson, Nokia, Samsung, Wipro, and Infosys, have taken proactive steps to reduce or eliminate the use of hazardous chemicals and materials in their products (Abul Hasan et al, 2010).

Tax Credits

Consumers that bring their e-waste to be recycled and organizations that collect electronic waste for recycling both receive tax credit. With this choice, the industry for recycling electronic waste could expand (Columbia University, 2006). The choice can be taken into account by producers and manufacturers who adopted the concept of eco-design, that is, adopted innovative activities for developing cleaner electronic and electrical products that are more durable, energy efficient, avoid the use of toxic materials, and are easily disassembled for recycling, even though it may be an additional administrative and financial burden on the government.

Deposit Refund System

Consumers who purchase electronic products pay a fee that is later reimbursed when they recycle the product with a recognized recycler. Customers who choose this option are given incentives to recycle their electronics. Additionally, if enacted, it could add to the administrative burden on the government, recyclers, and producers.

2.10 NATIONAL POLICY

2.10.1 Solid Waste Management Act, 2011

- In Nepal, primary national law governing the waste management sector is the Solid Waste Management Act (Solid Waste Management Act, 2011).

- The Act defines "solid waste" broadly to include all waste categories, including household, industrial, chemical, medical, and hazardous waste. But, there is no safe mechanism for collecting any kind of e-waste in Nepal by government sector(Parajuly et al., 2018).
- The objective of the act is to maintain a clean and healthy environment by minimizing the negative effects of solid waste on the environment and the general public.
- According to the act, municipal governments must take the necessary steps to encourage 3R (reduce, reuse and recycle), including source-separating.
- Additionally, it allows for open bidding participation in SWM from the corporate sector, community-based organizations (CBOs), and non-governmental organizations (NGOs).
- Physical, socioeconomic, and consumption patterns all have an impact on the types of waste that are produced and the technologies that are employed to treat it before disposal.

2.10.2 Solid Waste Management Rules, 2070 (2013)

- It includes a provision for the management and discharge of hazardous and chemical waste.
- It is against this act to mix hazardous, chemical, organic, or inorganic waste with other waste.
- Method, technology, and management should adhere to the standards defined by the Government of Nepal.
- Only after hazardous, chemical, organic, or inorganic waste has been converted into a general waste should arrangements be made for final discharge.
- When managing hazardous, chemical, organic, or inorganic waste, any individual, group, or agency creating such waste must adhere to all environmental laws in effect as well as the government of Nepal.
- The collecting, storage, and transportation of hazardous waste shall only be done using a safe way.
- The final discharge and disposal of harmful waste shall only be carried out if the treated waste has been transformed into normal waste.

- Unfortunately, this legislation also did not mention e-waste as a particular waste stream.

2.10.3 Environment Protection Act, 2019

- Any substance designated in the Basel Convention that is not reused and has a negative impact on the environment is a hazardous substance under this act (MoEF, 2019).
- Sample collection is permitted if the concerned body intends to study, test, examine, or analyze the wastes that are likely to be produced by mechanical equipment, such as a machine or a motor vehicle.
- The responsible person or body must properly manage the hazardous substance when collecting, storing, processing, selling, distributing, disposing of, or transferring it so as to minimize any negative environmental effects.
- The responsible party or organization is responsible for managing the toxic material at their own cost.
- If any person, organization, or local community sustains loss or damage as a result of pollution or improper disposal of hazardous waste by another person, they may submit an application to the relevant body in order to receive compensation for the harm they have suffered.
- The Environment Protection Act, which the Nepali government has been using to address all environmental challenges, has no mention of managing e-waste.

2.10.4 Kathmandu Metropolitan City Environment and Natural Resources Protection Act, 2073

- This law included electrical equipment waste.
- The objective of this act is to prohibit anybody or any organization from generating pollution that goes against the rules already in force and has a major harmful impact on everyday life, human health, and the environment (KMC, 2021).
- In order to protect the environment, the metropolitan or municipality can implement the appropriate initiatives to reduce greenhouse gas emissions.

- No mechanical equipment, technical facility, motel, restaurant, or other place or thing shall be permitted to emit sound, visible heat, radioactive radiation, waste, or pollute water in violation of the established requirements.
- The sample should be collected in order to study, test or analyze the pollution, noise, smoke, heat and waste created or emitted by any industry, factory, facility, vehicle, etc. To collect the sample, the relevant person or organization shall provide such persons or organizations as necessary to the person or organization authorized by the Metropolitan Municipality.
- Environmental inspectors can inspect, test or examine tools, machinery, organisms, objects, documents, documents or other goods or objects.
- The construction and management of the facilities necessary for the collection, processing, and ultimate disposal of waste, including the transfer center, will fall under the control of the metropolitan municipality.
- In order to prevent the manufacturer or people from negatively affecting the environment or public health, hazardous waste must be appropriately managed at its own cost.
- Under this act, it is illegal to dispose hazardous waste. If this is done, the metropolitan corporation may fine the offender up to 50,000 rupees. If the offender commits the same offense again, they may be fined twice as much and have their permit revoked in accordance with the law in effect.
- Compensation if any harm or loss to any person or organization due to the discharge of hazardous waste that has caused pollution contrary to this act or the rules, guidelines or standards made under this act, or due to any accidental pollution, the person or organization affected by such action shall be liable to the metropolitan municipality or can apply for compensation from the designated agency.
- Prohibition of use of harmful heavy metals contrary to prescribed standards and affecting human health.

2.10.5 15th Five Year Plan

The main objective of the 15-year plan is to construct modern waste management facilities in major cities and industrial zones. It prevent and control all types of pollution

by preparing national standards for water, air, soil, sound, radiation, hazardous waste, and electrical pollution and have polluters pay compensation to pollution victims.

2.10.6 National Urban Development Strategy, 2017 NUDS

Poor solid waste collection, open dumping, and a lack of long-term, sustainable approaches to solid waste management are major problems for urban development (MoUD, 2017). The treatment of electronic waste has not been given priority in NUDS.

Strategies

Solid waste collection

- Encourage public-private partnerships in waste management and collection
- Promote community-led garbage segregation and collection

Sanitary Landfill site

- To get to a condition of 3R, adopt a sanitary landfill site as a transitional strategy.

3R: Reduce, Reuse and Recycle

- Promote 3R in the home and society.
- Promote waste recycling and reuse in the private sector by utilizing the necessary technology.

SWM unit in municipalities

- Create a committed and proactive SWM unit in every municipality.
- Specify national institutional accountability and responsibility for SWM.

2.10.7 The Public Procurement Regulation, 2007

In Nepal, many institutional buildings like government offices and banks carry out public auctions periodically in order to avoid the accumulation of disposed electronic equipment. Some enterprises dispose of electronic waste with formal e-waste recycling companies for safe e-waste disposal while government offices sell their electronics to the highest bidders in the auction (Whitehead, 2007).

As per the public procurement regulation, if the supplier does not take back the rejected goods within the specified period in the procurement contract, the concerned Public Entity shall sell such goods by public auction and return the amount balance after deducting from the auction sale amount the cost incurred for the storage of the goods and other incidental expense related to that from the outstanding advance amount, liquidated damages and also another amount.

2.11 INTERNATIONAL CONTEXT

"Despite the regulations and mechanisms previously described, more than half of the e-waste that is collected for recycling in developed countries is transported to the developing countries to be processed or disposed of. Leading e-waste manufacturers include the US, the EU, and Japan. In 2010, it was predicted that these three countries alone exported 4.49 million tons of domestic e-waste.

Switzerland

In terms of e-waste management legislation, Switzerland has been a pioneer. The "Ordinance on The Return, the Taking Back and the Disposal of Electrical and Electronic Equipment (ORDEE)" in the Swiss Federal Office was introduced in 1998 for the Environment (FOEN) to handle electronic waste. However, before the regulation went into effect, producer responsibility organizations had formally begun the initiative for WEEE's collection and administration through voluntary efforts (de Oliveira et al., 2012). The nation built its legislative and administrative framework around the EPR model, which holds exporters and manufacturers accountable for the material costs associated with managing, recycling, and disposing of e-waste in an environmentally sound manner.

SENS and SWICO have both built thorough take-back and recycling systems, with consumers paying an Advanced Recycling Fee (ARF) when purchasing their EEEs (Hischier et al., 2005). A buyer is far more eager to pay a tiny fee at the time of purchase of a product than paying for the disposal of an item that is useless, making ARF more of a consumer than a shareholder funded system (Dhungana et al., 2020).

Sweden

In July 2001, Sweden implemented its e-waste management policy to ensure that it is treated properly (Sasaki, 2004). Customers can now return outdated goods to merchants in exchange for comparable new goods (old-for new or new-for-old rule). Additionally, residential customers can dispose of their e-waste at municipal collection sites, while institutional and business users must pay for the treatment. Municipalities are in charge of running these e-waste collection stations for residential consumers, while manufacturers are in charge of paying for WEEE collection and treatment expenses. In the interim, a shop must take WEEE from customers in accordance with the "old-for-new regulation."

Japan

Air conditioners, televisions, laundry equipment, and refrigerators are the four main electrical equipment wastes that Japan began recycling and treating in April 2001 (Kahhat et al., 2008). Consumers must consent to the introduction of a "recycling fee" as a pre-treatment fee (Sasaki, 2004). Additionally, but at the retailer's discretion, customers are frequently charged for transportation. Institutional and business users can either treat their e-waste as industrial garbage at their own expense or send it to retailers with the pre-treatment fee. Retailers are obligated to transport accepted e-waste to producers at designated collection places as well as to accept designated e-waste at the request of customers (Chung, 2008).

India

The "Municipal Solid Waste Management Rules" from 2004 and the "Hazardous and Waste Management Rules" from 2008 are the rules and regulations that the Ministry of Environment and Forests (MoEF) issues for waste management. The "2010 E-waste Management and Handling Rules," includes more detailed new restrictions, go into force in 2012. They regulate the six RoHS materials—lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs)—as hazardous substances. Collection points and EPR regulations are also required for recycling.

Singapore

For the export, import, or transit of garbage in Singapore, a permit from the Pollution Control Department (PCD) of Singapore is necessary. As long as there exist records

demonstrating that the equipment is still operational and suitable for reuse, used electronics can be imported and exported. Used electrical and electronic equipment (UEEE) cannot be exported if it cannot be used in another way. It is forbidden to import UEEE with the intention of disassembling it and exporting the separated parts (BCRC China, 2011).

In Singapore, take-back and take-in by merchants have been done for profit, and the cost of used mobile phones is determined by the quality. Mobile phones can typically be used at a cheaper price than the sales price during the contract period (for example, two years) due to leasing programs. According to reports, used mobile phones are returned in about 95% of cases. Singapore has a thriving second-hand mobile phone market with a large number of retail stores selling used phones (Dowa, 2007)."

2.12 CONTRIBUTIONS OF E-WASTE MANAGEMENT TO ACHIEVING SDG

The problem of managing e-waste was integrated into the broader pursuit of sustainability with the establishment of the 2030 Agenda for Sustainable Development (Baldé et al., 2017). How different goals help to achieve sustainability by management of e-waste is addressed below:

- Goal no 3: A healthy lifestyle for everyone in society is ensured by preventing equipment from being disposed of improperly. Vocational training and the gift of used equipment boost people's wellness and self-esteem regardless of age.
- Goal no 8: Access to education and technology boosts people's ability to pursue respectable work. The doors to economic progress would be unlocked via vocational training. People in a circular economy model could be able to make money by selling repaired equipment and parts. These programs also produce trained workers and job prospects.
- Goal no 9: By applying creativity in the reuse of parts and components from electronic waste, the waste going to landfills might be decreased.
- Goal no 11: Access to information technology helps build "smart cities" that consider environmental protection by properly disposing of e-waste and achieving social, environmental, economic, and cultural goals.

- Goal no 12: Awareness-raising and instructional efforts can help people practice responsible consumption and production.
- Goal no 17: The majority of e-waste programs and projects encourage public-private strategic partnerships to develop solutions, indirectly aiding in climate change mitigation and the achievement of the SDGs.



Figure 7: E-waste management contributions to achieving SDG (Perina & Ratynski, 2019)

2.13 INTERNATIONAL CONVENTION

Following the environmental crisis, environmental movements and international environmental legislation were born in Europe and the United States in the 1970s and called for a reaction to the unsuitable use of nature. The issue of e-waste is now more well understood and reflected in a number of international treaties that aim to encourage steps to lessen the environmental effect that emerges from the illegal trafficking of e-waste (ITU, 2018).

Currently, there are international tools under the e-waste legislation that apply both directly and indirectly to e-waste. They consist of the following.

2.13.1 The Basel Convention

The Convention is the most important multilateral environmental agreement (MEA) in respect to addressing the challenges surrounding e-waste and its management (Karin, 2012). Its objectives include:

- the prohibition of transboundary waste movement, unless it is deemed to be in conformity with the principles of environmentally sound management.
- a regulatory system applying to cases where transboundary movements are permitted, to prevent illegal traffic.
- to reduce the volume and nature of hazardous waste generation and to promote environmentally sound management of hazardous wastes, wherever the place of disposal.

2.13.2 Vienna Convention and Montreal Protocol

Reduced production and consumption of several compounds that contribute to the ozone layer's deterioration are the goals of the Vienna Convention and Montreal Protocol. The primary chemicals that are destroying the ozone layer are to be eliminated from production and consumption by the dates set forth in this Protocol. The key initiatives include:

- establishing control dates for ozone-depleting compounds
- restricting commerce with non-protocol states
- banning the import and export of depleting substances or goods containing them.
- the grouping of member nations
- the adoption of a finance system.

2.13.3 Stockholm Convention on Persistent Organic Pollutants

Persistent Organic Pollutants (POPs) are organic, or carbon-based, substances that are persistent. In this convention, participating countries agreed to take actions to reduce the production, use and release of Persistent Organic Pollutants. When POPs are released into the environment, they have a particular set of chemical and physical properties, including the following:

- They last for a very long time (many years) in perfect condition;
- They are widely distributed in the environment as a result of natural processes involving soil, water, and, most importantly, air;
- They easily accumulate in the fatty tissue of living organisms, including humans
- They are found in higher concentrations at the top of the food chain.
- Both humans and animals find them poisonous.

2.13.4 Rotterdam Convention

Rotterdam Convention is introduced to safeguard the environment from the harms of harmful chemicals and pesticides. The prior informed consent (PIC) method and information exchange are the two fundamental aspects of the Convention that help it accomplish its goals. By prohibiting unauthorized imports of dangerous chemicals, particularly into developing nations, the Convention creates a first line of defense against future disasters. By giving all nations the ability to protect themselves against the risks of hazardous substances, the global bar for the preservation of the environment and human health will have been raised and everyone will be on an equal footing.

2.13.5 Minamata Convention

To protect against the damaging effects of mercury and its compounds on both human health and the environment, the Minamata Convention was developed. Key provisions of the Minamata Convention include controls on emissions to the atmosphere, land, and water, prohibitions on new mercury mines, closures of existing mercury mines, elimination or gradual reduction of mercury use in a range of products and procedures, and regulation of the unorganized sector of artisanal and small-scale gold mining.

2.13.6 The Durban Declaration

The 2008 Durban Declaration on e-waste management in Africa follows the 2006 ministerial declaration on e-waste released in Nairobi as a result of Conference of the Parties (COP8) of the Basel Convention. Countries must examine current legislation, boost compliance with existing legislation, and update existing waste management legislation in order to control the management of e-waste (Durban Declaration, 2008). As a result, most African countries are now creating e-waste legislation (Patel, 2019).

2.13.7 EU WEEE Directives & EU Restriction of Hazardous Substances Directive (RoHS)

The first WEEE Directive (Directive 2002/96/EC), which established collection systems where customers could easily return their WEEE, entered into force in February 2003. To manage the fast growing stream of e-waste, the amended Directive 2012/19/EU went into effect on August 13, 2012. In February 2003, Directive 2002/96/EC was put into effect. It asks for the safer replacement of heavy metals including lead, mercury, cadmium, and hexavalent chromium as well as flame

retardants like polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

On January 3, 2013, the RoHS recast Directive 2011/65/EU went into effect. The proposed 2017 RoHS 2 scope review. The format for producer registration and reporting to the register was established by Commission Implementing Regulation (EU) 2019/290 of February 19, 2019.

2.13.8 Solving the E-waste Problem (StEP)

StEP, which was formally established in 2007 by UN agencies, collaborates with eminent academic and governmental organizations (including MIT and the USEPA) to promote recycling and the management of e-waste pollutants.

2.14 CASE STUDIES

2.14.1 E-Basura Programme, Argentina



Figure 8: E-Basura Programme (ITU, 2018)

The National University of La Plata serves as the parent institution for E-Basura. E-Basura, which was founded in 2009 to address the regional e-waste issue, advocates the 3Rs (reduce, reuse, recycle) philosophy. Additionally, it improves access to technical resources for kids, teens, and adults.

The links between research, teaching, innovation, and outreach have made it possible to incorporate e-waste as an environmental concern and a social requirement into UNLP research and teaching. The concepts of e-waste and "green IT" have been similarly

incorporated in the computer science and systems degree program, supporting outreach programs that foster student innovation.

E-Basura actively participates in social environmental initiatives and campaigns like "Donate the old computer you don't use anymore" and "Take the environment seriously and bring in your old cell phone" that aim to spread the word and increase public understanding of the causes of and solutions for e-waste. Additionally, it provides training and donations to the most vulnerable groups in society (ITU, 2018).

E-Basura gives priority to preparing ICT sector e-waste for reuse, making it easier for low-income social sectors to access new technologies and for more people to use technology. In order to ensure donor confidentiality, it performs the required operational checks and deletes personal information. To prevent software piracy, free software is installed.

The staff is made up of college students who have received vocational training to cover the assigned area as well as repair, refurbish, and disassemble e-waste from university lecturers. There is no cost for training.

The team's members frequently offer free seminars and training sessions, participate in congresses, and produce publications on a national and worldwide level. They also conduct important training and instructional activities, such as classes on environmentally responsible PC assembly and maintenance, which are crucial for improving educational standards and eliminating social and technological divides in the country. The fact that E-Basura offers training to many socioeconomic sectors is one of the key benefits it offers in this regard.

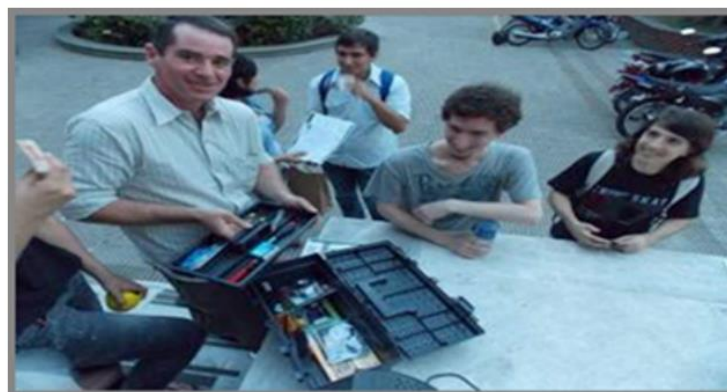


Figure 9: Training in PC assembly and repair (ITU, 2018)

As a result of numerous media outlets, including print, radio, and television, visiting e-Basura, it has a sizable media presence. Students from elementary and secondary schools also use its facilities.

The project has supplied guidance to numerous groups, as well as speeches and training sessions on environmental issues, to businesses, associations, and educational institutions.

In order to reduce trash production, promote a circular economy, and maximize reuse and remarketing of waste, E-Basura and the provincial government of Buenos Aires reached an agreement in 2016 to collaborate on the reuse of electrical and electrical equipment.

The project advances university students' professional growth by bringing them into closer contact with other social realities, in addition to addressing a social, educational, and environmental challenges. Students are expected to pay back some of the investment society placed in them by attending public and free colleges like UNLP.

By encouraging university research aimed at reducing the negative effects of e-waste through innovative solutions that help achieve the Sustainable Development Goals and facilitating discussions of environmental protection from a technological perspective, E-Basura serves as a hub for innovation in the region.

2.14.2 Hewlett-Packard E-Waste Management in South Africa

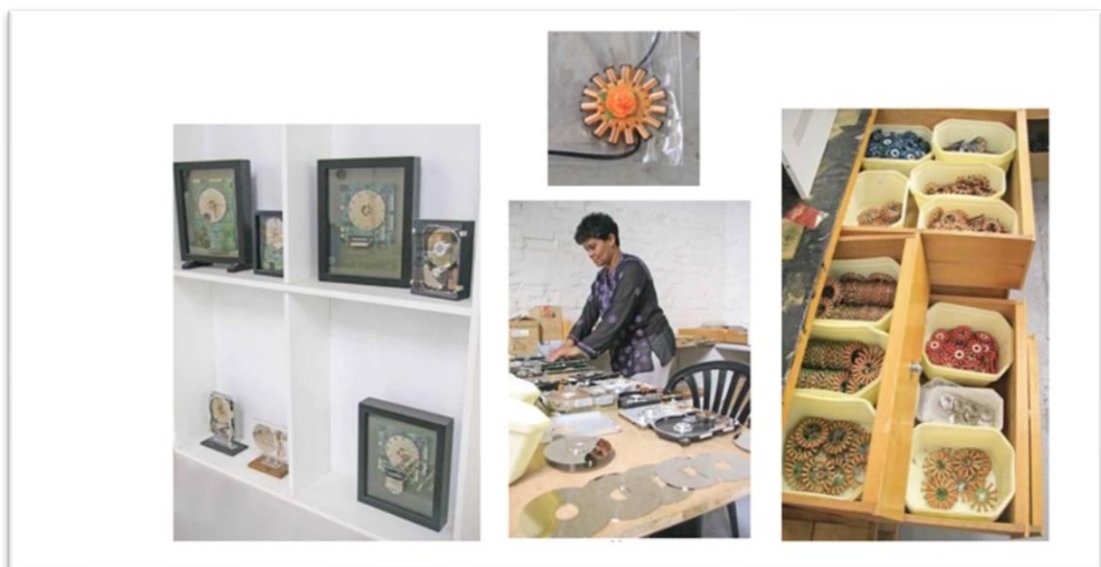


Figure 10: Waste to art product (ITU, 2018)

Although studies have revealed the illegal transfer of e-waste to African nations since 2005, China and India were once thought to as the traditional landfills for global e-waste.

The program, which was born out of the nation's e-waste dilemma, could serve as a template for other African nations with comparable issues. It was started by the private corporation Hewlett-Packard as part of its EPR initiative and developed into a CSR endeavor. Although it has benefited financially from local, national, and international partners, its ultimate objective is self-sufficiency. Early in 2008, the effort gave money to South Africa so that the MRF in Cape Town could continue to operate until the end of the year, when it intended to become self-sufficient (ITU, 2018).

Globally, Empa has recognized numerous efforts, including this one. The project actively encourages the development of practical, moral, and sustainable e-waste management approaches. It addresses the issue of e-waste by collecting, disassembling, refurbishing, and selling items. It even produces works of art from materials that would otherwise be considered waste.

Operational personnel are recruited from the unorganized sector and taught to carry out activities in their specialized area. The initiative is not managed by businesses, academic institutions, or the government. The initiative also conducts advertising campaigns and provides training to the unorganized sector in an effort to fill skilled staff positions.

Finally, through African IT WEEE pilots and a number of desk studies, Hewlett-Packard has assessed the electronic recycling environment and tested ways to enhance recycling techniques and tools in its search for a financially and environmentally sustainable solution.

2.14.3 Kitakyushu Eco Town Project

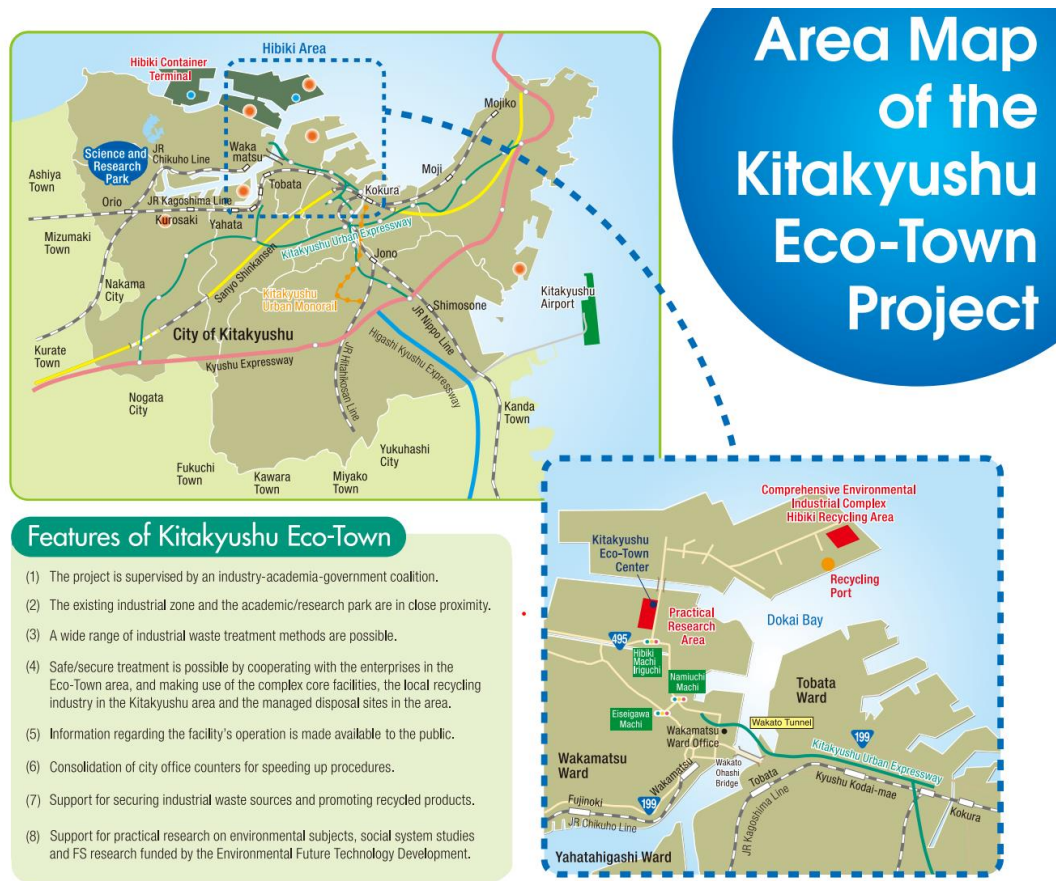


Figure 11: Kitakyushu Eco Town Project (Environment Bureau, 2019).

The Eco-Town Center was created in June 2001 as an environmental learning facility to disseminate information regarding the initiatives at Eco-Town and to serve as a one-stop shop for all of the businesses at Eco-town. At the Kitakyushu Eco-Town Center, panels and other exhibits provide an overview of Kitakyushu's Eco-Town projects as well as businesses that are concerned with the environment. A tour of various recycling facilities is also provided (Environment Bureau, 2019).

In order to further encourage the growth of environmental industries, the city of Kitakyushu wants to combine cooperative zero emissions environmental enterprises together in a structured organization. It consists of recycling household electronics, automobiles, workplace equipment, and pet bottles made of plastic. (Environment Bureau, 2019). It further contributes to environment through wind power generation, machine recycling, waste wood and plastic recycling, beverage container and vending machine recycling, cellular phone recycling, food waste recycling and reuse of office electronics.

2.14.4 Chhatrapati Shivaji Maharaj International Airport



Figure 12: Wall art made from computer circuit boards (Singh, 2022)

The Chhatrapati Shivaji Maharaj International Airport has put in place a number of sustainable practices to lessen its dependence on nonrenewable energy sources and reduce energy consumption. Condensers, resistors, and computer circuit boards were repurposed for use in the Airport.

3 CHAPTER THREE: STUDY AREA

3.1 STUDY AREA SELECTION

Kathmandu Metropolitan City is divided into 32 administrative wards. Among these wards, ward no. 22 (which is formed by merging ward no 22 and ward no. 24) is a major economic hub due to presence of most of the important commercial centre in Nepal. The area of the ward is approximately 27 hectares. This ward is bordered to the east by Tundikhel, to the south by Bhotebahal, to the west by Dharmapath, and to the north by Watu.



Figure 13: Study area

This ward of the KMC lies near to the centre of the city with old settlement, historic monuments, festivals and culture. It is located within the traditional core of Kathmandu city with major consumer routes for electronic markets like Newroad, Khichapokhari, Dharmapath, Bhotebahal, Tebahal and so on. Since this ward is located in the commercial centre of the country, therefore multi-storied modern buildings are mostly found. Newroad which serves as the nation's commercial hub, has the largest market for electronic and electrical equipment, according to a 2011 CEPHEd report (Oewg, 2010). Chinese products dominate the Kathmandu market. In addition to

Chinese, Kathmandu also has electrical equipment from Malaysia, Singapore, Japan, India, and other countries.

3.2 WASTE MANAGEMENT IN KATHMANDU METROPOLITAN CITY

Kathmandu produces 479 tons of solid was per day (ADB, 2015). The municipality supports the management of waste in core areas of Kathmandu metro. The Bancharedanda landfill site serves as the location for the disposal of solid waste for Kathmandu. Recycling is low despite the fact that there is a transfer station for the separation of recyclable and non-recyclable material. To lessen the amount of waste that ending up in landfills, the Kathmandu Metropolitan City has begun collecting segregated biodegradable and non-biodegradable waste. The waste composition of the KMC does not mention electronic waste in their waste category.

Table 1:Waste composition of Kathmandu Mahanagarpalika (DOE, 2022)

S.N	Waste Compostion	Proportion
1.	Organic	70.87%
2.	Plastic	9.18%
3.	Paper	8.51%
4.	Rubber	0.54%
5.	Textiles	3.02%
6.	Metals	0.92%
7.	Glass	2.50%
8.	Inert Materials	4.33%
9.	Leather	0.12%

3.3 E-WASTE COLLECTION AND DISPOSAL PRACTICES IN NEPAL

Nowadays, the use of modern technology such as information technology (IT) industries are growing in Nepal (Pradhan & Systems, 2002). Technology is changing at a rapid pace. Covid 19 has also had an impact on how electronics and digital solutions are used. Electronics are being used by people to stay in touch with their families,

friends, coworkers, doctors, and other professionals in the healthcare and medical fields.

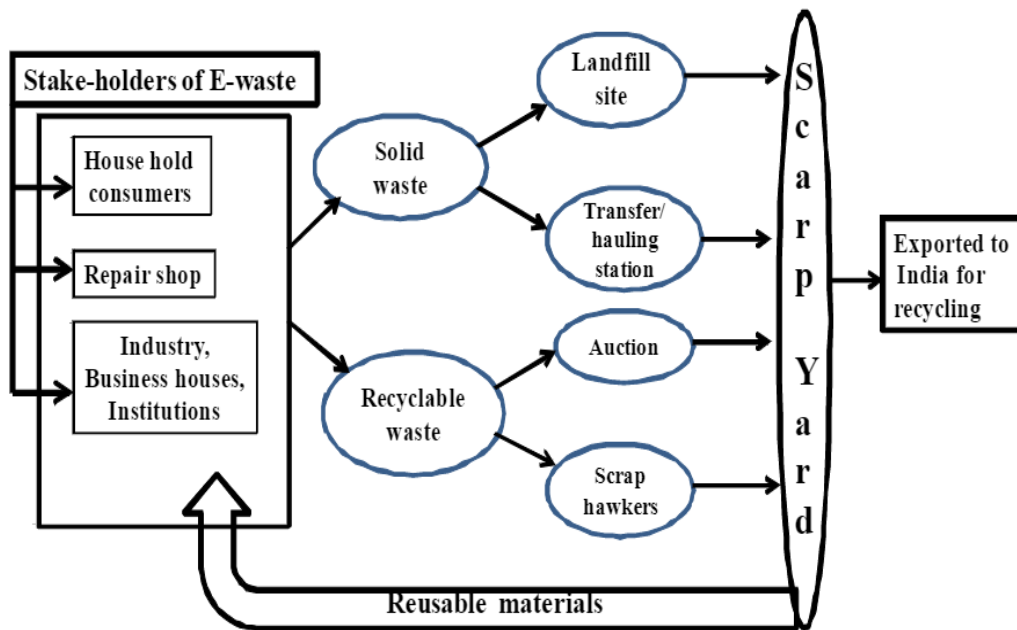


Figure 7: General Practice of waste disposal and recycling in Kathmandu (Giri et al., 2020)

Disposal practices vary depending on the types of stakeholders that produce e-wastes. The producers, household users, businesses, institutions, and electronic repair shops account for 50% or more of the total stock of electronics, are the real stakeholders in e-waste in Nepal. Scavengers, scrap hawkers, and scrap dealers get all of these e-wastes from the customers, and then they collect and dispose of them in the informal sector (Giri et al., 2020). From repair and maintenance shops, they gather the remaining unused parts. When all of the metal has been recovered from these wastes, the remaining components are exported to the closest Indian markets from Birgunj and Janakpur (Oewg, 2010).

With the expansion of technology, commercial buildings, workplaces, and institutions also produce significant amounts of electronic waste after using all of their resources. These producers call auctions to dispose of their electronic waste (BC, 2020).



Figure 14: E-waste transported to India for recycling

In order to dispose of electronic waste in a manner that has the least negative impact on the environment and human health, formal recycling facilities have been established in Kathmandu. One of the earliest such recycling facilities in Nepal is Doko Recyclers which scientifically disposes the e-waste generated from residence, offices, schools etc. 90% of electronic waste can be recycled in such formal recycling centers, which is a huge step toward lowering the amount of waste dumped in landfills.



Figure 15: Location of formal e-waste recycling company

4 CHAPTER FOUR: CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY

4.1 RESEARCH PARADIGM

A research paradigm is the philosophical framework around which your study is built. ResearchParadigm is “The set of common views and agreements shared across scientists about how problems should be understood and treated” (Mertens, 2003). It provides a framework of assumptions and comprehensions upon which your research project's theories and methods can be based. Ontology, epistemology, and methodology make up a research paradigm. A paradigm, according to Guba (1990), is defined by the ways in which three fundamental questions are addressed:

1. Ontology: What constitutes "reality"? What about the truth?
2. Epistemology: How does the inquirer obtain knowledge? Alternatively, what is the nature of the interaction between the questioner and reality?
3. Methodology: What steps should the researcher take to discover the truth? It describes a group of theoretical ideas and approaches used to address the research questions.

The positivist paradigm is predicated on the presumption that there is a single, observable, quantifiable concrete reality (Park et al., 2020). Ontologically, positivist believes in external reality. In terms of epistemology, positivists take a very controlled, strict, and rigorous approach in their quest for an unwaveringly objective truth (Plack, 2005). This research cannot be conducted in a controlled environment because its objective is to understand how e-waste is managed in the Kathmandu Metro. The result obtained from the research cannot be universal. As a result, the positivist paradigm cannot be used to frame this research.

Post-positivist researchers start with research hypotheses, and through an experimental or quasi-experimental design which may incorporate both quantitative and qualitative research methodologies, the a priori hypothesis would either be validated or rejected (falsified). Ontologically, post-positivists hold the view that social reality exists on a fundamental level. According to post-positivist epistemology, likely statistics can be used to approach or approximate knowledge of the real world, as mentioned (Plack,

2005). This paradigm usually begins with a theory, but in this research, there is no theory in this research.

The goal of interpretivist research methods is to comprehend human nature and thought. According to Creswell (2003), the interpretivist researcher frequently relies on "participants' interpretations of the situation being investigated" and is aware of the influence of their own background and experiences on the research. On the other hand, interpretivist mainly rely on qualitative methods only which cannot fulfil the main objective of the research. Epistemologically, interpretivist involves the relationship of researcher and the researched so that the findings are literally created as the investigation proceeds.

According to the pragmatic paradigm, truth is what actually exists and has proven to be true for specific reasons rather than something that can be discovered once and for all time. Understanding the current practice of e-waste management in ward 22 is the objective of this study, which calls for both qualitative and quantitative data. Therefore, this research lies in pragmatic paradigm.

The pragmatic paradigm's ontology holds that there are several perspectives on realities and the best explanations can be found inside individual value systems. The ontological claim of this study is that the current practice of e-waste management includes incineration or dumping in landfills with other solid waste.

Pragmatists examine people's behavior in the context of their behavior. They seeks knowledge based on the conditions under which the occurrence takes place. The epistemology of this study was brought from the interviews with different key informants, observation and questionnaire surveys in ward 22 involved in handling e-waste from production to consumption including reuse and refurbishment to material recovery based on pragmatic paradigm.

Deductive logic is the process of reasoning from one or more statements to reach a conclusion. It is a top-down logic and a single conclusion is made at the end. But, based on the pragmatic paradigm, it cannot draw single conclusion. Inductive logic is a type of reasoning where a likely conclusion is formed from premises or observations. Inductive reasoning can only at best imply that a conclusion is extremely likely based on the premises, unlike deductive logic, which guarantees the reality of a conclusion

based on undeniable evidence. The abductive logic is a form of reasoning which starts with observation that seeks to find the simplest or the most likely explanation. Abductive thinking is applied in this research because the explanation of respondents is interpreted to draw a conclusion.

4.2 METHODS

4.2.1 Data and Document Collection

Policy documents regarding management of e-waste in national and international level is reviewed. For the qualitative data collection, key informant interviews with recyclers, repair shops, municipality were done. Personal opinions of various stakeholders, including their answers to the issues of which sector of society should bear primary responsibility for managing e-waste and what function they perceive the government playing, are noted. And quantitative data were collected through questionnaire survey among consumers in residential, commercial and institutional zones.

4.2.2 Case Studies and Literature Review

Review of relevant national and international literature on urban planning and e-waste management was done. The international literature focused on theoretical approaches, international conventions, case studies, etc. The major source of literatures for this research study came from internet and organizations like Environment Management Department. For national and international cases, various documents, books, thesis, reports, journals etc. were reviewed to get thorough views and necessary qualitative data. Case studies on different recycling centers were done to understand the consumer awareness and intention on e-waste management.

4.2.3 Field Visit for Observation

A field visits were done in study area as well as formal e-waste recycling companies and repair shops, where observation and questionnaire survey was carried out.

4.2.4 Interviews

Open ended interviews with a few key informants were done to understand the current disposal practice of e-waste in ward number 22 of Kathmandu metro. Interviews with multiple stakeholders were done to triangulate the qualitative data and quantitative data with literatures.

4.2.5 Questionnaire survey

The objective of study was to comprehend how electronic waste is generated and how it is disposed of. Utilizing the characteristics found in the literature, a thorough questionnaire was created. The questions were based on the various grounds of information regarding background information, demographic information, e-waste generation and disposal practice, awareness level and consumer intentions of e-waste disposal. The type of question made was semi structured question which was pretested before field investigation among our friends and family to find out the feasibility of the question and the time required for each survey. The solutions were then imported into the Kobo toolbox for field operationalization, and afterwards deployed and gathered using Kobo collect, a free open-source application for mobile data gathering based on the selection of buildings.

Sample size

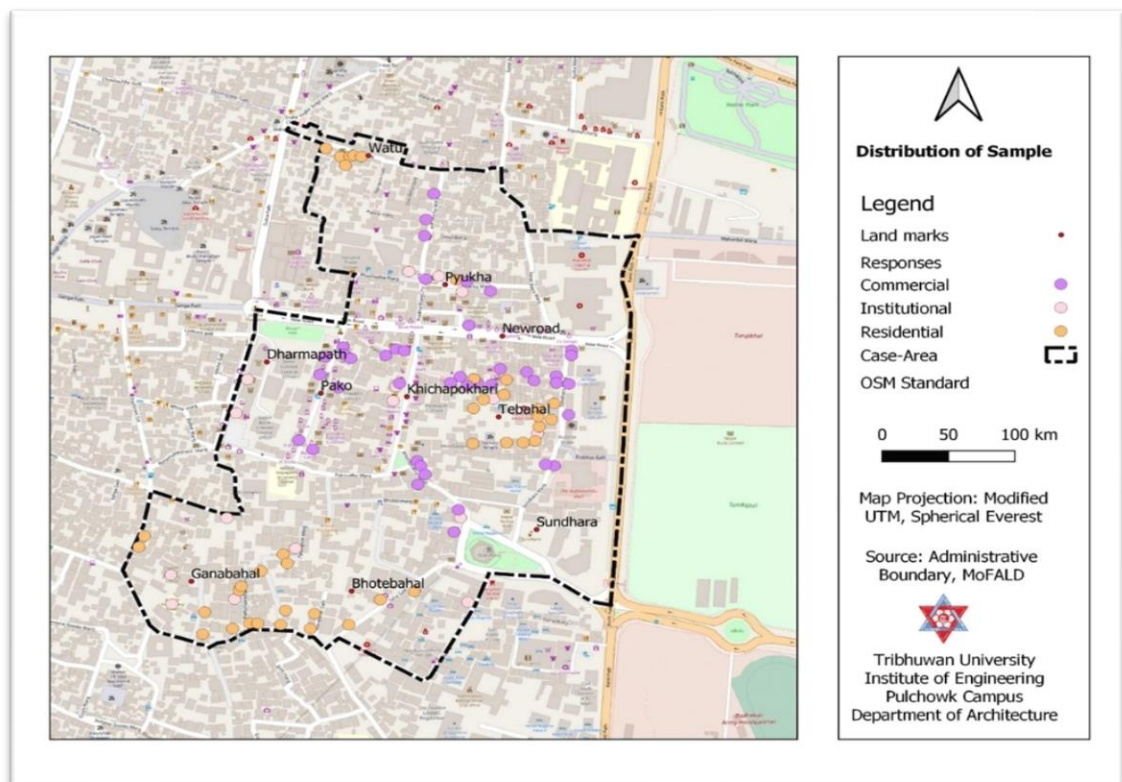


Figure 16: Distribution of sample

A sample is a group that has been chosen from a population for investigation purpose with a comparatively smaller number of individuals. The participants or respondents are the individuals who make up the sample. This study comes under the category of

non-probabilistic sampling, in which specific persons may hold relevant and divergent opinions regarding the theories and concerns under investigation, necessitating their inclusion in the sample population (O. C. Robinson, 2014). In order to find and select cases that will make the most efficient use of the limited research resources, purposeful sampling is applied to choose respondents who are most likely to provide accurate and meaningful information (Palinkas et al., 2015). 112 samples from various respondents were gathered from the study area based on residential, commercial, and institutional buildings until the saturation point was reached while collecting data.

4.3 FRAMEWORK FOR DATA COLLECTION

Table 2: Framework for Data Collection

Research Objective	Literature Review	Data Sources
1.To study the e-waste generation depending on the source 2.To identify the disposal practice of e-waste in the study area	Types of e-waste generation in different land use zones E-waste collections and transportation practices Methods of e-waste disposal Socio Economic benefits of recycling	Questionnaire survey Municipality Recyclers Literature
3.To understand the level of awareness of the public regarding e-waste.	Roles of various stakeholders in e-waste handling Attitude and behaviour related to household level e waste segregation Knowledge and Perceptions on e-waste handling Effects of e-waste on health and environment	Individual households survey Municipality E Goods Repair shops Recyclers
4. To find possible ways to reduce e-waste going to landfills	Existing legal and policy framework in e-waste management International Convention	Literature Review Literature Case studies

	Scientific disposal system E-waste management strategies National and international Case studies	
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4.4 DATA POINTS

Data points are the benchmarks used to demonstrate the reliability of the information used in the research. In order for a study to be regarded credible, a minimum of three data points must be legitimate. So, the data points required for the credibility of data collected for the research include:

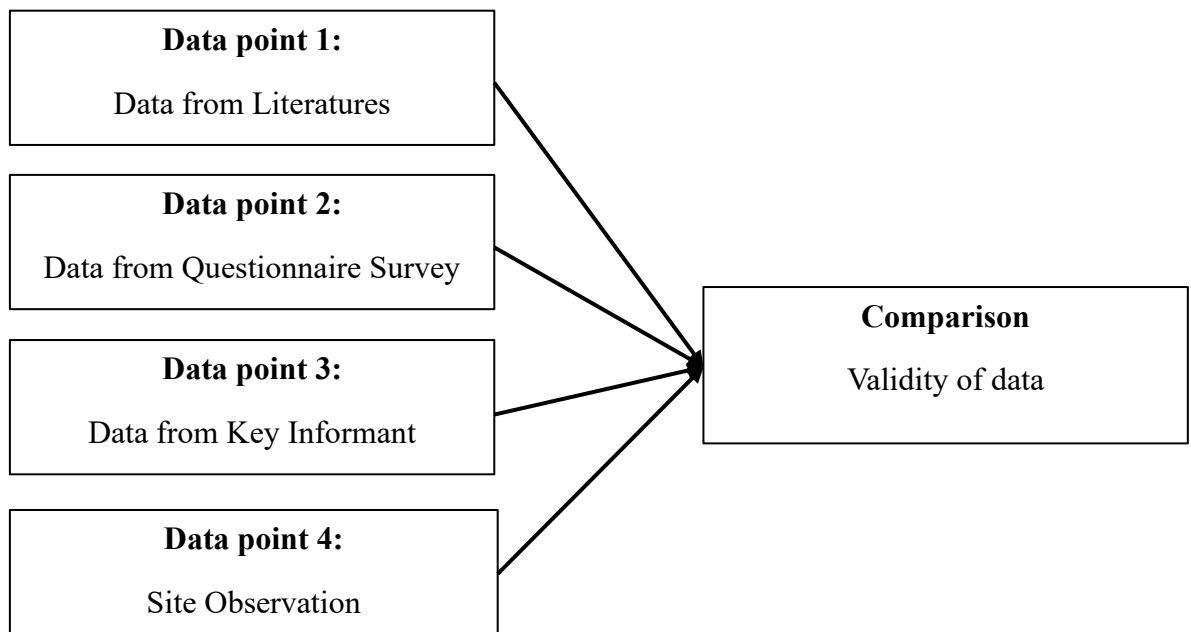


Figure 17: Data Points

5 CHAPTER FIVE: FINDINGS AND ANALYSIS

The survey was done with 112 people to understand their perception on e-waste generation. The source of data is 52 from residential source, 40 from commercial source and 20 from institutional source of ward number 22 in different land use zones. The data is collected in an inclusive manner by including all gender, building owners and renters, high rise and low-rise buildings..

5.1 RESULTS FROM QUESTIONNAIRE SURVEY

5.1.1 Socio-Demographic Information

Age of respondents

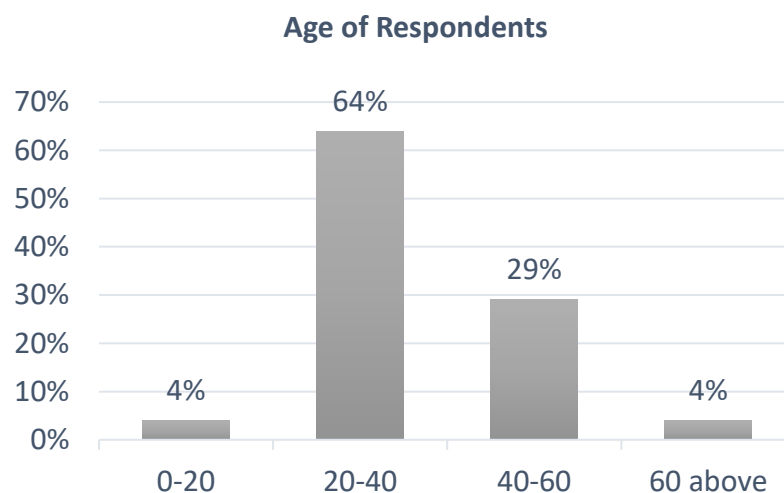


Figure 18: Chart showing age of respondents

Amongst the 112 respondents, the age group of 20-40 years were the majority with 72 (64%) respondents belonging to this age group. Closer to this is 32 (29%) respondents were in the age group of 40 -60. Only 4 (4 %) were in the age group of above 60 years. However, it was observed that only 4 (4%) respondents in the age group of below 20 years. The study includes responses from varied age groups such as youngsters, adults and older persons.

Gender of respondents

Majority of the respondents in the study were males with a total of 76 numbers i.e. 68%. The female respondents in the survey were found to be 36 in number i.e. 32 %.

Gender of Respondents

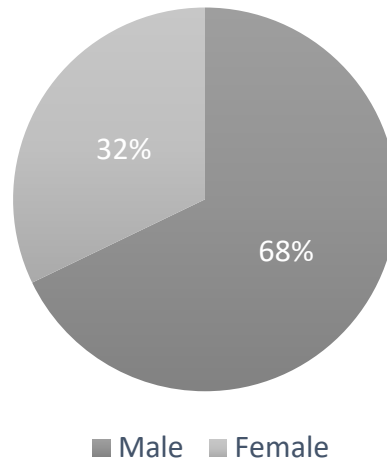


Figure 19: Chart showing gender of respondents

Education

Understanding consumer awareness and the various strategies they employ in electronic waste management requires taking into account the respondents' educational backgrounds. The biggest step in bringing about change in e-waste management is, in essence, good education. In the survey, it was found that the majority of the respondents 60 (53%) were graduates. 20 (18%) were higher secondary school respondents who were and other 20 (18%) were secondary school completed respondents. Further to this, there were respondents 12 (11%) who had master's degree.

Education of Respondents

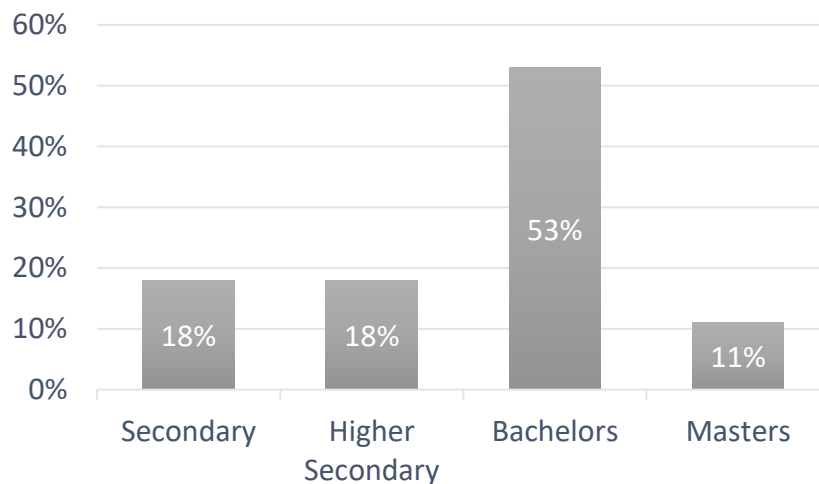


Figure 20: Chart showing respondents education level

Occupation

The occupation of the respondents included in the survey is being recorded here. In the survey, it was found that the majority of the respondents i.e., 52 (46%) respondents had their own business. Followed by this were 28 (25%) respondents were employed in government and private sectors. 20 (18%) respondents were students and 12 (11%) respondents were homemakers, retired government employees etc. The knowledge and awareness of the respondents is easily influenced by their field of employment and in most cases the waste management practices within workplaces influence people to be more concerned of wastes within households as well. Here, as respondents employed in various fields are part of the study.

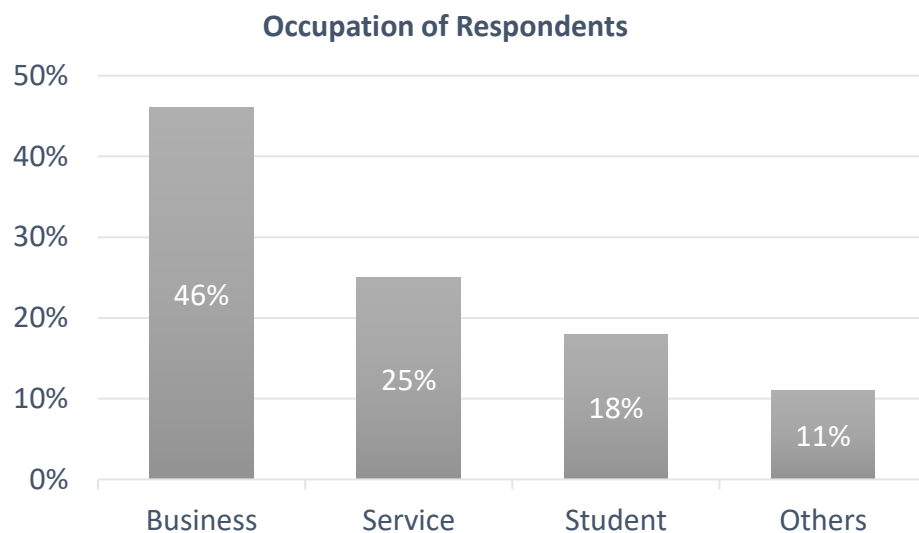


Figure 21: Chart showing education level of respondents

Monthly Household Income

The household income in the survey is the total income of all the working members in the family. The income variable is found to be a major element to identify methods adopted in households to dispose of e-waste depending on facilities accessible. In the survey, nearly 60 (53%) of the households earned a monthly household income of around Rs. 25000 to Rs. 50000 group. This was followed by 40 (36%) households with income above Rs. 50000 and 12 (11%) households belongs to less than Rs. 25000 income group respectively. The study includes households having varied levels of monthly incomes.

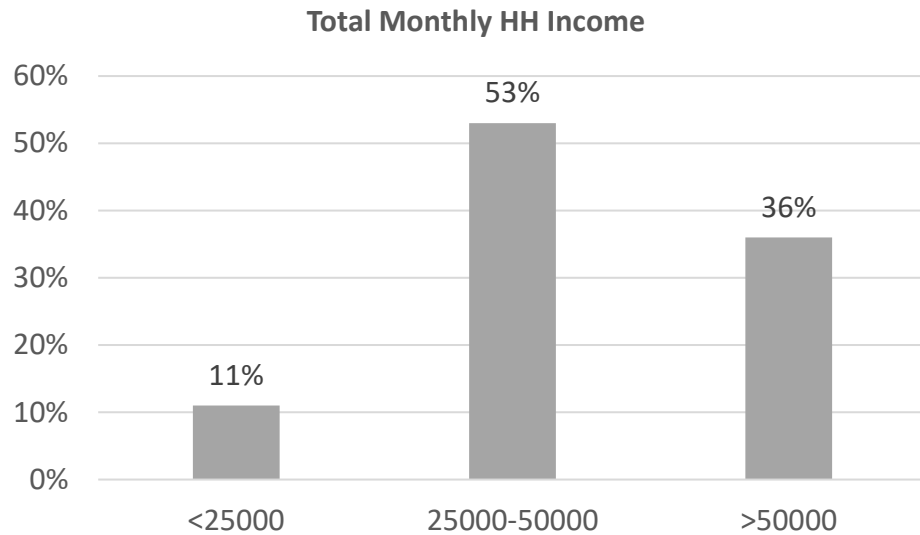


Figure 22: Chart showing total household monthly income of respondents

Building Ownership

The study included building ownership of the surveyed houses. The classification on the basis of own and rental status gives further dimension to understanding the practices in e-waste management specially the tendency of people in creating space at their living areas and overcoming inconveniences of storage. Of the surveyed buildings, only 29% is rented while the other 71 % of the buildings were owner owned building.

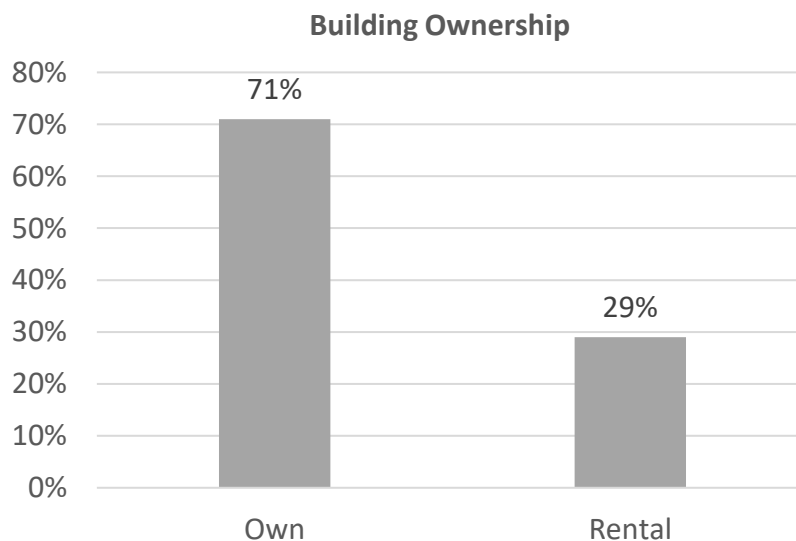


Figure 23: Chart showing building ownership

Family Size

Family size of Respondents

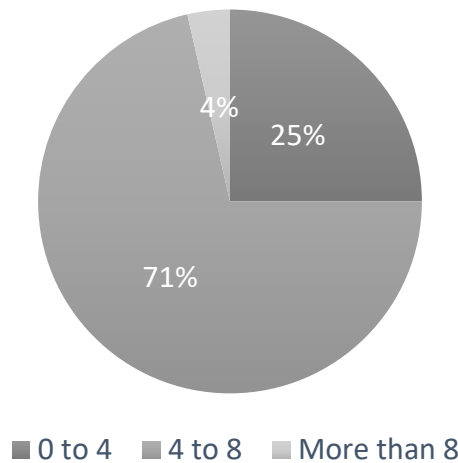


Figure 24: Chart showing family size of respondents

An important variable was the total number of members in the households. This was analysed to understand the usage patterns of electronic devices in the households based on the number of family members. Majority of the surveyed households, i.e., 80 (71%) consisted of 4 to 8 family members. 28 (25%) households had 0 to 4 family members. 4 (4 %) households had more than 8 family members.

Building use

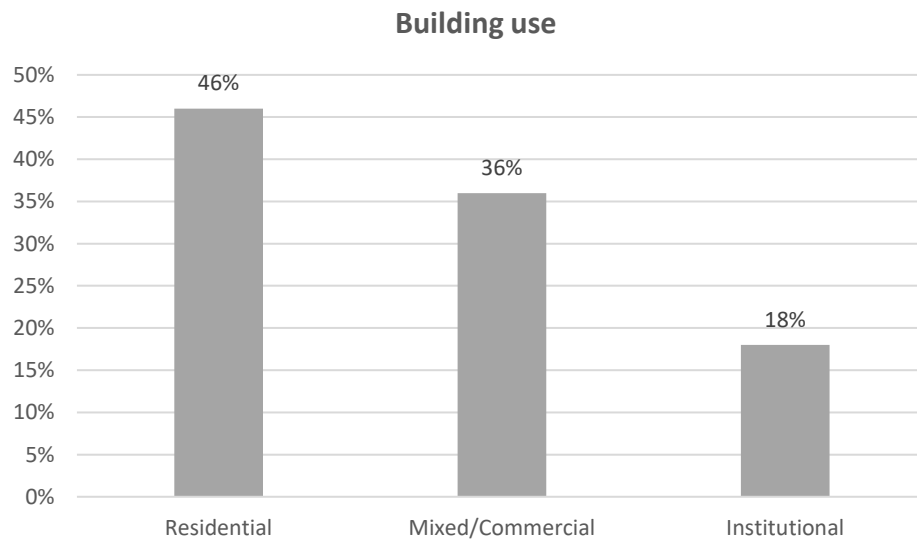


Figure 25: Chart showing building use in surveyed area

The survey included data collection from three classified use of building such as residential, mixed/commercial and institutional building collected from map study and

field survey. Three different building types were chosen to provide a clear view of e-waste situations in all areas in the society. The data consisted of nearly 52 respondents (46%) from residential area. 40 respondents (36%) were from commercial/ mixed use buildings. The survey also included 20 respondents (18%) from institutional building.

5.2 ANALYSIS OF E-WASTE GENERATION DEPENDING ON SOURCE

Unused electronic equipment (e-waste) stored in the household

The information regarding different unused e-waste equipment in the households were collected. The list of items was used from the classification given by the United Nations Global Monitor (Baldé et al., 2015). From the six categories, equipment that was found to be studied in the literature and also found to be common during study was included here. The most unused equipment under the list were TV (28%) and mobile phones (25%) followed by personal computer (21%). 7% respondents stated of having unused laptop while other 7% respondents have unused washing machine in their household. 4% respondents have unused iron, other 4% have unused refrigerators in their household. 4% respondents from institutional building stated of having damaged air conditioners.

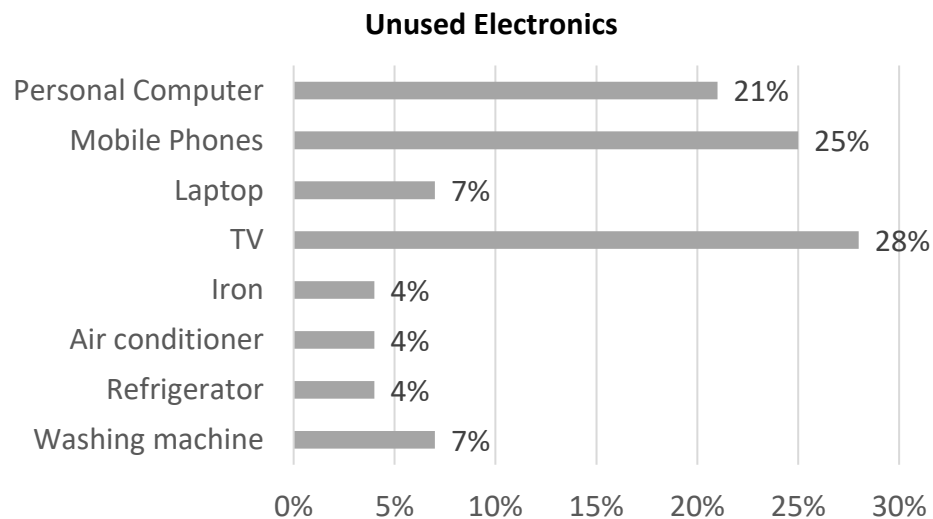


Figure 26: Chart showing percentage of unused electronics

Annual e-waste generation

Depending on source, 80% of 1kg to 3kg of e-waste is generated annually by residential source only and rest 20% by commercial source. In 3kg to 5 kg annual e-waste

generation category, majority (46%) of e-waste is generated by commercial source which is followed by residential then institutional. Also in 5kg to 7kg annual e-waste generation category, majority (46%) of e-waste is generated by commercial source which is followed by residential then institutional.

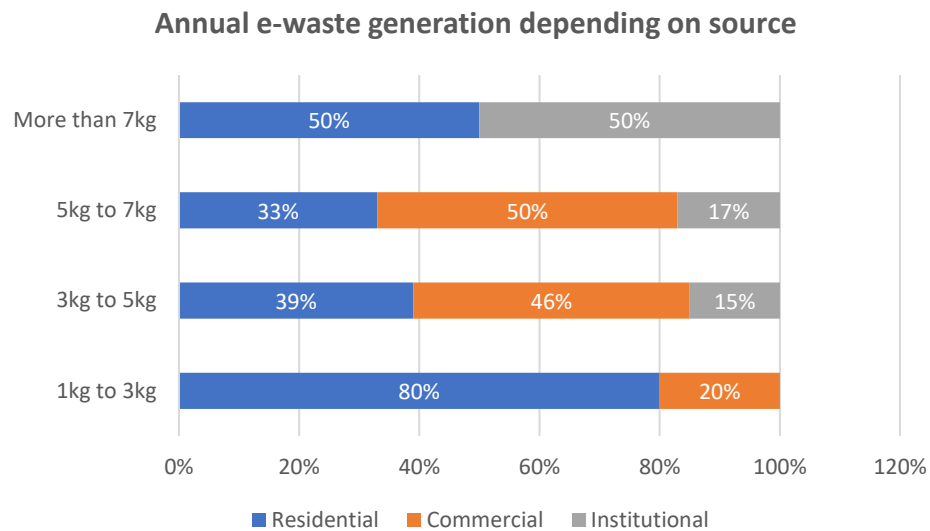


Figure 27: Chart showing percentage of annual e-waste generation depending on source

Key Informant Analysis

As per Bhuwan Chalise, e-waste researcher from Doko recyclers, **“E-waste generated in residential source is occasional as high volumes of string lights are disposed during the festive season such as Deepawali and wedding months.”**

“More than 60% of e-waste includes mainly of household sources” as per Ronish Shakya of Blue waste to value.

5.3 ANALYSIS OF E-WASTE DISPOSAL PRACTICE

Reason for discarding electrical equipments

During the survey, the respondents were asked for reasons behind discarding the equipment. 36 (32%) respondents stated that the equipment was broken while 28 (25%) respondents mentioned dysfunctional. 20 (18%) respondents stated that they had no place to store. 16 (15%) respondents said that the old equipment was functional but outdated, and other 12 (11%) respondents said they had bought new devices.

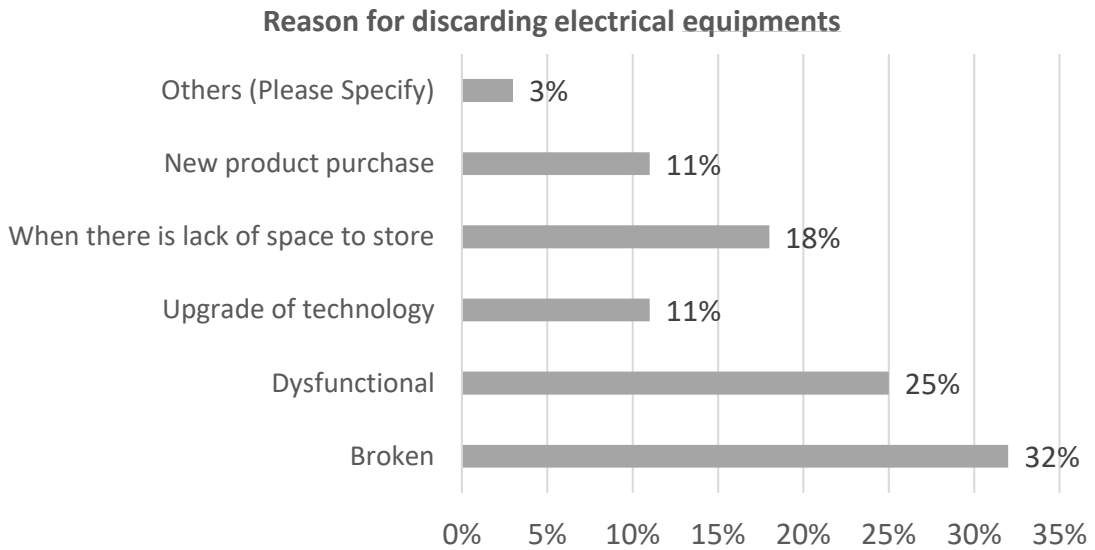


Figure 28: Chart showing reason for discarding electrical equipment in percentage

Methods followed for e-waste disposal

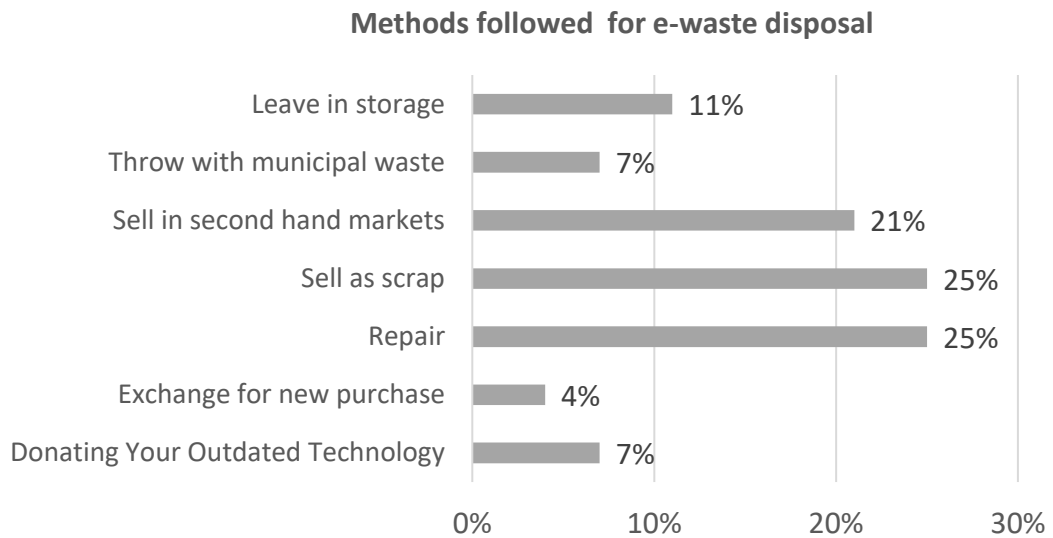


Figure 29: Chart showing method of e-waste disposal in percentage

Majority of respondents 28(25%) disposed their e-waste by repairing them and 28(25%) respondents sold them as scrap. 24(21%) Respondents were also selling in second hand market if their electronic device were functional, 12(11%) respondents stored their electronics in their home if it is large equipment, only 8(7%) donated their outdated technology to needy while other 8(7%) throw their e-waste and only 4(4%) had exchanged their electronics to get a discount in new purchase.

Key Informant Analysis

The perception of ward chairman differs from that of respondents as he told that “**Except for batteries, e-waste is disposed along with municipal waste**”. In the study area, it was also found that the waste from commercial buildings were disposed along with other household waste. Additionally, the local repairing shops in the Newroad neighborhood openly dispose their electronic waste nearby their shops. The open dumping in the streets harms the environment and also gives the unpleasant appearance.



Figure 30: Open dumping of e-waste by repair shops

Owner of a repair shop Shankar Agrawal claims that the “**majority of household devices come for repair.**” The tendency of Nepalese people to repair their technology reduces the amount of waste that is dumped in landfills. He continued by stating that inappropriate disposal of electronic waste once it can no longer be repaired poses serious environmental and health risks.

5.4 ANALYSIS OF AWARENESS OF LEVEL OF PEOPLE REGARDING THE E-WASTE

5.4.1 Awareness of E-waste Problem

Majority of respondents, 44 (40%) were highly aware that electronics generate e-waste when not used and dumped aside. 24 (21%) respondents were not aware at all, 16 (14%) respondents were aware 16 (14%) had no opinion and 12 (11%) respondents showed little knowledge of how the e-waste problem came to be. There is a need for proper e-waste management in the study area as showed by the respondents perception regarding e-waste management are evident.

Many studies have found a direct effect of e-waste on environmental degradation. From the survey, it was found that majority of respondents, 60 (54%) were highly aware that environmental degradation occurs through e-waste. 24 (31%) respondents were aware of such degradation. 16 (14%) respondents were found to be not much aware; 8 (7%)

respondents had no opinion and there were 4 (4%) respondents who were not at all aware on the same. Thus, respondents had good awareness about the environmental degradation through e-waste.

Studies have shown that toxins in e-waste easily leach into soil through water resources and groundwater, mainly through unsafe treatment of e-waste. Majority i.e., 48 (43%) respondents were highly aware about the fact that e-waste toxins enter the food cycle through leaching in crops and plants. 32 respondents were aware, 12 respondents (11%) were not at all aware, 12 (11%) respondents had no opinion and 8 (7%) respondents were not much aware. It was found during the survey that respondents with considerable awareness of e-waste were concerned about how they disposed of unused electronics.

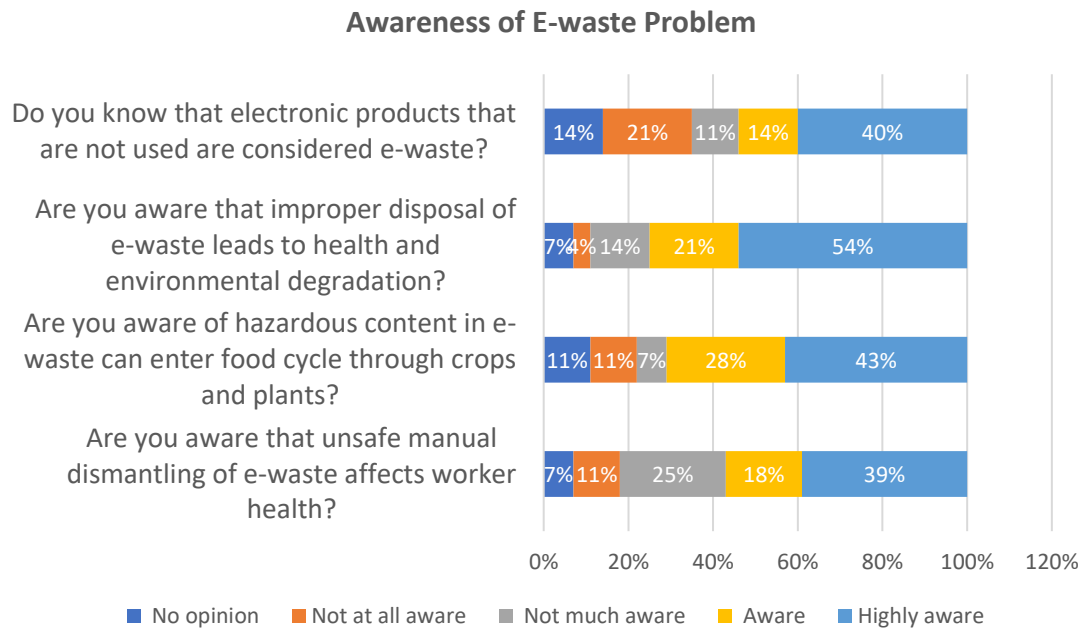


Figure 31: Chart showing awareness of e-waste problem

One of the biggest challenges in e-waste is dismantling components made of hazardous substances. Majority of respondents 44 (39%) were highly aware about e-waste affecting worker health, 28 (25%) respondents were not much aware, whereas 20 (18%) were aware of the same, 12 (11%) respondents were not at all aware and 8 (7%) had no opinion. Lack of awareness may also affect their concern on how such workers deal with workplace dangers and toxins.

5.4.2 Awareness about E-waste Management

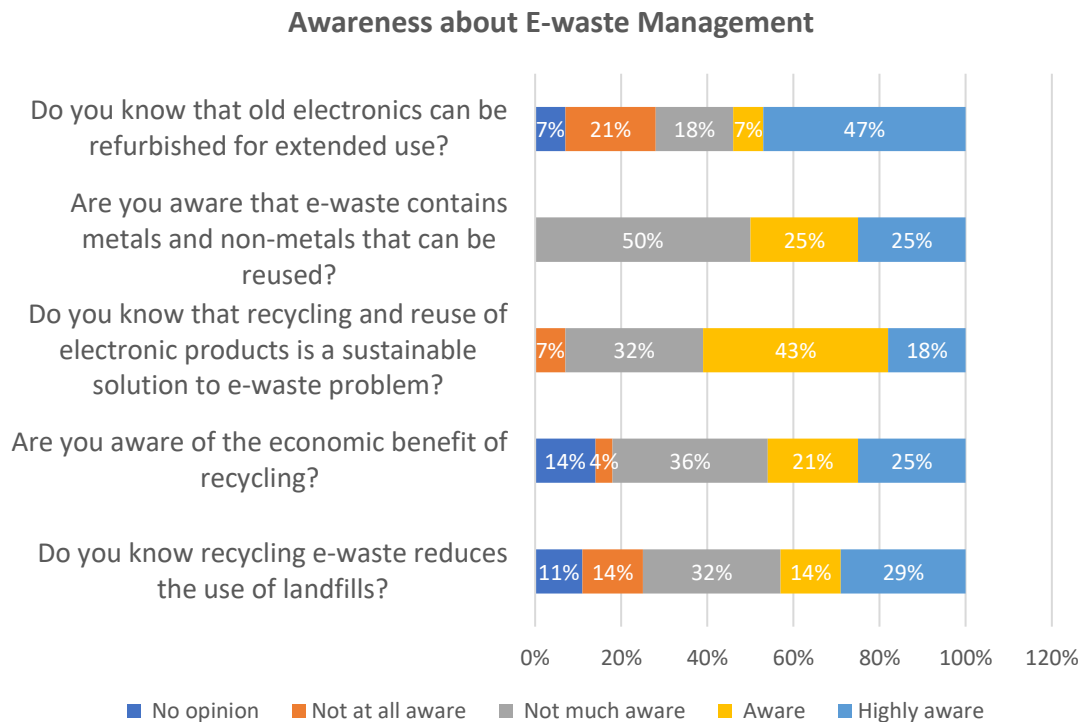


Figure 32: Chart showing awareness of e-waste management

It was necessary to find out from this survey whether respondents considered repairing electronics necessary. It showed that out of the 112 respondents, 52 (47%) respondents were highly aware that electronics should be repaired to reduce e-waste. 24 respondents (21%) not at all aware, 20 respondents (18%) respondents were not much aware about this phenomenon. 8 (7%) and 8(7%) respondents were aware and had no opinion respectively. Although many respondents were found to be aware about repairing electronics that had minor defects, many of them stated that it was better to buy a new product rather than waste money and resources to go after repair and service.

The good thing about electrical and electronic devices is that the components that go into making the devices, if segregated, can be reused. This awareness is required among people so that they understand the importance of conserving resources. Survey result showed that, 56 (50%) respondents were not much aware that metal and other useful resources can be generated from used e-waste devices. 28 (25%) respondents were highly aware and 28 (25%) respondents were aware about the same. Since people had fair awareness of the reuse of metals and nonmetals from e-waste,

Scientific recycling of e-waste is found to be the optimum solution to e-waste management. Recycling e-waste using formal methods is considered to be less polluting and safer. From the survey, it was found that 48 (43%) respondents were aware that recycling is a sustainable solution for managing e-waste. 36 (32%) respondents were not much aware, 20 (18%) respondents were highly aware and only 8 (7%) respondents were not much aware of recycling e-waste as a solution. Respondents have fair awareness about the concept.

Amongst 112 respondents, 40 (36%) were not much aware of economic benefit of recycling such as discounted price for new electronics from their discarded electronics while 25% (28) respondents were highly aware, 24 (21%) respondents were aware of recycling enterprises provides money for their e-waste. Only 16 (14%) respondents had no opinion while 4 (4%) respondents were not aware at all due to lack of related information.

Majority of respondents 36 (32%) were not much aware that recycling e-waste reduces the use of landfills. 32 (29%) respondents were highly aware while 16 (14%) were only aware of the same. 16 (14%) respondents were not at all aware while 12 (11%) had no opinion of the recycling e-waste reduces the use of landfill.

5.4.3 Willingness of people regarding E-waste Management

According to study from 2004, customer willingness to recycle is influenced by two factors: first, ease of access and understanding of available resources and services; and second, comfort (Tonglet et al., 2004). 60% of respondents said they would be willing to take part in recycling e-waste, and 47% said they would be happy to pay for ecologically friendly, healthy, and secure recycling of e-waste. While 47% of respondents were also willing to buy electronics from the second-hand market while other 46% of respondents were unwilling to buy. However, the rating was very positive but we need to emphasize on efficient ways of recycling of e-waste in the study area.

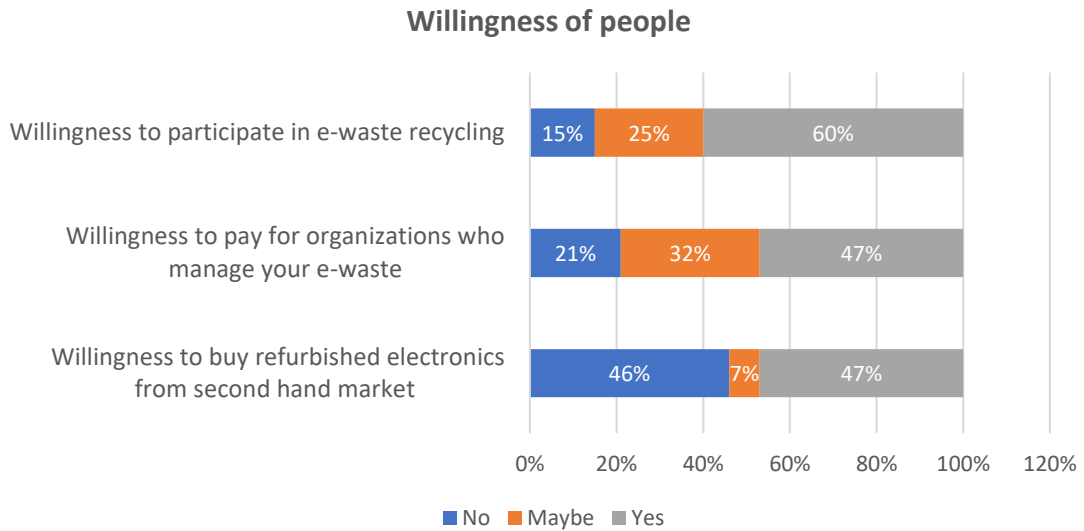


Figure 33: Chart showing willingness of consumers regarding e-waste management

5.4.4 Relationship Between Education and Awareness Level

1. Education Level and Awareness of electronic products that are not used are considered e-waste

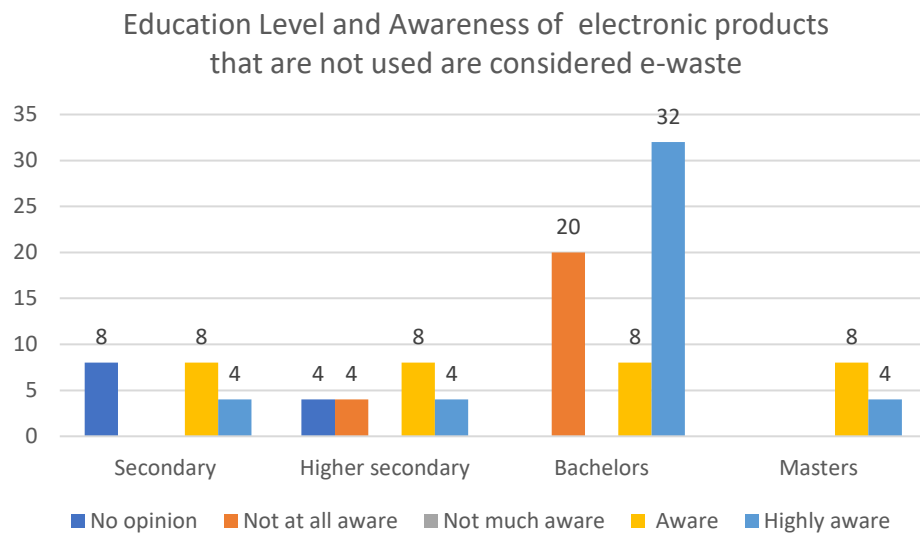


Figure 34: Chart showing Education Level and Awareness of electronic products that are not used are considered e-waste

Being aware is essential for responsible use and disposal because it can improve the efficiency of an e-waste management system. The majority of people i.e., 44 (39%) are highly aware of the electronic products that are not used are considered e-waste. But the respondent with secondary school degree is not aware about the e-waste. Education, which was found to have a substantial effect on awareness, can raise the very low level

of awareness that exists in the study area. Highly qualified respondents were found to be more aware of e-waste in contrast to less qualified respondents.

2. Education level and awareness of improper disposal of e-waste leads to health and environmental degradation

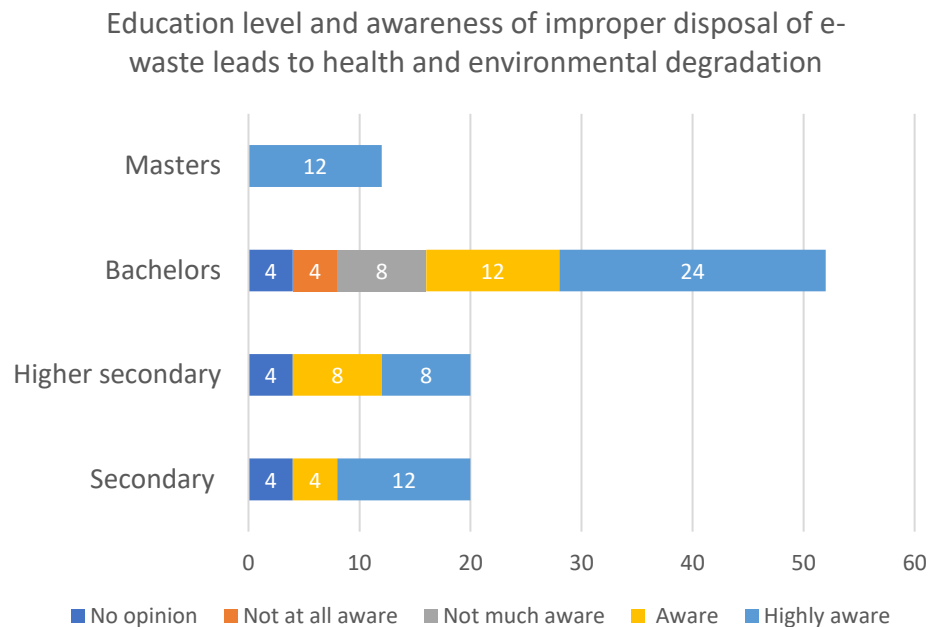


Figure 35: Chart showing Education level and awareness of improper disposal of e-waste leads to health and environmental degradation

E-waste has a higher awareness of poisonous and dangerous materials such as lead, mercury, and arsenic. Most people, regardless of educational background, agree that improper e-waste disposal can have harmful effects on the environment and, subsequently, on human health. From the survey it is found that, disparities between education level categories are negligible regarding awareness of improper disposal of e-waste, indicating that individuals with lower qualifications are just as aware as those with higher qualifications.

3. Education level and awareness of hazardous content in e-waste can enter food cycle through crops and plants

The awareness of hazardous content in e-waste that can enter food cycle through crops was found to be high among respondents with master's degree as well as secondary school degree. It is notable that there are negligible disparities in education levels,

indicating that persons with lower qualifications are just as knowledgeable as those with higher qualifications.

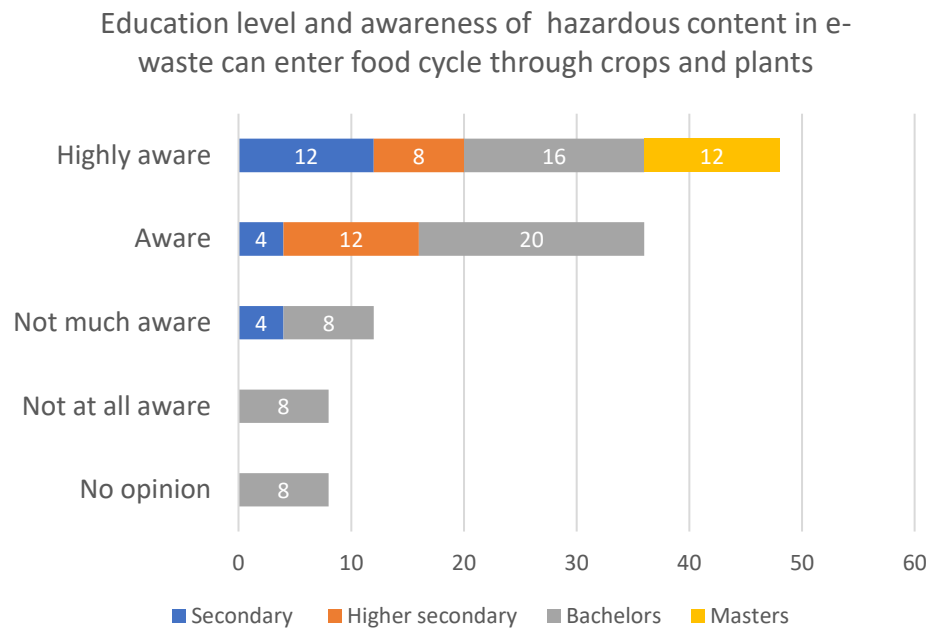


Figure 36: Chart Showing Education level and awareness of hazardous content in e-waste can enter food cycle through crops and plants

4. Education level and awareness of unsafe manual dismantling of e-waste affects worker health

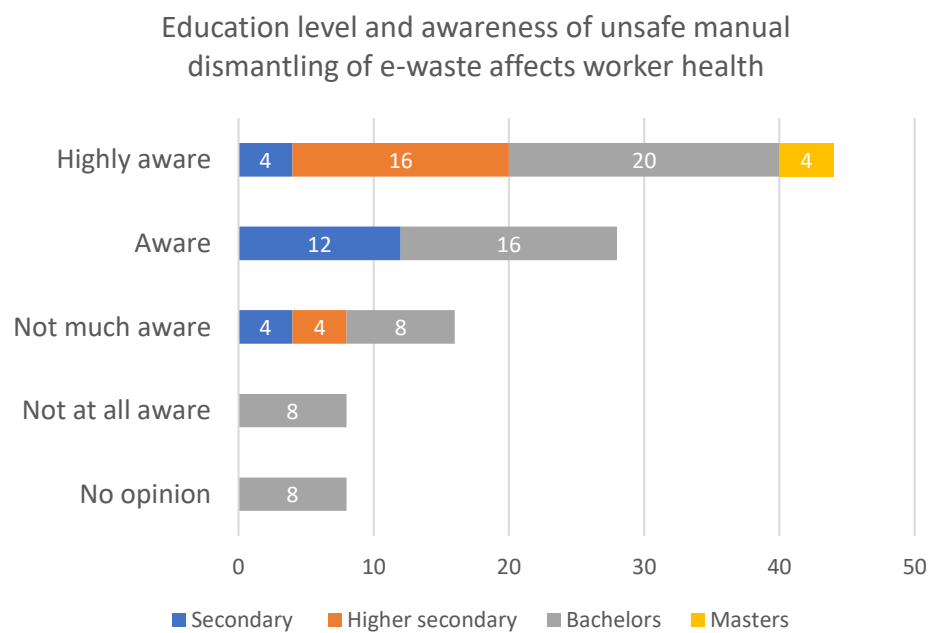


Figure 37: Chart showing Education level and awareness of unsafe manual dismantling of e-waste affects worker health

Respondents with bachelor’s degree and higher secondary degree were found to be highly aware of unsafe manual dismantling of e-waste affects worker health than other education group. Therefore, it is crucial to highlight that there aren't many disparities between the various categories of education level, which suggests that those with less education are just as knowledgeable as those with higher education.

5. Education level and awareness of extended use of refurbished products

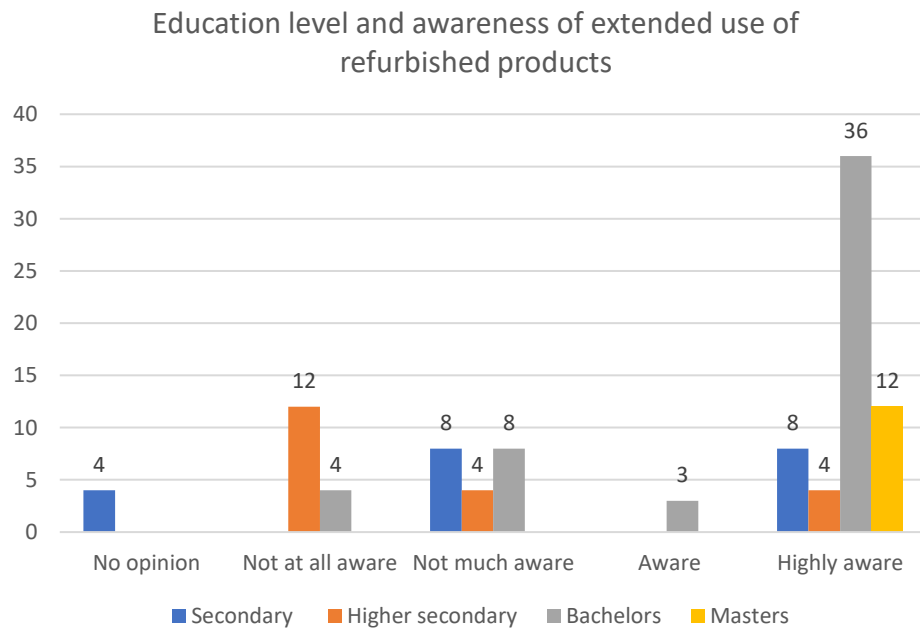


Figure 38: Chart Showing Education level and awareness of extended use of refurbished products

Respondents with master’s degree were found to have more awareness of extended use of refurbished product in contrast to less educated respondents. Education, which was discovered to have a substantial impact on awareness, can raise the very low level of awareness that exists right now.

6. Income level and Willingness to pay

About 60% of individuals are willing to pay the price to support proper e-waste recycling and management, according to the survey on willingness of respondents. It is noteworthy to note that there are little disparities between income groups, indicating that persons in low-income groups and those with high incomes are both equally willing. As a result, it does not seem as though income level has an impact on people's willingness to pay for an effective e-waste management system.

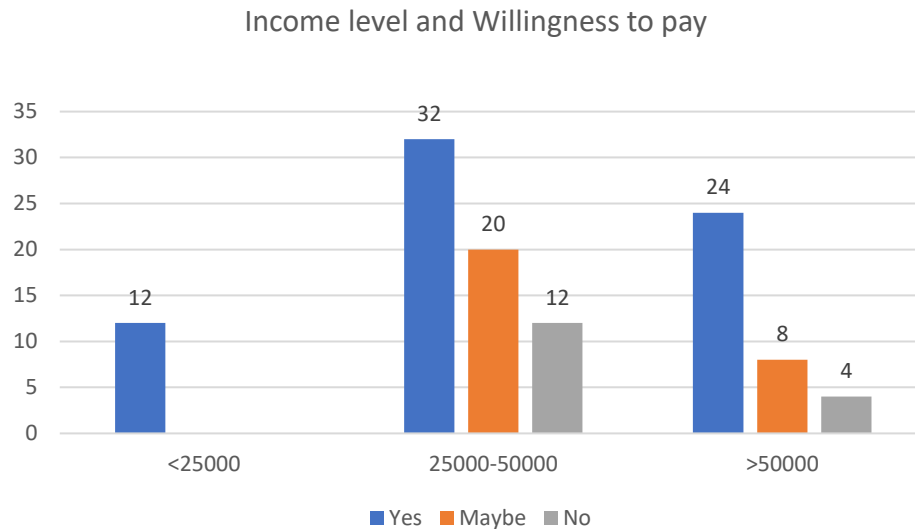


Figure 39: Chart showing Income level and Willingness to pay

Key Informant Analysis

According to Jenisha Maharjan of Doko Recyclers, “**when awareness programs were held in schools, the proportion of parents who came to recycle also rose**”. People were unaware of the number of recycling companies processing e-waste in Nepal prior to this campaign.

5.5 ANALYSIS OF POSSIBLE WAYS TO REDUCE E-WASTE

In the study area, most respondents stated of repairing their electronics and using till the end of its life. Selling to scrap dealers was also practiced in the study area which contributes in reducing the volume going to landfills.

The case study of Hewlett-Packard e-waste management in South Africa promotes e-waste to art by recycling electronics that are no longer in use. This helps to reduce e-waste and provides value to the waste.

Key Informant Analysis

Sarita Rai, Chief of the Environment Management Department said that “**there is a need for appropriate sustainable e-waste management solutions such as policy formulation, which must occur before the e-waste problem becomes difficult to manage just like in the case of other waste streams.**”

6 CHAPTER SIX : DISCUSSION AND CONCLUSION

6.1 DISCUSSION

The data from survey has helped to highlight e-waste management practices in our context. Discussion is presented in terms of research questions.

How does the generation of e-waste differ depending on the source?

According to the survey, residential sources account for a greater percentage of unused electronic equipment than institutional or commercial sources, which is consistent with the statements of recycling company. Electronic devices are affordable and enable people to complete their task in half the time it once did. The fact that new technological advancements are released every week, whether they be in the form of smartphones or kitchenware, is another factor. When a new model is released, people just store the old equipment in a house corner or discard it. It shows that e-waste in households is increasing. More e-waste is generated from houses such as TV due to introduction of new technology. Study of Luitel (2017) also found the increase in trend of buying more household electronics in the form of smartphones or kitchenware.

What are some of the general practices of disposal of e-waste?

Three major factors affect respondents decision to switch to new electronic devices include when device is damaged, dysfunctional, or there isn't enough room to store e-waste. Due to the absence of a door-to-door collection program in the study area, electronic waste is likely being stored at home.



Figure 40: Electronic waste stores at home with other waste

Due to the absence of practical methods for disposing of it effectively or recovering it for other uses, such household storage of e-waste has also been documented in other research. In the study area, the most popular e-waste disposal technique involves repairing and selling the waste as scrap. According to a study by Parajuly et al. (2018) repair businesses have up to 50% of the entire collections of e-waste, which are sold to scrap dealers.

What is the awareness level of people regarding the e-waste problem and e-waste management?

The study discovered that, the respondents had high degree of awareness of dangerous and hazardous substance, potential threats to the environment and human health from improper disposal, and the existence of valuable metals in electronic equipment, despite a lack of knowledge about e-waste management strategies.

The less awareness of e-waste management is due to having less idea of recycling centers which is one of the effective ways of treating e-waste. The level of willingness in e-waste management was also positive. It may be due to attitude and perception level of respondents towards environment. The finding from this study also explained that those who get higher degree have more knowledge on e-waste and understand the importance of environmental protection

What are the possible ways to reduce e-waste going to landfills?

There are several possible ways to reduce e-waste but e-waste is observed differently in different countries one approach cannot be effective in influencing how people dispose of their electronics. However, people can practice responsible consumption and production by participating in recycling activities. Nepal does not have a specific legislation on e-waste, but the environment protection act has initiated the polluters pay principle, which is a good step toward sustainability.

6.2 CONCLUSION

In our survey, e-waste generation and disposal, awareness of consumers, and possible ways to reduce e-waste in ward no. 22 of Kathmandu Metropolitan City were investigated. To safely dispose of, reuse, and recycle e-waste and reduce exposure to

harmful components, it is crucial to have knowledge and understanding of the subject. From the findings of our survey, the following conclusions are derived.

Unused electronic devices mentioned by most households included TV (28%) and mobile phones (25%) followed by a personal computer (21%). Also, the majority of unused electronics come from residential sources than institutional and commercial sources due to availability of electronics at cheaper rates. When studying the reason for discarding their e-waste, it was found that the majority of people only discard their devices when the equipment was broken and could not be repaired. Though consumers were not much aware of the formal e-waste recycling centers, they sent their e-waste to scrap dealers which also help in reducing the waste going to landfills.

Inadequate public awareness has been linked to irresponsible e-waste disposal practices, hence raising public awareness and enlisting the public's participation is essential for the success of initiatives to reduce electronic waste (Borthakur & Singh, 2022). The study's findings revealed that, despite consumers' awareness of the issues with e-waste, there is a serious lack of information about e-waste management, particularly about the existence of formal recycling facilities. Similarly, when willingness to participate in e-waste management was assessed, it showed a positive result. There is no provision by the municipality for disposal of e-waste but the environment protection act has initiated polluters pay principal as a responsibility of producers in managing waste.

It is found that there is a gap in knowledge regarding sustainable e-waste management methods in the study area. Additionally, the problems and consequences of e-waste was not mentioned in urban planning documents like National Urban Development Strategy (2017) either. These prevented to include e-waste issues into urban planning efforts. Even though e-waste is a result of urbanization and industrialization, it was discovered that it was not taken as topic of major concern in urban planning efforts compared to other general environmental challenges.

7 CHAPTER SEVEN: RECOMMENDATION

7.1 SPECIFIC RECOMMENDATION

- i. Most respondents were aware about the problem of unsafe disposal of e-waste but they are not much aware about management. In order to promote responsible e-waste management in the study area, it is needed to educate the general population about such management strategies as extended producer responsibility, circular economy, etc.
- ii. From the survey high willingness of people to participate in e-waste management was found. Therefore, it is necessary to provide awareness that prevents generation of avoidable e-waste through 3R and reduce the volume going to landfill by segregation e-waste from municipal waste.
- iii. In Newroad area, repair shops are disposing broken screens of laptops along with the municipal waste. Such activities should be prohibited and people responsible for mixing should be fined.
- iv. Training for repurposing e-waste into art form just like in the Hewlett-Packard case study should be provided to reduce waste and protect the environment.
- v. Since most of the households in the study area depend on informal recyclers for disposal of their e-waste as they found them convenient, easily accessible, and also provided a financial return. Therefore, it is needed to formalize the current informal sectors for better collection and dismantling of e-waste.
- vi. It is also needed to aware consumers of buying, repairing, selling, or discarding their electronics only in certified places to be protected from cyber thieves.

7.2 POLICY RECOMMENDATION

- i. Our existing solid waste management act and Solid waste management rules have no provision for e-waste. So it needs proper and specific legislation to cope with the e-waste to address the current and future challenges due to haphazard disposal of e-waste.
- ii. Government should provide incentives to the formal e-waste management company for their contribution to reducing waste to landfills as they can reduce 90% of e-waste going to landfills. It is also needed to promote research works in e-waste.

- iii. National Urban Development Strategy (NUDS) must create plans for recovering precious metals, which is an important aspect of managing e-waste and could be advantageous for boosting economy.
- iv. Separate mechanism for collection, transportation, dismantling, and disposal of e-waste is needed in Nepal, Also, separate e-waste collection centers are required so that it doesn't get mixed with other waste and end in landfills.
- v. Government should ban unscientific recycling techniques that could harm the environment and human health, such as open burning, incineration, and the crude extraction of metals from e-waste using acids.
- vi. Educational institutions can provide opportunities to create knowledge about awareness of the environment and electronic waste management by including the topic of e-waste management in their textbooks.
- vii. The government should collaborate with the Central Bureau of Statistics to incorporate data on electronic equipment into the routine Census of Manufacturing Establishments and to incorporate data on e-waste into the population census.
- viii. The government ought to collaborate with the Department of Customs to enhance the information on imported electronic components and assemblies. Additionally, prohibit the illegal import and export of electronics and impose severe penalties if done.
- ix. In urban areas with a higher rate of e-waste generation, the Local Government Operation Act should be used to create local legislation for the protection of the environment and human health.
- x. The task of waste collection and disposal has been regarded as one of the most dangerous jobs that exposes employees to occupational dangers. Employees managing e-waste should take safety measures by wearing gloves, a mask, safety goggles, and ear plugs.

7.3 DIRECTION FOR FUTURE RESEARCH

- i. Focused research should be done in other similar urban areas to understand the practice of e-waste generation and disposal.
- ii. Future research on integration of informal e-waste recycling sector into the waste management department can be done

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ANNEX-I: QUESTIONNAIRES

ELECTRONIC EQUIPMENT'S CONSUMER QUESTIONNAIRE

Respondents Name

Location

DEMOGRAPHIC INFORMATION

1.Age

- a) 0-20
- b) 20-40
- c) 40-60
- d) Above 60

2 Sex

- a) Male
- b) Female

3. Education

- a) Primary
- b) Secondary
- c) Higher Secondary
- d) Bachelors
- e) Masters

SOCIO-ECONOMIC CHARACTERISTICS

4. Occupation

- a) Business
- b) Service
- c) Student
- d) Others

5. Family Size

- a) Less than 4 members
- b) 4-8 members
- c) More than 8 members

6. Household Ownership

- a) Own
- b) Rental

7. Total HH Income

- a) Less than Rs25000
- b) Rs25000- Rs50000
- c) More than Rs50000

8. Building Type

- a) Residential
- b) Commercial
- c) Institutional

If commercial or institutional, specify the type

E-WASTE GENERATION AND DISPOSAL PRACTICE

9. Unused electronic equipment (e-waste) in the household

No.	Items	No.	Items
	Large equipment's (LE)		Lighting Equipment's (LP)
1	Washing machine	6	CFL
	Cooling Equipment's (CE)		Screens and Monitors (SM)
2	Refrigerator	7	TV
3	Air conditioner	8	Laptop
	Small Equipment's (SE)		Small IT and Telecommunication Equipment

4	Mixer-grinder	9	Mobile Phones
5	Iron	10	Personal Computer

10. Storage duration of unused electronic equipment (e-waste) in the household

No.	Items	Duration		
		<6 months	6 month -1 year	>1 year
1	Large equipment's (LE)			
2	Cooling Equipment's (CE)			
3	Small Equipment's (SE)			
4	Lighting Equipment's (LP)			
5	Screens and Monitors (SM)			
6	Small IT and Telecommunication Equipment			

11. When do you discard your e-waste?

- a) Broken
- b) Dysfunctional
- c) Upgrade of technology
- d) When there is lack of space to store
- e) New product purchase
- f) Others

12. What is the reason for non-disposal of e-waste?

- a) Emotional attachment
- b) Personal data security
- c) Valuable Product
- d) Others

13. How much e-waste is generated annually?

- a) 1kg-3kg
- b) 3kg-5kg
- c) 5kg-7kg
- d) More than 7kg

14. Do you segregate e-waste from other household waste?

- a) Yes
- b) No

15. What method you follow for e-waste disposal?

- a) Repair
- b) Sell in second hand market
- c) Donating your outdated technology
- d) Exchange for new purchase
- e) Leave in storage
- f) Throw with municipal waste
- g) Sell as scrap
- h) Others

16. What prevented you from bring your e-waste to collection points?

- a) Poor e-waste collection system
- b) Improper knowledge about e-waste recycling
- c) Lack of vehicles
- d) Lack of time
- e) Don't care

AWARENESS LEVEL

17. Awareness of E-waste Problems

Please assign your opinion on a 5-point scale, for the following statements based on your awareness. (1 – No opinion, 2 –Not at all aware, 3-Not much aware, 4-Aware, 5-Highly aware)

No.	Items	Opinions				
		1	2	3	4	5
1	Do you know that electronic products that are not used are considered e-waste?					
2	Are you aware that improper disposal of e-waste leads to health and environmental degradation?					
3	Are you aware of hazardous content in e-waste can enter food cycle through crops and plants?					
4	Are you aware that unsafe manual dismantling of e-waste affects worker health?					

18. Awareness about E-waste Management

Please assign your opinion on a 5-point scale, for the following statements based on your awareness. (1 – No opinion, 2 –Not at all aware, 3-Not much aware, 4-Aware, 5-Highly aware)

No.	Items	Opinions				
		1	2	3	4	5
1	Do you know that old electronics can be refurbished for extended use?					
2	Are you aware that e-waste contains metals and non-metals that can be reused?					
3	Do you know that recycling and reuse of electronic products is a sustainable solution to e-waste problem?					
4	Are you aware of the prevailing laws & regulation about e-waste management?					
5	Are you aware of the economic benefit of recycling?					
6	Do you know recycling e-waste reduces the use of landfills?					

19. Willing of Consumer in E-waste Management

No.	Items	Opinions		
		Yes	Maybe	No
Willingness				
1	Willingness to participate in e-waste recycling			
2	Willingness to pay for organizations who manage your e-waste			
3	Willingness to buy refurbished electronics from second hand market			

13. Would you like to give any suggestions to the government, associations, NGOs, local bodies etc.?

KEY INFORMANT QUESTIONNAIRE

Municipality

1. What is the role of a municipality for managing e- waste?
2. What is the major source of e-waste?
3. Do they pick waste daily? Do they also pick e-waste? If yes then where is it transported to?
Is there any provision of separate collection of e-waste?
Quantity of e-waste collected per year
4. What method do you follow for e-waste disposal?
5. Is the landfill site being used for the disposal of e- waste in this municipality?
6. Who are the stakeholders involved in the waste management and what is their role?
7. Is there any plans and programs for proper transfer, collection & management sites inside the municipality?
8. What are the obstacles in managing e-waste?
9. Is there any resource recovery initiative taken by the municipality?
10. What government laws and policies are there for e-waste management?
11. KMC environment and natural resource protection act-2021 has stated about e-waste
12. What is the awareness of the level of people regarding the segregation of e-waste?

13. Is there any awareness program held about the problems of e-waste ? What is the medium of awareness used?
14. What are the organizations involved in the management of the E-waste?
How they are maintained with municipality act & policies?
15. Are you running any programmes that officially addresses the safe e-waste disposal?
16. Have you provided e-waste bins in your municipality?
17. Do you have further suggestions or comments regarding management of e-waste?

Ward Office

1. How is waste collected? Frequency of collection
2. Do they pick waste daily? Do they also pick e-waste? If yes then where it is transported to? Is there any provision of separate collection of e-waste?
What is the awareness of the level of people regarding the segregation of e waste?
3. Is there any awareness program held about the effects of e-waste? What is the medium of awareness used?
4. What government laws and policies are there for e-waste management?
5. Are you running any programmes that officially addresses the safe e-waste disposal?
6. Have you provided e-waste bins in your municipality?

Recycling Center

1. What is the reason for forming this company?
2. What are the major activities of your company?
3. What is the major source of e-waste that comes for recycling?
 - a) Residential
 - b) Commercial
 - c) Institutional
4. How is e-waste collected?
Do you buy them or they are donated?
Which issues prevent a proper e-waste collection?


5. Can you provide the statistics of e-waste generated?
6. What is the lifespan of electrical and electronic equipment?
7. For what reason do you replace your old electronic appliances?
8. How do you categorise the types of e-waste and why?
9. Are the staff given training on e-waste management?
10. What is the role of various stakeholders in e-waste handling?
11. What methods do you follow for disposal of e-waste?
12. Do you recycle or refurbish them ? If yes where? What % of waste is recycled?
13. Where do you sell your refurbished products? If yes where?
14. What are the prospects of people buying refurbished electronics?
15. What kind of health and safety measure is applied in handling e-waste?
16. Any health risk appeared till now due to recycling?
17. Does your company follow EPR strategy for management of e-waste?
18. Who does you think should be responsible for their e-waste?
19. What is the willingness of people to participate in e-waste management?
20. What is the role of government in your organization?
21. What government laws and policies are there for e-waste management?
22. What are the possible ways to reduce e-waste through sustainable production and consumption and how can this be addressed in the policies?
23. Do you have further suggestions or comments regarding management of e-waste?

Repair Shop

1. What is the major source of e-waste that comes for repair?
 - a) Residential
 - b) Commercial
 - c) Institutional
2. Can you provide the statistics of e-waste generated?
3. What is the lifespan of electrical and electronic equipment?
4. For what reason do you replace your old electronic appliances?
5. How do you categorize the types of e-waste and why?
6. Are you aware of the effect of e-waste that it poses on health and environment?
7. Are you aware that some electronic parts may be profitably recycled?

8. Are you aware that e-waste needs a special treatment in order to be safely disposed of?
9. What methods do you follow for disposal of e-waste?
10. Do you recycle or refurbish them ? If yes where?What % of waste is recycled?
11. What kind of health and safety measure is applied in handling e-waste?
12. Any health risk appeared till now due to recycling?
13. What government laws and policies are there for e-waste management?
14. Who do you think should be responsible for their e-waste?
15. Do you have further suggestions or comments regarding management of e-waste?

ANNEX II: KEY INFORMANT INTERVIEW

Environment Management Department (KMC)	
<ul style="list-style-type: none">• Kathmandu metropolitan city is only responsible for managing biodegradable and non-biodegradable waste.• Since the portion of e-waste coming is very minimal and there is inadequate knowledge about e-waste in the public, there is no any regulation to manage them.• She also said it is important to create awareness about e-waste to reduce its effects on health and environment.	 <ul style="list-style-type: none">• Sarita Rai• Department Chief of Environment Management Department

Ward Office	
<ul style="list-style-type: none">• The municipality collects household waste, commercial waste along with e-waste in their vehicles.• There is no separation of e-waste and it is taken to a transfer station along with other wastes.• However people separate their medical waste as they are aware about its need for treatment before disposal.• People are not aware about the effects of improper management of e-waste.• The ward has provided waste bins in different places such as in public places and schools.	 <ul style="list-style-type: none">• Chini Kaji Maharjan• Ward no.22 Chairman

<ul style="list-style-type: none"> • There have been programs of waste management in this ward. 	
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Repair Shops

Birendra Sharma- Repair Shop Owner

Electronics from residential and institutional source comes for repairing. Repair shops have been found to store the electronic equipment after the useful life and abandoned by the owners for a few years. The purpose of such storage is to reuse some of the parts from such equipment to repair similar electronic items with defect in other parts. Electronic parts are stored for long time so that some of the components can be taken out and used for repairing other electronic equipment which they are also sold in second hand market. In case of broken screen, they are dispose together with the Municipal waste to the dumping site.

Shankar Agrawal- Repair Shop Owner

Most of the household electronics comes for repair in his shop. Nepalese people have a habit of repairing their gadgets, which lowers the amount of waste that ends up in landfills. He added that there are major environmental and health risks associated with the improper disposal of electronic waste after it is no longer repairable.

Recycling Company

Blue Waste To Value

Ronish Shakya-Genaral Manager
Blue waste to value is a e-waste recycling company started in 2019 with a purpose of reducing waste to landfills. Total volume of e-waste collected is approx 5 tonnes which includes mainly household sources. The e-waste was collected with the aim for scientific disposal and to reduce the effect on environment.
<u>Method of disposal:</u> The company collects e-waste from different sources at first. If the e-waste is repairable then it is repaired with the help of technicians and then send to second

hand market. If the e-waste is not repairable then it is dismantled and harmful materials are segregated and other useful metals are recovered for further use.

Campaigns

Blue Waste to Value ran campaigns like collection drive programs on campuses for e-waste management trainings and also collected e-waste from students. In order to ensure that consumers' e-waste is properly recycled through Blue Waste to Value, they have also partnered with CG group to implement the first official take back system, which allows consumers to dispose of their waste at the outlets of CG and LG Lifestyle Shoppe (BW2V). Customers have a choice of two programs under the E-waste take-back system, depending on the size and type of E-waste.

First is the drop off system where non-bulky items can be directly dropped-off at the CG outlets and other is door-to-door system where bulky items, like refrigerator, washing machine, and television can be requested for door-to-door pickup. Discount vouchers are provided for the items under door-to-door pick-up. They had also collected roadside wires from Lagankhel to Satdobato stretch twice where 450 kgs of wires were collected.

DOKO Recyclers

Jenisha Maharjan-Operation Incharge

Bhuwan Chalise- Research Intern

Doko Recyclers is the first e-waste recycling company formed by four engineers with an aim to formalize e-waste handling practices in Kathmandu. The company started four years ago and the major source of e-waste comes from institutional buildings such as US embassy, standard chartered banks. Total 241 tonnes e-waste has been collected so far.



Figure 41: E-waste Section

Method of disposal

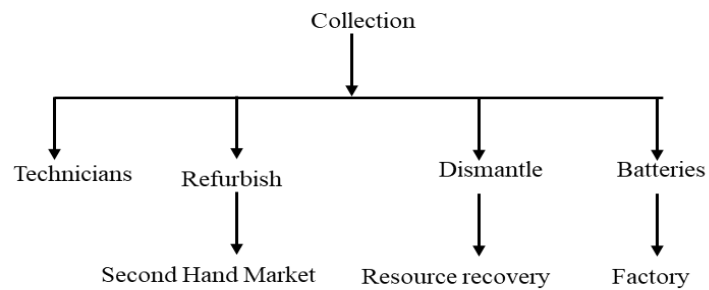


Figure 42: Method of Disposal

All the waste are bought at a scrap value. Major problem here is the lack of GPS which creates problems during collection. The good thing is 90% waste is recycled out of which 55% is refurbished and 45% is dismantled in safely with safety equipments like fire extinguisher, gloves, safety goggles, mask, boots, ear plugs are provided for the staffs of e-waste section. They also introduced EPR strategy where they brought the old and discarded electronics from exchange offer of CG Digital.

Campaigns

- KOIKA project for schools and corporate offices for providing training on segregation.
- Repair and revolution program for the students of age group 10-14 years where they were taught to repair wires such as extension cord, electric jug and also provided tool bag for their use at home.

ANNEX III: SITE PHOTOGRAPHS



Figure 43: Newroad



Figure 44: Pako Newroad

Fig: Commercial Zone

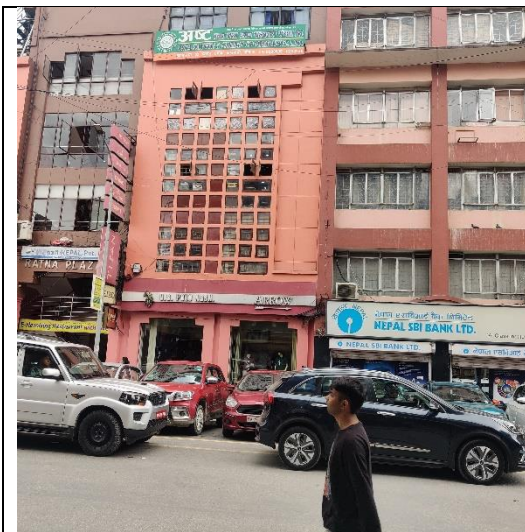


Figure 45: Dharmapath



Figure 46: Ranjana Galli

Fig: Institutional zone



Figure 47: Ganabahal



Figure 48: Tebahal

Fig: Residential Zone



Fig: Repair Shops

ANNEX IV:FINAL PRESENTATION COMMENTS

Table 3: Final Presentation Comments

S.N	Professors	Comments	Addressed Comment Pg.No
1)	Mr. Kumar Prasad Lohani (External Examiner)	Show the route where electronic waste is transported	Pg No.40
		Add safety measures in recommendation section	Pg.No.68
2)	Er. Chakravarti Kanth (External Examiner)	Review of Buyback Method	Buy back scheme is also known as take back system which is addressed in the Pg. No. 19, 20
		Blow up map of the study area	Pg. No.7
		Review of public procurement rules for auction	Pg. No.24,25
		Add the role of LGOA in recommendation	Pg. No.68
		Add source in figures	
3)	Dr. Jib Raj Pokhrel	Disosal practices of electronic waste in urban areas	Pg. No.38,39

ANNEX V:IOE GRADUATE CONFERENCE

Acceptance letter



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Date: September 14, 2022

To Whom It May Concern

This is to confirm that the paper titled "*Managing E-waste in the Kathmandu Metropolitan City: A Case of Ward no. 22*" submitted by **Shraddha Dotel** with Conference ID **12137** has been accepted for presentation at the 12th IOE Graduate Conference being held in October 19 – 22, 2022 at Thapathali Campus, Kathmandu.

Khem Gyanwali, PhD
Convener,
12th IOE Graduate Conference

