A Study on Repair and End of Life (EoL) for Electric Cooking and Domestic Appliances in Nepal

Authored by:

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for, Doko Recyclers

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Executive Summary

Electrical and Electronic Waste (e-waste) generation and its engineered disposal is becoming a major challenge in Nepal due to fast urbanization and rising electronic device consumption. The Government of Nepal has initiated several programs to promote the use of electric stoves and biogas plants to decrease reliance on traditional sources of energy. However, with the increased adoption of electronic cooking equipment, there is a growing concern about the management of e-waste in Nepal. To address this challenge, Doko Recyclers, a leading e-waste management company in Nepal in collaboration and support from Loughborough University UK and Modern Energy Cooking Services (MECS, UK), decided to conduct research on the repair and end-of-life ecosystem of electronic cooking devices and home appliances in Nepal. The main objective of this study is to investigate how the electrical and electronic devices are handled at the end of their life cycle and the repair culture in Nepal. The study primarily focused on understanding the patterns of disposal, repair, and recycling behavior in four regions. The study area included; Kathmandu Metropolitan City, Janakpur Sub Metropolitan City, Aaurahi Rural Municipality, and Mahankal Municipality.

This study aimed to identify the current practices and challenges of repair behavior and end-of-life management for electrical and electronic devices in Nepal, specifically e-cooking devices. This study collected and analyzed data on the end-of-life ecosystem in both urban and rural contexts, conducted stakeholder mapping, and identified key players and their roles in the ecosystem. The study addressed research questions related to current management practices, opportunities and barriers for repair and recycling, and drivers of consumer and stakeholder decisions. The findings contributed to broader research and offered recommendations for sustainable end-of-life practices and policy interventions to promote the circular economy for e-cooking devices.

This study conducted by Doko Recyclers collected data from 268 households in urban and rural areas of Nepal during period of Dec 2022 to Jan 2023. The data revealed that the end-of-life management of electrical and electronic devices in Nepal is an emerging challenge, with a lack of awareness and appropriate disposal infrastructure being the main reasons for the challenge. The study found that there is a need for better coordination between stakeholders, including households, waste collectors, recyclers, and policymakers, to improve the management of end-of-life electronic cooking devices in Nepal. The study also found that the replacement rate of electronic cooking devices in Nepal is

relatively high. The study revealed that households in Nepal often choose to dispose of their electronic cooking devices in informal ways, such as throwing them away in the trash, burning them, or selling them to informal waste collectors, rather than taking them to formal e-waste recycling facilities. This is due to several reasons, including the lack of awareness about e-waste and its disposal, the absence of accessible e-waste collection centers in many areas, and the lack of incentives for households to dispose of their e-waste responsibly.

Additionally, the study identified several challenges in the current end-of-life ecosystem for electric cooking devices in Nepal. These include a lack of appropriate collection and transportation systems for e-waste, insufficient infrastructure and technical know-how for e-waste recycling, limited public awareness about the dangers of improper e-waste disposal, and a lack of policies and regulations for e-waste management. The absence of an effective e-waste management system exacerbates the environmental and health hazards associated with e-waste, as it often leads to informal e-waste disposal methods, which are associated with open burning and dumping of electronic waste.

The study also found that the majority of stakeholders in the end-of-life ecosystem of e-cooking devices are informal waste aggregators, who often engage in unsafe and environmentally harmful disposal methods such as burning or open dumping. There is a clear need to formalize the waste management industry in Nepal to ensure safe and sustainable disposal practices. The study recommends that policymakers in Nepal should implement several initiatives to address the challenges of e-waste management, including raising awareness about the importance of proper disposal methods for electronic equipment, providing incentives for the proper disposal of e-waste, and promoting the growth of formal waste management companies.

The research highlights the need for policymakers to implement measures that encourage the formalization of waste management in Nepal, promote sustainable disposal practices, and create incentives for the proper disposal of e-waste. By doing so, it is anticipated that Nepal can address the challenges of traditional energy sources, promote the use of sustainable energy sources, and contribute to the attainment of the Sustainable Development Goals.

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Abbreviation

AEPC	Alternative Energy Promotion Center
ARM	Aaurahi Rural Municipality
BSP	Biogas Support Program
CBS	Central Bureau of Statistics
CRT	Cathode Ray Tube
EoL	End of Life
EPR	Extended producer responsibility
ES	Electric Stoves
FGD	Focus Group Discussion
GoN	Government of Nepal
HDD	Hard disk drive
ICIMOD	International Centre for Integrated Mountain Development
IEC/TR	International Electrotechnical Commission/Technical report
IFC	International Finance Corporation
INGO	International Non-governmental Organization
JSMC	Janakpurdham Sub-Metropolitan City
KII	Key Informant Interview
KMC	Kathmandu Metropolitan City
LPG	Liquefied Petroleum Gas
MOEST	Ministry of Environment, Science and Technology
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoFE	Ministry of Forests and Environment
MOICT	Ministry of Information and Communications Technology
MRM	Mahankal Rural Municipality
NBS	Nepal Bureau of Standards
NEA	Nepal Electricity Authority
NGO	Non-governmental organizations
NS	Nepal Standards
NTA	Nepal Telecom Authority
PCB	Polychlorinated biphenyl
SDG	Sustainable Development Goals
SSD	Solid-state drive
TV	Television
WEEE	Waste Electrical and Electronics Equipment
WHO	World Health Organization

1. Introduction

1.1. Background

Nepal, like many developing countries, is facing a significant challenge in achieving sustainable development goals, especially in transitioning towards clean and efficient energy sources. The majority of energy needs in Nepal are still being met through traditional sources such as firewood, straw, and agricultural waste. Not only does this lead to deforestation and soil erosion, but it also causes indoor air pollution that results in respiratory illnesses. To address these challenges, the Government of Nepal has initiated several programs to promote the use of electric stoves and biogas plants as a means to decrease reliance on traditional sources of energy.

To support this initiative, the Alternative Energy Promotion Center (AEPC) has been working to promote alternative energy sources, such as electric stoves and biogas, for cooking. The AEPC has collaborated with various urban and rural municipalities in the Terai region of Nepal to install 10,000 biogas plants in the first phase and provide 500,000 electric stoves to replace all kerosene stoves currently being used in the Terai region. The Government of Nepal (GoN) has set an ambitious plan to award one electric stove to every household in the nation as part of the newly unveiled budget plan for the upcoming fiscal year 2022-2023. By 2030, there is plan to promote electric stoves in 25% of the nation's homes to reduce the usage of firewood to 30%. However, with the increased adoption of electronic cooking equipment, there is a growing concern about the management of electronic waste (e-waste) in Nepal. The end-of-life management of electronic cooking devices is becoming a significant challenge in Nepal due to the lack of awareness and appropriate disposal infrastructure. In response to this challenge, Doko Recyclers decided to conduct research on the end-of-life usage of electronic cooking devices in Nepal.

This study aims to investigate the end-of-life ecosystem of electronic cooking devices in both rural and urban areas of Nepal. It will examine current trends in the end-of-life procedures for failed equipment and augment the limited existing literature on end-of-life e-cooking devices. By collecting household data and market intelligence from key stakeholders, this study will contribute to broadening the scope of earlier research and highlight the challenges and opportunities for the growth of the end-of-life ecosystem for e-cooking devices in Nepal.

The objective of this study is to examine the variables influencing consumers and key stakeholders decisions on end-of-life e-cooking devices in Nepal and based on findings, suggest a way forward to manage EoL home appliances in Nepal. These suggestions and findings are intended to assist policy makers in determining the degree to which policy intervention may be required if the SDGs are to be attained. Additionally, this study aims to provide the groundwork for strategies and initiatives aimed at extending the reach of electronic cooking equipment repair and recycling to solve the issues of e-waste management, precious material recovery, greenhouse gas emissions, and trade imbalance.

This report presents the findings of the research study conducted by Doko Recyclers on end-of-life handling of e-cooking devices and other household appliances in Nepal. The report is organized into several sections, including the methodology used in the study, an analysis of the data collected from households, and a review of the end-of-life ecosystem of e-cooking devices, and recommendations for policymakers and stakeholders in Nepal. The report concludes with a discussion on the implications of the findings and potential areas for future research.

1.2. Research Objective

The primary aim of this study was to investigate the current end-of-life landscape of electronic cooking devices in Nepal, with a particular focus on understanding patterns of disposal, repair, and recycling behavior in four regions: Kathmandu Metropolitan City, Janakpur Sub Metropolitan City, Aaurahi Rural Municipality, and Mahankal Municipality. The study seeks to identify the challenges and opportunities for the growth of the end-of-life ecosystem for e-cooking devices in Nepal. The specific objectives of the study included:

a. Examining current practices and challenges of consumers at the end of life of electric stoves.
b. Collecting and analyzing data on the end-of-life ecosystem of e-waste in both urban and rural contexts.
c. Mapping the end-of-life ecosystem of e-cooking devices.
d. Conducting stakeholder mapping and analysis to identify key players and their roles in the end-of-life ecosystem.
e. Gaining insight into existing practices related to e-waste, with a focus on e-cooking devices, to identify gaps and opportunities for intervention.

1.3. Research Questions

The primary aim of this study was to investigate the current usage patterns and disposal practices of e-cooking devices, identify the key stakeholders involved in the end-of-life pathways, and evaluate the barriers and opportunities for repair, refurbishment, and recycling of these products in Nepal. Through an examination of the drivers of consumer behavior and the environmental and social impacts of different end-of-life pathways, this study will develop recommendations for sustainable end-of-life practices and policy interventions to promote the circular economy for e-cooking devices. To achieve these objectives, the study has addressed following research questions:

1. What are the current end-of-life management practices for electronic devices in Nepal, and what factors influence these patterns?
2. What opportunities exist for the repair and recycling of e-cooking devices in Nepal, and what are the barriers to realizing these opportunities?
3. What are the key drivers of consumer and stakeholder decisions regarding end-of-life management of electronic devices?
4. What are the challenges and opportunities for the growth of the end-of-life ecosystem for e-cooking devices in Nepal?
5. What variables influence consumers and key stakeholders decisions regarding the end-of-life management of e-cooking devices in Nepal?

2. Literature Review

The end-of-life management of electric and electronic items (e-waste) has become an increasingly important issue in Nepal due to the significant amount of electronic waste generated by the country. .Nepal generates approximately 28,000 metric tons of e-waste in 2020 (Global e-waste Monitor, 2022) with year on year growth rate of 7%. Recycling of e-waste can bring significant benefits to energy utilization, including the protection of public health and the environment, as well as the recovery of valuable resources to sustain and contribute to the circular economy. . However, the management of electronic waste in Nepal faces various challenges. There is a lack of awareness and knowledge about the proper management of electronic waste and solid waste management among consumers, retailers, and policymakers. Furthermore, the informal sector, which handles the majority of electronic waste in

the country, faces issues such as poor working conditions, lack of safety measures, and low levels of technological capacity. In 2010, the government passed the Solid Waste Management Act, which provided a framework for the management of municipal solid waste, but didn't address e-waste and other hazardous waste. .

Despite these efforts, challenges remain in the proper management of electronic waste in Nepal. The lack of an effective monitoring and enforcement mechanism for the Solid Waste Management Act has resulted in inadequate implementation of the act. Additionally, the formal sector's involvement in electronic waste management is limited, and the recycling and resource recovery technologies are underdeveloped. The end-of-life management of electronic items is a critical issue in Nepal. Proper management can bring significant benefits, but the country faces several challenges in this regard. While the government has implemented various policy and programmatic interventions, more needs to be done to improve the effectiveness of these interventions and promote the sustainable management of electronic waste in Nepal.

2.1. E-waste status in Nepal

Electric & Electronic items have become an integral part of our daily lives, and with the rapid growth of technology, the rate of their consumption has increased. As a result, e-waste has become a major concern worldwide, including Nepal. End-of-life management of electronic items is essential for environmental sustainability and health protection, and there is a growing body of literature exploring the benefits and challenges of e-waste management in Nepal. The existing literature on end-of-life management of electronic items in Nepal highlights several benefits. Proper e-waste management can reduce the negative impact of e-waste on human health and the environment. E.g. e-waste recycling can reduce the release of harmful chemicals and pollutants into the environment, such as lead, cadmium, and mercury, which can cause serious health problems for humans and other living organisms.

Moreover, e-waste management can generate economic benefits by creating job opportunities and providing a source of raw materials for the manufacturing industry. E-waste recycling can create employment opportunities, particularly for low-income groups, and generate income for communities. Furthermore, e-waste recycling can recover valuable materials such as gold, silver, copper and other rare earth metals, which can be reused in the manufacturing of new electronic products. However, the literature also highlights several challenges to e-waste management in Nepal. One of the key

challenges is the lack of proper infrastructure and facilities for e-waste management. There is an issue in the entire value chain process of end of life management starting from collection, transportation, storage, treatment. recycling, and disposal in Nepal. The lack of infrastructure and facilities results in the improper disposal of e-waste, which can lead to environmental pollution and health hazards.

Another challenge is the lack of awareness and education about e-waste management. Studies have shown that many people in Nepal are not aware of the negative impact of e-waste on human health and the environment (Shobha Dahal, 2018), and they often dispose of e-waste improperly. Therefore, there is a need for education and awareness-raising campaigns to promote proper e-waste management practices among the public. The literature review reveals that proper end-of-life management of electronic items is essential for environmental sustainability and health protection (Arya & Kumar, 2020, Nnorom & Osibanjo, 2010).

While e-waste management can generate economic benefits, there are also several challenges, including the lack of infrastructure and facilities and the lack of awareness and education. Policymakers, stakeholders, and the e-waste producers need to work together to address these challenges and promote sustainable e-waste management practices in Nepal.

2.2. E-waste Management Policy in Nepal

Nepal has been facing significant challenges related to the sustainable end-of-life management of waste electrical and electronic equipment (WEEE), also known as e-waste. From the data of the global e-waste monitor published by United Nation University 2020, Nepal generates 28,000 tons of e-waste which is 0.9 kg per capita. The Government of Nepal (GoN) has not yet developed any specific policies for the management of the expanding amount of e-waste. Nepal is a signatory country of the BASEL convention which also restricts the trans-boundary movement of e-waste. A legal framework for the management of solid waste is only provided by the National Solid Waste Management Act, which was passed in 2011 to address all types of waste (SWM Act, 2011). This doesn’t specify any particular methodology to handle hazardous waste fractions like e-waste, chemical waste etc. It requires local governments to develop and implement waste management plans, including plans for e-waste management. However, the implementation of this act has been slow, and many local governments have not yet developed waste management plans.

On the positive side, several initiatives have been implemented by various stakeholders to promote sustainable e-waste management. For example, the Ministry of Information and Communication (MoIC) has launched a stakeholder dialogue and initiated a draft policy related to E-waste. The key points in this policy dialogue was moving ahead with establishing guidelines to manage e-waste in different stages of its value chain (from generation, collection, transportation, storage, dismantling, refurbishing and recycling). It also highlighted the implementation of Extended Producer Responsibility. This activity is undertaken by Nepal Telecom Authority (NTA), a regulatory body working under MoIC. The draft report is expected to be published in 5-6 months. Similarly, the private sector has initiated several e-waste collection and recycling programs. For instance, Doko Recyclers, a private sector company, has set up an e-waste collection and recycling facility in Kathmandu. Few companies (Sabkophone.com, arkostore.com) are working on a take back system of old mobile phones, Television, Freeze etc and after refurbishing, send it back to market for resale. CG electronics and Him Electronics have initiated an old device (household appliances) exchange program in collaboration with Doko recyclers where old appliances are sent to Doko for refurbishment or end disposal collected from retail consumers.

However, these initiatives have faced several challenges. One of the major challenges is the lack of policy and guidelines which can act as the foundation stone to start e-waste management. The strong dominance of the informal sector and in absence of guidelines has created unsafe practices of cherry picking (only collecting high value items and dumping low value components). Many people still dispose of e-waste in landfills along with other municipal waste, which can lead to environmental and health hazards. Moreover, Nepal's lack of infrastructure and capacity for managing e-waste has caused it to accumulate in landfills and open dumping grounds (Nepali Times, 2018). There is a need for stronger enforcement of regulations and greater incentives for producers and importers to comply with e-waste management rules. Additionally, there is a need for greater public awareness and investment in infrastructure and capacity for e-waste management in Nepal.

2.3. Standard Specification of E-cooking device in Nepal

The Nepal Bureau of Standards (NBS) from GoN is responsible to establish and implement national standards for any kinds of electrical and electronics device import or production. Nepal presently only has a few e-cooking device standards in place. Table 1 mentions some of the current standards, such as NS 561 and NS 562, which detail specific specifications for induction hobs and hotplates,

respectively. These requirements are designed to guarantee the security and effective operation of these gadgets. Additionally, NS 564 provides basic safety rules for domestic and similar electrical equipment, while NS 563 establishes performance standards for induction and household hobs. As a result of Nepal's attempts to control and encourage the usage of e-cooking devices in the nation, all of these criteria were adopted in the year 2076 BS (2019 AD). Consumers may feel secure knowing that the e-cooking devices they buy and use are secure and trustworthy that complies with these criteria which can further promote acceptance and usage in Nepalese families.

Table 1 List of Nepal Standards for E-cooking Devices

S.N.	NS Number	Nepal Standards	Year
1	NS 561:2076	Household And Similar Electrical Appliances Particular Requirements For Induction hob	-
2	NS 562:2076	Household And Similar Electrical Appliances Particular Requirements For Hot Plate	-
3	NS 563	Performance Standards For Household and Induction Hobs	2076 BS (2019 AD)
4	NS 564	Household and Similar Electrical Appliances - Safety: Part 1- General Requirements	2076 BS (2019 AD)

The Nepal Bureau of Standards (NBS) has established standards specifications for e-cooking devices through the publication of NS 561:2076 (MoFE, 2021). These standards are intended for household use of induction hobs and similar cook tops. It is important to note that these standards do not apply to industrial appliances. The set standards provide specific requirements for e-cooking devices, including safety and performance criteria. Some of the key highlights of these standards include testing for power output, energy efficiency, and thermal insulation. Standards such as Nepal Bureau of Standard and Metrology, 2018 are crucial in ensuring the safety and quality of e-cooking devices for household use in Nepal.

2.3.1 Input Voltage

The first key highlight of the standards set by the Nepal Bureau of Standards (NBS) for e-cooking devices is related to the rated input voltage. According to NS 561:2076, the rated input voltage should not exceed 250 volts for single-phase supply and 440 volts for three-phase supply. This ensures that

the e-cooking devices are designed to operate safely within a specific range of voltage inputs, which helps to prevent the risk of electrical hazards and damage to the appliances.

2.3.2 Diversity Factor

The next important highlight of the standards pertains to the diversity factor applied to appliances with more than three heating units per phase. The diversity factor F, is used to calculate the current used to establish the size of the terminals and the nominal cross-sectional area of the supply cord. The formula used to calculate F is based on the number of heating units per phase that can be energized together (N). This requirement ensures that e-cooking devices are designed to efficiently distribute power among multiple heating units, which can help to reduce energy waste and improve performance.

$$F = 0.35 + 0.65/\sqrt{N} \text{ ..... (i)}$$

Where,
F = Diversity Factor
N = Number of Heating Units per Phase

2.3.3 Operation and Hobs

The third requirement according to the standards set by Nepal Bureau of Standards for e-cooking devices, during normal operation, induction hobs must be used with vessels specified in Table 2, which contain cooking oil at room temperature. The thermal controls are adjusted to their highest setting until the oil temperature reaches 180°C ± 4°C, after which they are adjusted to maintain this temperature. The oil temperature is measured 10mm above the center of the bottom of the vessel, and the vessel is positioned centrally on the cooking zone. If several cooking zones are marked for one hob element, the most unfavorable cooking zone is used for the test. In the case of non-circular cooking zones, the smallest non-circular vessel is used that can cover the cooking zone as much as possible, taking into account the hob rim and other vessels. The quantity of liquid used is determined based on the minor diameter of the cooking zone as shown in table 2.

Table 2 specifies the quantity of oil that should be used for testing the induction hob, based on the diameter of the cooking zone. The quantity of oil ranges from 0.6 liters for cooking zones with a diameter of 110mm or less, to 3 liters for cooking zones with a diameter greater than 220 mm and up to 300mm. These quantities of oil were selected to ensure that the thermal controls of the induction hob are tested under normal operating conditions, with vessels containing cooking oil at room temperature. It is important to note that the vessel used for testing should have a diameter

approximately equal to the diameter of the cooking zone and should be positioned centrally on the cooking zone. If the cooking zone is non-circular, the smallest non-circular vessel that covers the cooking zone as far as possible should be used, with the quantity of oil determined based on the minor diameter of the cooking zone.

Table 2 Quantity of Oil for Different Diameters of Cooking Zones in Induction Cooktop

Diameter of cooking zone (mm)	Quantity of oil (l)
≤ 110	0.6
> 110 and ≤ 145	1.0
> 145 and ≤ 180	1.5
> 180 and ≤ 220	2.0
> 220 and ≤ 300	3.0

Src:: NBS document, the type and density of cooking oil not specified

2.3.4 Electrical Safety

If the appliance comes with a socket-outlet, an appropriate plug identified in IEC/TR 60083 is engaged. The plug is connected to a 1 kW resistive load using an ordinary polyvinyl chloride sheathed flexible cord having a cross-sectional area of 0.75 mm^2. The temperature rise of the plug is determined during the last 30 minutes of the test. After the appliance has been operated for the specified duration, the controls are adjusted to their highest setting, and the leakage current is measured within 10 seconds of it attaining its highest value.

For stationary Class I appliances, the leakage current shall not exceed the following values: for other appliances, 1 mA or 1 mA per kW rated power input with a limit of 10 mA, whichever is higher. If there is earthed metal between live parts and the surface of glass-ceramic or similar material of hobs, the leakage current is measured between live parts and each vessel connected to the earthed metal. If there is no earthed metal, the peak value of the leakage current between live parts and each vessel connected to the hob's surface of glass-ceramic or similar material shall not exceed 0.21 mA as measured using the circuit described in Figure 4 of IEC 60990. In addition, a test voltage of 1,000 V is applied between live parts and all vessels connected to earthed metal, or 3,000 V is applied between live parts and the vessels if there is no earthed metal. This test ensures that the appliance's electrical

components are safe for use and meet the necessary safety standards set by Nepal Bureau of Standards.

2.3.5 Accidental Operation

One of the prominent standards set is construction of hobs to ensure that accidental operation of touch controls does not result in hazardous situations due to spillage of liquids, including that caused by vessels boiling over. To test compliance, a specific procedure is followed where each hob element is energized in turn and then without energizing any hob elements. Water is poured steadily over the control panel, and a white cloth saturated with water is placed on the panel in any position. The appliance should allow for the touch controls to switch off any energized hob element during the test, unless it switches off automatically.

Induction hobs that incorporate touch controls must have visual indicators to show when each hob element is energized. Compliance is tested by manual inspection and testing. Additionally, induction hob elements must only operate when a vessel is placed on the cooking zone. To test compliance, an iron bar with specific dimensions is placed in the most unfavorable position on each cooking zone in turn. The controls are adjusted to their highest setting, and the temperature rise of the bar should not exceed 35 K.

Appliances with at least one hob element must be designed to switch off any energized hob element in the case of electronic component failure. Compliance is tested by following specific procedures where fault conditions are considered and, if necessary, applied to the electronic circuit. Additionally, the hob element should not become energized unintentionally in case of electronic component failure. The appliance is operated under certain conditions, and fault conditions are applied one at a time to the electronic circuit. There should be no operation of any induction hob element for longer than 10 seconds, and if a pan detector is incorporated, a suitable vessel is placed on the cooking zone. For induction hob elements controlled by an electronic circuit, safety should not be impaired in the event of a fault in the electronic circuit, and compliance is tested by applying fault conditions to the electronic circuit controlling the duty cycle for each hob element in turn.

2.3.6 Rusting & Corrosion

The sixth requirement according to the standards set by Nepal Bureau of Standards is an essential part of ensuring that ovens have adequate resistance to rusting and corrosion. It is particularly important in

the case of ovens intended for use on board ships, where exposure to saltwater mist can be a significant challenge. To ensure compliance for these ovens, the salt mist test Kb of IEC 60068-2-52 is used, with different severities of the test applied depending on the intended use of the oven.

The salt mist test is a rigorous and comprehensive test designed to evaluate the ability of the oven to withstand exposure to saltwater mist. To conduct the test, the coatings of metal parts are carefully prepared by creating five scratches at least 5 mm apart and at least 5 mm from the edges of the relevant parts to be tested. The test pin of Sub Clause 21.2 is then used, held at an angle of 80° to 85° to the horizontal and loaded with a force of 10 N ± 0.5 N to its axes. The pin is drawn along the surface at a speed of around 20 mm/s, creating scratches that simulate the effects of exposure to saltwater mist.

After the test, the appliance must be inspected to ensure that it has not deteriorated to the extent that it impairs compliance with the standard, especially Clauses 8 and 27. The coating must remain intact and not be broken or detached from the metal surface. This is essential to ensure that the oven can withstand the harsh conditions it may encounter while being used on board ships. By meeting these requirements, the oven can be considered fit for use in these challenging environments, ensuring the safety and well-being of those on board.

2.4. E-waste management practices in Nepal

E-waste management is dominated by the informal sector in Nepal where valuable items are collected by scrap collectors, aggregators and dismantlers and rest items are either dumped or burnt. Several studies have highlighted the concerning state of e-waste management practices by informal sectors in Nepal. According to a study conducted by Parajuli in 2017, it was reported that informal recycling and disposal of e-waste is prevalent in Nepal due to the absence of proper regulations and infrastructure which is being sold to scrap dealers who extract valuable metals by using hazardous techniques such as acid bath and burning, leading to severe environmental and health impacts (Parajuli et al., 2017).

Nepal being a signatory country of Basel convention has to manage the e-waste generated internally with proper policy, infrastructure setup and formalizing the present informal sector. Studies in other countries have also shed light on the benefits and challenges of sustainable end-of-life management of electronic items. For example, a study identified the need for collaboration between stakeholders,

including producers, consumers, and governments, for sustainable e-waste management (Alblooshi et al., 2022). Another study emphasized the importance of circular economy principles and technological innovation in e-waste management.

Sustainable consumption behaviors have also been identified as crucial in addressing the issue of e-waste. Awareness and education programs could effectively promote sustainable consumption behaviors among consumers, leading to reduced e-waste generation. Similarly, designing sustainable electronic products and promoting eco-design principles could reduce the environmental impacts of e-waste. In conclusion, the literature on e-waste, end-of-life management practices, and sustainable consumption behaviors in Nepal and other relevant contexts highlights the need for comprehensive regulations, infrastructure, and stakeholder collaboration for sustainable e-waste management. It also emphasizes the importance of sustainable consumption behaviors and circular economy principles in mitigating the adverse environmental and health impacts of e-waste.

However, despite these policy and programmatic interventions, the implementation of sustainable end-of-life management practices for electronic items in Nepal is still a challenge due to the lack of awareness, inadequate infrastructure and funding, and weak policies and regulations. Therefore, there is a need for effective policies and regulations, proper infrastructure, and awareness-raising programs to promote sustainable end-of-life management practices in Nepal.

2.5. Import volume of major electric cooking devices

With increase in electricity supply, increasing cost of LPG, and ease of availability of e-cooking devices, the trend of use of electric cooking devices is gaining popularity. The increasing trend of imports in these electric cooking devices (Induction Stove, Infrared Cooktop, Microwave Oven, and Rice Cooker) shows the reality. The import statistics provided by Department of Customs in Nepal is shown table 3:

Table 3 Import Volume of major E-cooking Devices in Nepal from 2019-2022

Year	2019	2020	2021	2022
Induction Stove	10,435	152,588	116,810	169,023
Infrared Cooktop	-	2,400	41,454	118,336
Microwave Oven	23,465	32,612	34,931	49,904
Rice Cooker	27,688	442,068	403,890	396,146

Source: Department of Customs (2019-2022) (Figure denotes number of units)

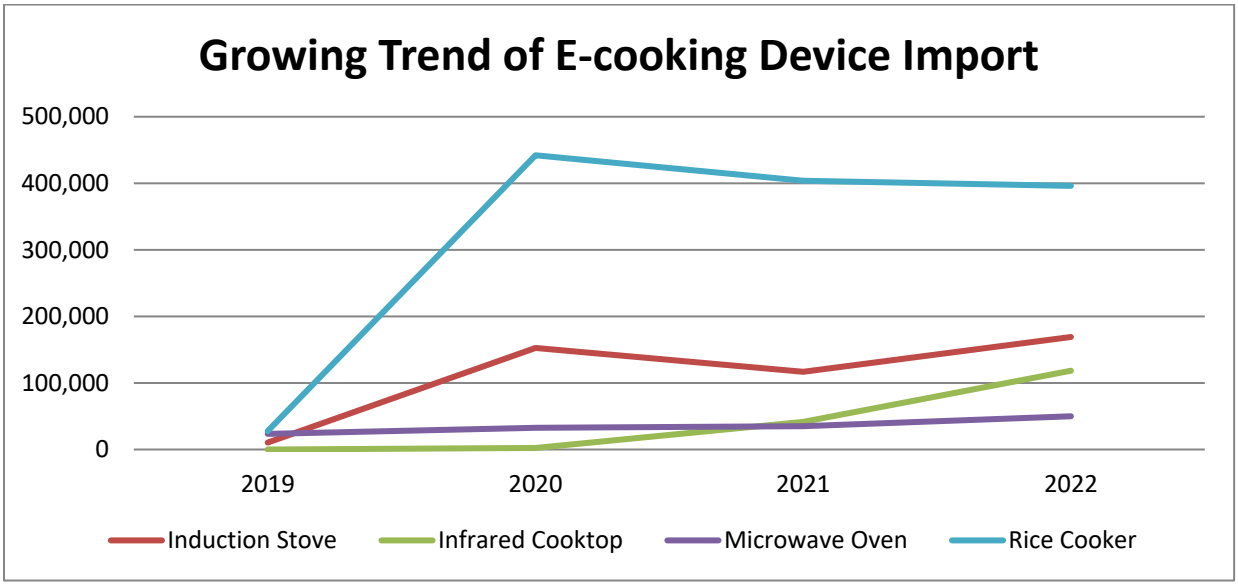

Figure 1 Import Volume of major e-cooking devices

Based on the given data, there has been a significant increase in the import volume of major e-cooking devices in Nepal from 2019 to 2022. The upward trend of importing three major e-cooking device (Induction stove, Infrared cooktop and Microwave oven) shows the popularity and future perspective of changing cooking behavior. With increasing device import and use, it is bound to have more e-waste after end of life of such devices. The overall trend suggests a growing demand for e-cooking devices in Nepal, as people are opting for more efficient, energy-saving, and convenient cooking options. Figure 1 provides a trend of the import volume.

2.6. Types of E-cooking devices available in Nepal

Based on information provided by key informants and survey observations, there is a wide range of electric cooking devices available in the Nepalese market with various brands. Some of the common brands for e-cooking devices are listed in Annex 1. Following is a list of the most common types of E-cooking devices available in Nepal. E-cooking devices are becoming increasingly popular in Nepal due to their convenience, energy efficiency, and ease of use. With a range of devices available, there is an E-cooking device for every cooking need and preference.

Table 4 different type of e-cooking device

Type of E-cooking device	Working Principle	Picture
Induction Cooktop	Induction stoves use electromagnetic fields to heat pots and pans, rather than relying on an open flame or electric heating element. They are highly efficient, as they only heat the cookware and not the surrounding air.	
Infrared Stoves	Infrared stoves use infrared radiation to heat up pots and pans, rather than relying on traditional heating elements. There is heating coil for heating purpose. They are highly efficient and can cook food quickly.	
Electric Pressure Cooker	Electric pressure cookers use steam pressure to cook food quickly and efficiently. They are ideal for preparing soups, stews, and other slow-cooked dishes in a fraction of the time it would take with traditional cooking methods.	

Microwave Oven	Microwave ovens use electromagnetic radiation to cook food quickly and efficiently. They are ideal for reheating leftovers or cooking simple meals.	
Rice Cooker	A rice cooker is a specialized cooking device that is designed to cook rice quickly and efficiently. It is ideal for preparing large quantities of rice for meals or for batch cooking.	
Electric Kettle / Water Boiler	An electric kettle is a specialized device that is designed to boil water quickly and efficiently. It is ideal for making tea, coffee, and other hot beverages.	
Roti Maker	A roti maker is a specialized cooking device that is designed to make round flatbreads, such as roti or chapati. It can save time and effort in preparing these types of bread.	
Air Fryer	An air fryer is a specialized cooking device that is designed to fry food using hot air instead of oil. It is ideal for preparing healthier versions of fried foods.	

3. Major cooking mediums used in Nepal

3.1. Liquefied Petroleum Gas (LPG)

Liquefied Petroleum Gas (LPG) is becoming increasingly popular as a cleaner and more efficient alternative to traditional biomass for cooking and heating in Nepal. The use of LPG has grown significantly in recent years, with the total consumption of LPG in Nepal increasing by 20.1% in the

fiscal year 2020-21 compared to the previous year, reaching 454,244 metric tons (Nepal Oil Corporation, 2021). LPG is a non-toxic, highly flammable liquefied mixture of propane and butane that emits less CO_2 and particulate matter than coal or biomass and has a higher calorific value than fuel wood. The use of LPG has several environmental benefits, including reducing indoor air pollution by 90% compared to traditional biomass, as noted in a study by the World Health Organization (2011). Additionally, the use of LPG can help reduce deforestation and desertification, two major environmental impacts associated with the collection and use of solid fuels such as fuel wood. However, despite its benefits, the use of LPG is not a sustainable long-term solution due to its non-renewable nature as a fossil fuel and its negative environmental impact from excess CO_2 emissions, contributing to global warming and climate change. Nepal has to import all petroleum products including LPG. Data from Nepal Oil Corporation (government body and a sole importer of all petroleum products) shows that in the year 2021-22 AD, Nepal imports 536,028 tones of LPG (Nepal Oil Corporation, 2022).

To promote the use of LPG in rural areas, the government of Nepal has initiated various programs such as the Free Gas Connection Scheme and the LPG Promotion and Cylinder Subsidy Program. These programs aim to provide clean cooking fuel to rural households at an affordable price and reduce the reliance on traditional solid fuels (Government of Nepal, 2021).

3.2. Solid fuel

Fire wood, biomass, cow dung cake, charcoal etc are considered as solid fuel. The use of solid fuel for cooking and heating is a significant issue in Nepal, particularly in rural areas where access to modern energy sources is limited. According to the CBS report of 2017, around 63.6% of households in Nepal use biomass for cooking, out of which 52.4% solely use fire wood as the primary cooking fuel. The use of solid fuel for cooking is more prevalent in rural areas, where over 85% of households use biomass for cooking compared to 32.7% in urban areas (Bhandari & Pandit, 2018). The reliance on solid fuel for cooking has significant negative health impacts. Cooking with traditional stoves that burn solid fuels releases harmful pollutants such as carbon monoxide, particulate matter, and other toxic gasses which can cause respiratory and cardiovascular diseases (Kaplan, 2010). As per the WHO, exposure to indoor air pollution caused by the use of solid fuels for cooking and heating leads to approximately 24,000 premature deaths in Nepal every year (WHO, 2019). Due to their increased

indoor activities and responsibility for cooking, women and children are particularly susceptible to the health impacts mentioned.

In addition to the health impacts, the use of solid fuel for cooking also has environmental consequences. Deforestation and soil degradation are the most prominent environmental impacts associated with the collection and use of solid fuels such as fire wood. As per the National Forestry Research and Development Centre, Nepal loses about 1.6% of its forest cover annually, primarily due to the use of fire wood for cooking and heating (Chapagain & Aase, 2020). To address these issues, various initiatives have been undertaken to promote the use of clean cooking technologies. The government of Nepal has initiated programs such as the National Biogas and Renewable Energy Program with the aim of encouraging the adoption of biogas as an alternative for solid fuels. The program has been successful in providing clean and sustainable energy for cooking and heating to over 30% of households in rural areas (GoN, 2018).

Similarly, the promotion of improved cook stoves has also helped reduce indoor air pollution and deforestation (AEPC). Despite these efforts, the use of solid fuels for cooking remains prevalent in Nepal, primarily because of issues pertaining to affordability and accessibility issues, especially in rural areas where alternative energy sources are limited.

3.3. Electric Cooking Medium

Electricity is an emerging and promising alternative for cooking in Nepal. As of 2021, the country has an installed capacity of around 1,900 MW of electricity generation capacity, with a target of achieving 15,000 MW by 2030 (Ministry of Energy, Water Resources and Irrigation, 2020). With this increase in electricity generation, there is a possibility of greater adoption of electric cooking appliances in Nepal. However, despite the increase in electricity production, the use of electric cooking in Nepal is still limited, especially in rural areas. A field survey conducted by the International Centre for Integrated Mountain Development (ICIMOD), showed that 25% of the households relied entirely on traditional cooking fuels while 67% and 8% of the households relied on mixed and commercial cooking fuels, respectively (ICIMOD, 2021).

Electric cooking offers several advantages, including energy efficiency, convenience, affordability, safety, and availability. Unlike traditional cooking fuels like firewood, electric cooking produces no

smoke, ensuring better indoor air quality (World Health Organization, 2021). Moreover, electric cooking is highly convenient, with features like automatic shut-off, keep-warm, pre-set cooking, and delay cooking, making it easier and more flexible for households to use (Renewable World, n.d.). The use of electricity for cooking in Nepal is still in its nascent stage, but it has significant potential for growth. A study conducted by the International Finance Corporation (IFC) estimated that by 2030, 40% of urban households in Nepal could be using electric cooking appliances (IFC, 2020). However, the high upfront cost of electric cookers and the need for reliable and affordable electricity supply remain major challenges for the widespread adoption of electric cooking in Nepal.

The use of electricity for cooking in Nepal is an emerging trend that has the potential to offer several advantages over traditional cooking fuels. With the government's focus on increasing electricity generation capacity, the adoption of electric cooking is expected to increase in the coming years, bringing benefits such as improved indoor air quality, convenience, and flexibility.

4. Research Methodology

This section outlines the research methodology used to conduct the E-cooking Device Survey 2022 in Nepal. The study utilized a mixed-methods approach to collect both quantitative and qualitative data to answer the research questions. The following subsections provide a detailed description of the research design, sampling technique, data collection instruments, data analysis, and ethical considerations.

4.1. Research Design

A cross-sectional study design was utilized in the E-cooking Device Survey 2022, as it is a suitable approach for collecting data at a single point in time from a representative sample. The study aimed to collect primary data from households using e-cooking devices in Nepal to gain a better understanding of their usage patterns, energy consumption, cost savings, and environmental impact. To accomplish this, a mixed-methods approach was utilized, which combines both quantitative surveys and qualitative interviews.

The quantitative surveys aimed to identify the factors that influence the adoption and usage of e-cooking devices in Nepal. The surveys gathered data on various aspects such as demographic

characteristics, household composition, cooking practices, and appliance usage patterns. On the other hand, the qualitative interviews conducted with key informants and focus group discussions aimed to provide a more in-depth understanding of the perspectives of stakeholders involved in the e-cooking device market in Nepal. This includes experts in the field of repair, waste management, supply of devices, as well as individuals who have experience using e-cooking devices.

By utilizing a mixed-methods approach, the E-cooking Device Survey 2022 was able to provide a more comprehensive understanding of the factors that influence the adoption and usage of e-cooking devices in Nepal. The quantitative surveys provided data on the prevalence of e-cooking device usage and the factors that influence adoption, while the qualitative interviews provided a deeper understanding of the perspectives of stakeholders involved in the e-cooking device market in Nepal.

4.2. Survey Area

The research study aimed to explore the use of electric cooking appliances in different communities across Nepal, taking into account their diversity in terms of ethnicity, religion, geography, and household income level. The study selected two urban and two rural communities as shown in figure 2 and used a stratified purposive sampling approach to select a sample size from each municipality. The survey team took into consideration the respondent's caste, race, gender, and economic situation while selecting the sample for the field survey. The households that have access to electricity and use e-cooking devices were chosen as the primary focus of the research.

The structured survey questionnaire was used to gather data on various topics, such as the types of electric stoves used, access to electricity, quality of e-cooking devices, practices when an appliance breaks down, options after its useful life, motivation for repair and recycling, willingness and capacity to pay, etc. The aim was to obtain a comprehensive understanding of the usage patterns, maintenance practices, and disposal practices of electric cooking appliances across different communities.

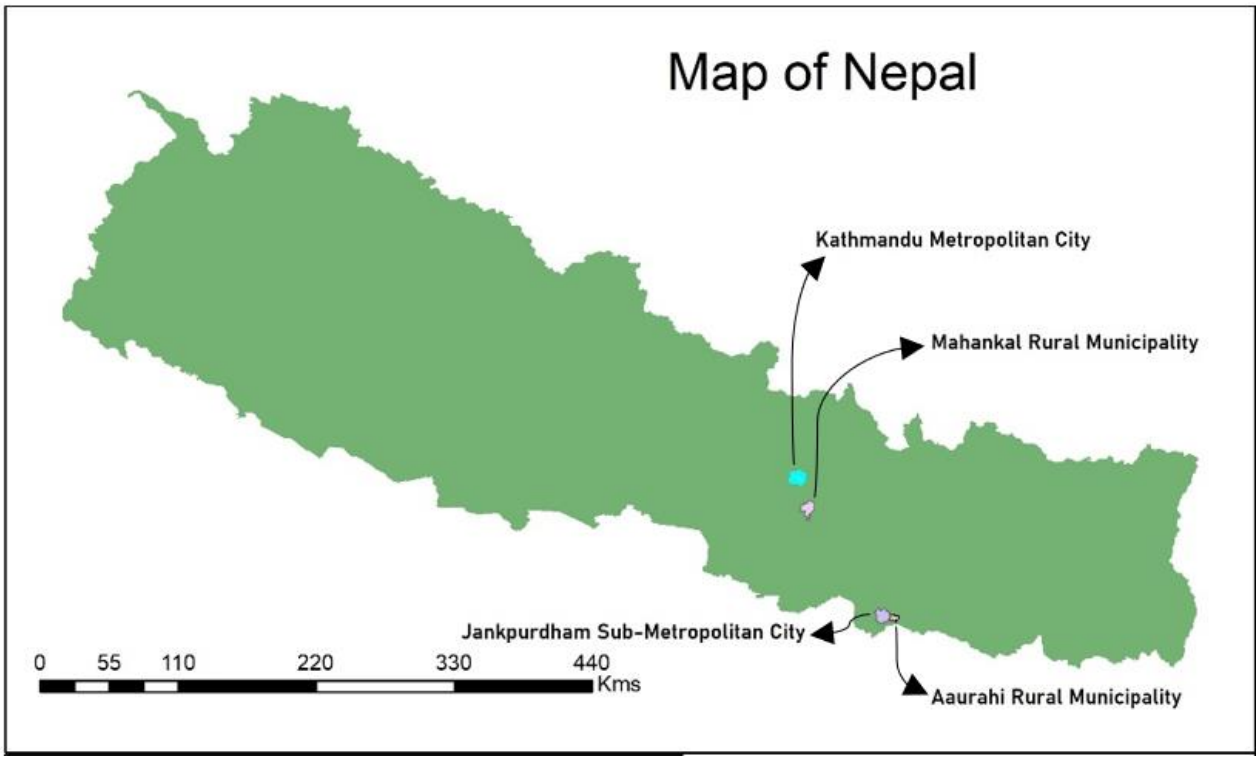

Figure 2 Survey Area for Research Study

In addition to the survey, the research study included Key Informant Interviews (KII) and Focus Group Discussions (FGD) with concerned local/regional stakeholders, concerned government officials, and concerned service providers. These interviews and discussions aimed to gather in-depth information on the use of electric cooking appliances, barriers to access, policy issues, and possible solutions. The study intended to provide valuable insights into the factors that influence the use of e-cooking devices in different communities and help formulate effective policies to promote their uptake.

4.2.1 Aurahi Rural Municipality (ARM)

Aurahi Rural Municipality, as shown in figure 3, is situated in the southern Terai region of Nepal's Madhesh province. The area is bordered by Videha Municipality to the east, Janakpurdham Sub-Metropolitan City to the west, Hanshpur Kathpulla Municipality to the north, and Dhanauji Rural Municipality to the south. With an area of 25.56 square kilometers and an average elevation of 44 meters above sea level, the municipality is home to 24,338 individuals living in 4,036 households, with an average family size of 5.36. The population growth rate is 1.14 percent annually, and there is an almost equal distribution of men and women. Education is a priority in Aurahi Rural Municipality, with five community primary schools, two community secondary schools, and three higher secondary

schools in operation. In addition, 11 institutional school programs and 19 child development centers are present, although seasonal-based child development centers are currently unavailable. The health infrastructure in the area is also satisfactory, with one primary health post and three health posts serving the population.

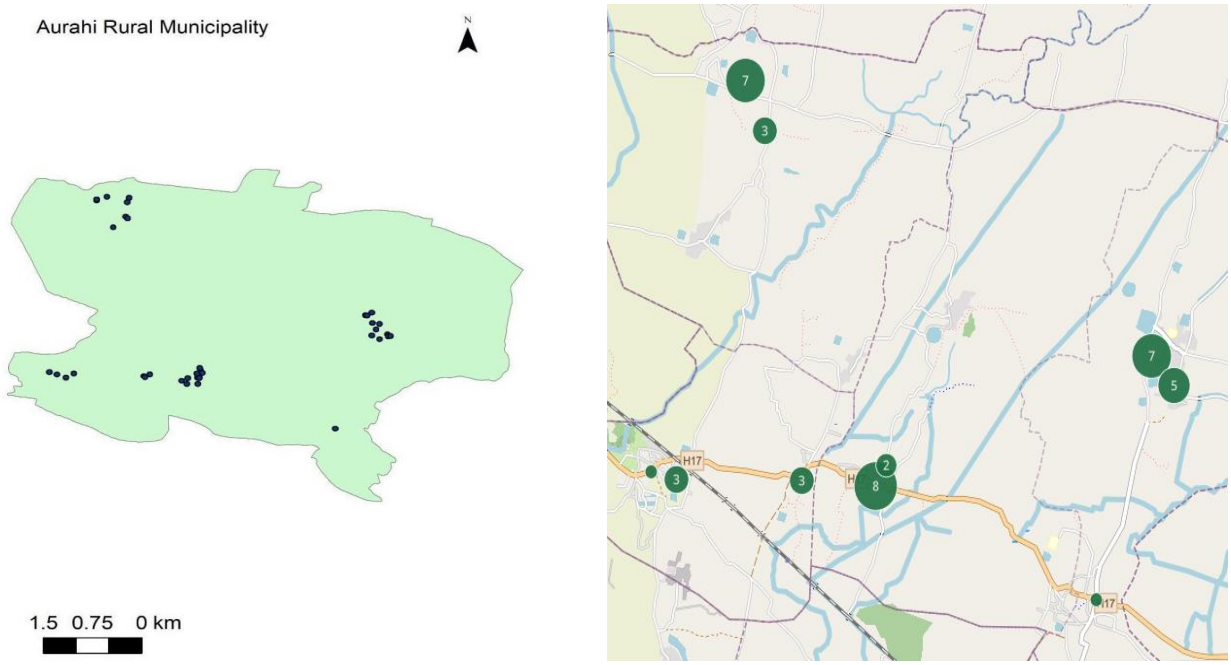

Figure 3 Map of Aurahi Rural Municipality with Sample points and cluster

The people of Aurahi Rural Municipality have a distinct way of life, influenced by their geographic location. Many villagers rely on dry materials such as leaves, sugarcane remains, and wood for cooking. Although some wealthier families use liquefied petroleum gas (LPG) for cooking, burning dry materials that can ignite remains a common practice in the region. The majority of the population continues to rely on traditional cooking methods using firewood, cow dung cakes, and mud stoves. LPG is used primarily for quick snacks and tea, but not for cooking full meals. Due to economic constraints, many are unable to shift to modern electric cooking methods, and the local government has not established any policies or grants to promote the transition to electricity. Additionally, there is a lack of awareness and education on the use and benefits of e-cooking devices in the area.

4.2.2 Janakpurdham Sub Metropolitan City (JSMC)

Shown in figure 4, Janakpurdham Sub Metropolitan city, the capital city of Madhesh province, lies in the southern part of Nepal that is rich in cultural heritage, traditions and festivals. Spread over 92 square kilometers, the city is home to 195,438 people living in 32,612 households and 41,941 families. Celebrating various festivals, Janakpurdham represents the century-old Mithila culture. One interesting aspect of the city is its varied cooking mediums, which range from electric and LPG to firewood. During festive celebrations, it is mandatory to cook ritual food in firewood, which reflects the traditional practices and cultural beliefs of the community. This unique combination of all mediums of cooking makes it an ideal city for studying the impact of different cooking methods on the environment, health, and economy.

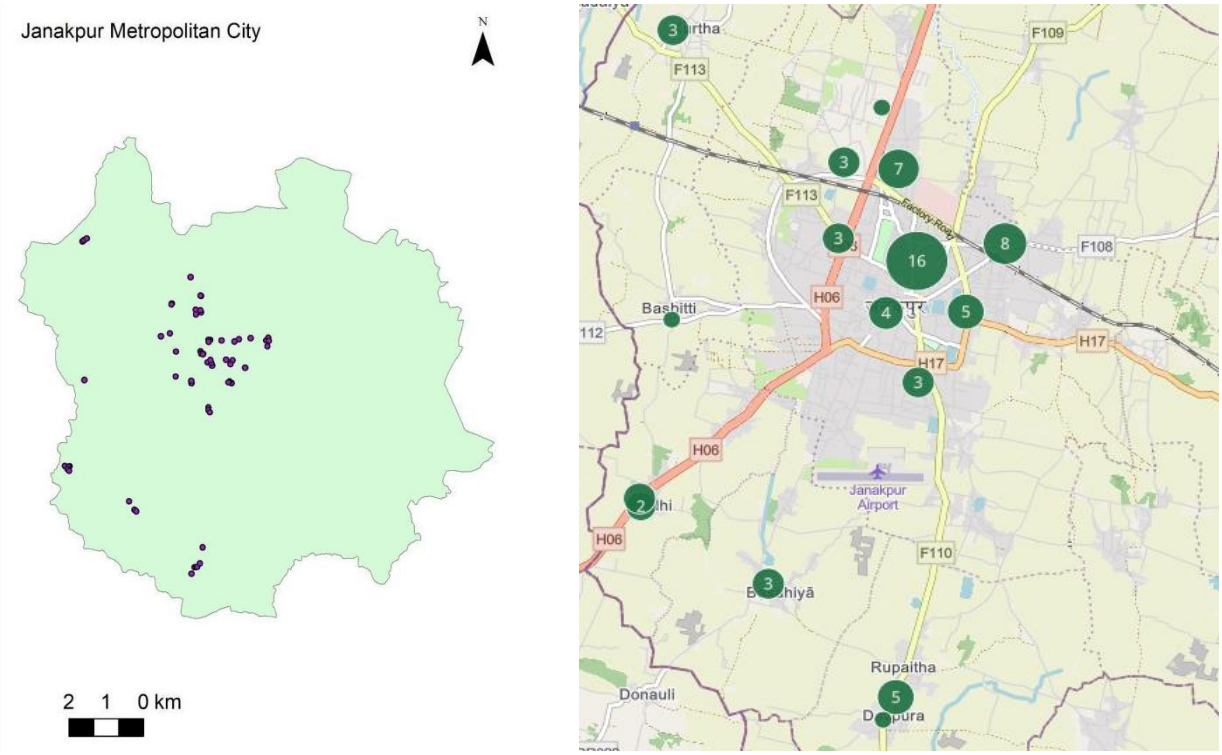

Figure 4 Map of Janakpurdham Sub-Metropolitan City with Sample points and Cluster

Given the diverse cooking mediums used in Janakpurdham, there is an opportunity to explore the different practices, their benefits and drawbacks, and their impact on people's lives. For example, the use of firewood as a cooking medium can contribute to deforestation, air pollution, and health problems, while electric and LPG cooking may be more convenient and cleaner but may have economic barriers for some families. Thus, studying Janakpurdham's cooking practices can help to identify opportunities for interventions to improve cooking methods and promote sustainable,

healthy, and accessible cooking practices that consider cultural and economic aspects of the community.

4.2.3 Kathmandu Metropolitan City (KMC)

Kathmandu Metropolitan City, the capital city of Nepal, as shown in figure 5, has emerged as a bustling metropolis and the economic and cultural hub of the country. The city, situated in the Bagmati Province and surrounded by the picturesque Himalayan Mountains, boasts a population of more than 845,000 people, residing in an area of 50.67 square kilometers, divided into 32 municipal wards. These wards showcase diverse characteristics, ranging from traditional and historic neighborhoods to modern developments. Given its status as the epicenter of urbanization in Nepal, Kathmandu offers a diverse demographic and a range of economic statuses, making it an ideal location to study the behavioral aspects of e-cooking devices as opposed to LPG gas. While the use of e-cooking devices has gained popularity in urban areas due to the availability of electricity, LPG gas is still prevalent in rural areas where access to electricity is limited. Research on the use of these cooking methods in the urban center of Kathmandu can provide insights into differences in consumer behavior, motivations, and environmental and health impacts.

Bagmati Province, which encompasses Kathmandu, has a population of over 2 million people, with one million living permanently and another million as a floating population from all 77 districts of Nepal. The province offers diverse communities, cultures, and lifestyles, providing a rich research setting to understand the factors that influence the use of e-cooking devices in households. With over 231,000 families and 105,000 households, Kathmandu serves as a bustling center of commerce and daily life, making it an excellent place to study the challenges and opportunities of e-cooking devices in a busy urban environment.

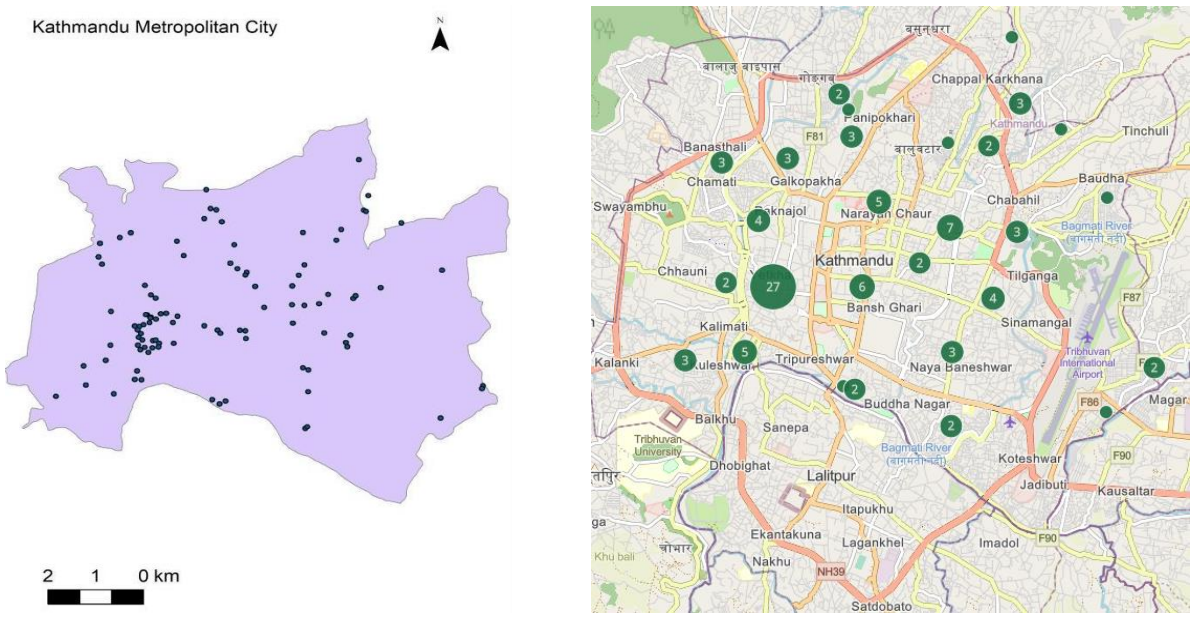

Figure 5 Map of Kathmandu Metropolitan City with Sample Points and Cluster

4.2.4 Mahankal Rural Municipality (MRM)

Mahankal Rural Municipality, as shown in figure 6, is situated in the Lalitpur district of Bagmati province, Nepal, covering an area of approximately 82.44 square kilometers. The region is home to 7,861 people and 1,942 households, divided into six wards: Bukhel, Manikhel, Gotikhel, Kaleshwar, Chandanpur, and Thuladurlung. Agriculture and overseas employment opportunities are the primary sources of income for households in the municipality. However, some disadvantaged areas in the locality lack access to electricity, despite most homes having this essential service. Mahankal is a rural area with sparse housing and a diverse community of people from different ethnic backgrounds who rely on farming and local occupations for their livelihoods. Most households depend on firewood for cooking, depending on their economic status. In collaboration with various projects in the region, the municipality has distributed a few e-cooking devices. This distribution makes the area an excellent location to study consumer behavior regarding e-cooking devices end-of-life, repair culture, disposal systems, and other home appliances.

The rural municipality's location presents unique challenges and opportunities for sustainable development. The community's limited access to electricity and dependence on firewood for cooking and heating could result in environmental degradation and health issues. However, the municipality's

initiative to distribute e-cooking devices could reduce the community's reliance on firewood, mitigating these challenges. Moreover, studying consumer behavior around e-cooking devices in this location could inform policymakers and stakeholders about promoting sustainable technologies in remote and rural areas. By understanding consumer behavior, policymakers and stakeholders can develop effective strategies to promote sustainable energy solutions and achieve sustainable development goals in rural areas like Mahankal.

Figure 6 Map of Mahankal Rural Municipality with Sample Points and Cluster

4.3. Summary of Sampling Data

Four municipalities in Nepal are covered by the research study, along with the corresponding districts and provinces. There are 280,379 families in the studied region, which has a total of 144,133 households. In addition to selecting 268 households for the household survey, the surveyors also interviewed 20 key informants and held five focus groups discussion in the study region. Aaurahi Rural Municipality and Janakpurdham Sub-Metropolitan City, two municipalities in the Madhesh Pradesh region, had a total of 44 and 68 households surveyed, respectively as shown in table 4.

Mahankal Rural Municipality and Kathmandu Metropolitan City, two municipalities in the Bagmati Pradesh region, each had 60 and 99 residents surveyed, respectively.

The study revealed variations in the number of surveyed homes, families, and groups between the various areas, with Kathmandu Metropolitan City having the greatest number and Aaurahi Rural Municipality having the lowest. The 267 households that were included in the sample size, along with the 20 KII and 5 FGD, may offer more information and insights about the communities surveyed. The variation in sample household size across different municipalities can be attributed to a range of factors that influence household behavior and demographics. Firstly, the total number of households in a given area plays a crucial role in determining the sample size. Municipalities with larger populations will generally require larger sample sizes to achieve statistical significance. In addition to population size, the purchasing power and economic status of households in each municipality may also impact sample size. Municipalities with higher income households may require larger sample sizes to obtain a representative sample. Moreover, the availability and efficiency of supply chains in each municipality may also influence the sample size needed. For example, households in areas with limited access to supply chain markets or other buying sources may require a larger sample size to ensure adequate representation.

Table 5 Details of Sample Households at Survey Sites

Provinces	Districts	Municipality	Total Household	Total Families	Sample Household	Total KII	Total FGD	Total Sample
Madhesh Pradesh	Dhanusha District	Aaurahi Rural Municipality	4,036	4,846	40	1	0	41
Madhesh Pradesh	Dhanusha District	Janakpur Sub-Metropolitan City	32,612	41,941	68	5	1	74
Bagmati Pradesh	Lalitpur District	Mahankal Rural Municipality	1,836	1,878	60	5	2	67
Bagmati Pradesh	Kathmandu District	Kathmandu Metropolitan City	105,649	231,714	100	9	2	111
Total			**144,133**	**280,379**	**268**	**20**	**5**	**293**

Furthermore, household behavior on using the e-cooking devices also plays a significant role in determining sample size. The use of electrical and electronic devices, especially e-cooking devices, can vary widely across different municipalities. For instance, households in urban areas may have greater access to e-cooking devices than households in rural areas. This difference in behavior may require different sample sizes to achieve a representative sample in each municipality. Overall, the variation in sample size across different municipalities is a result of multiple factors that affect household use behavior and demographics. These factors should be considered when designing sampling strategies to ensure that the resulting sample is representative of the population in each municipality. The data offered a helpful snapshot and overview of the selected regions of Nepal and can be used as a starting point for further more comprehensive study.

4.4. Sampling Design

The research study used a multistage cluster sampling method, which involves dividing the population into smaller groups or clusters and then selecting a representative sample from each cluster. In this case, the clusters were households in four municipalities of Nepal. These municipalities were selected based on their level of urbanization and access to e-cooking devices. This ensured that the sample was representative of the population of interest and would provide valuable insights into the factors that influence the adoption of e-cooking devices. The sample size for the study was determined based on the population and prevalence of e-cooking device usage in each municipality. To ensure that the sample was diverse and represented different types of e-cooking devices and durations of usage, the samples were stratified based on the type of e-cooking device used (induction cooktop or electric rice cookers) and the duration of usage. This allowed the research team to analyze the data and draw conclusions about the factors that influence the adoption of e-cooking devices in different contexts.

The research was conducted in both urban and rural areas of four municipalities: Kathmandu Metropolitan City and Janakpur Sub-Metropolitan City, Mahankal Rural Municipality, and Aaurahi Rural Municipality. To select households for the survey, the research team used a multistage sampling technique. First, they identified the wards within each municipality. Then, they randomly selected households in each ward. Finally, they selected respondents for the household survey. This ensured that the sample was representative of the population of interest and that the data collected would be reliable and accurate. For the KII and FGDs, purposive sampling was used to select respondents who were experts in the field of repair, waste management, supply of devices, as well as individuals who

have experience using e-cooking devices. This approach ensured that the research team collected in-depth and nuanced data from individuals who had specific knowledge or experience related to the topic of interest. Overall, the sampling strategy used in this study was rigorous and designed to collect high-quality data that would provide valuable insights into the factors that influence the adoption of e-cooking devices in Nepal.

4.5. Sample Size Calculation

Sample size calculation was a crucial step in our research study as it helped us determine the number of participants needed to be included in the study to ensure that the results are reliable and representative of the population of interest. In this study, to determine the appropriate sample size required to estimate the population proportion of an attribute with a margin of error of 6% and a confidence interval of 95%. It is important to note that the sample size calculation is based on several assumptions, such as a normal distribution of the population and a random selection of participants. These assumptions should be carefully considered when interpreting the results of the study.

The given information for the calculation includes a population size of 144133 and a population proportion of 50% (Table 6). The margin of error is set at 6%, which is used for studies with a large population size. The standard error for this study is calculated to be 0.03061, which is a measure of the variability of the sample proportion. Using the above information, the required sample size is calculated to be 267. The relative standard error is 6.12, which is an acceptable level for studies with a large population size. The sample size calculation for this study indicates that a sample of 267 participants is required to obtain a reliable estimate of the population proportion with a margin of error of 6% and a confidence interval of 95%. This information can be used to guide the recruitment and selection of participants for the study to ensure that the results are representative of the population of interest.

Table 6 Sample Size Calculation Details

S.N.	Particulars	
1	Confidence Interval	95
2	Population Proportion	50%
3	Margin of Error	6%

4	Population Size	144,133
5	Total Sample Size	267
6	Standard Error	0.03061
7	Relative Standard Error	6.12 %

4.6. Questionnaire Framework and Design

It is our intention to create a 30-to-45-minute survey questionnaire on household E-cooking Device use and behavior once the device is broken in the surveyed area. The survey's questions were created to gather wide range of data including socioeconomic status of the households, the primary cook's (generally female) means of livelihood, the households' patterns of fuel use, their use of solid fuels and LPG, their use of cooking technologies, their perceptions of different cooking technologies, their purchasing habits, their options in the event that a device malfunctioned, options available for management of broken devices, repair habits and their level of satisfaction. The many parameters that are taken into account in the survey are shown in Figure 7. Following a review of current survey instruments and previous survey instruments, the questionnaire's initial draft was created. All of the feedback from the pilot studies and the input from the MECS team was incorporated into the final edition of the questionnaire.

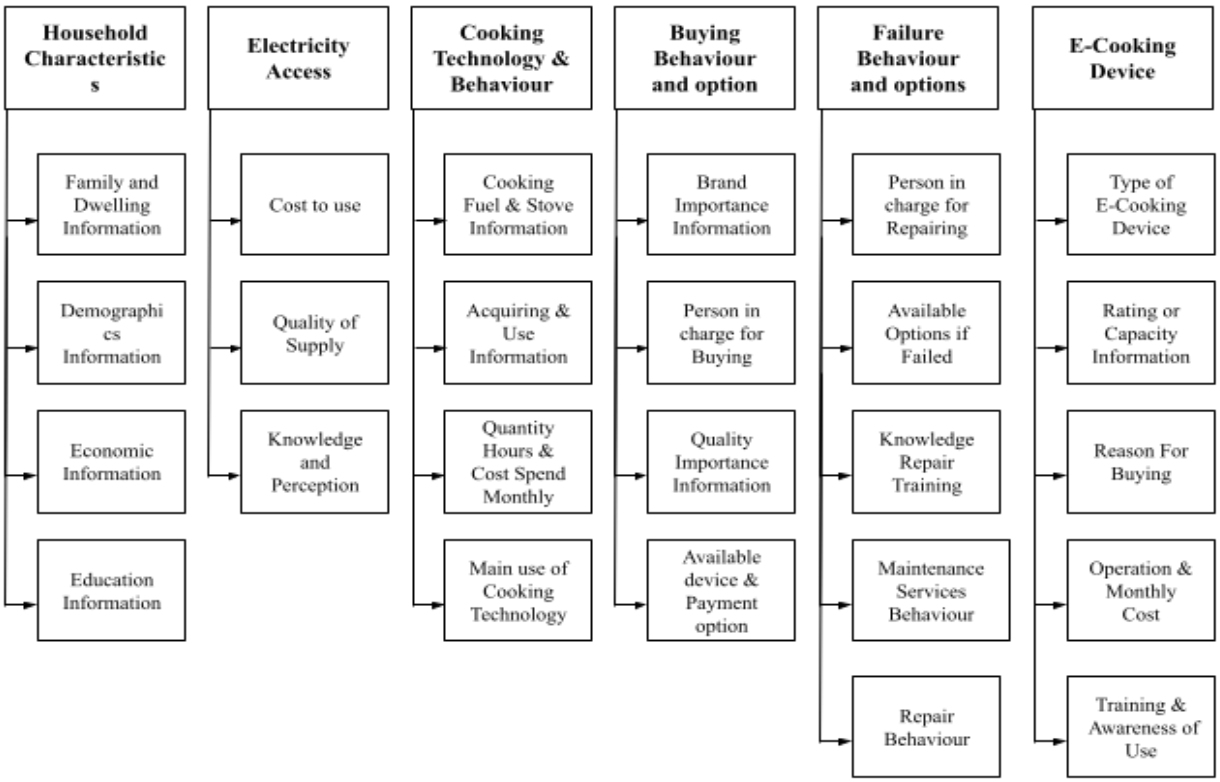

Figure 7 E-cooking Device EoL Survey 2022 questionnaire framework

4.7. Data Collection Procedure

To achieve the research objectives, a mixed-method approach was employed. The study used both quantitative and qualitative data collection techniques. For the quantitative data, a structured questionnaire was used to collect data from households on their cooking habits, energy consumption, and willingness to adopt e-cooking devices. The questionnaire was administered through in-person interviews with the head of the household or their representative. For the qualitative data, KIIs and FGDs were conducted with experts in the supply of devices, energy and waste management, as well as individuals who have experience using e-cooking devices. The KIIs was conducted with key informants who have a deep understanding of the issues related to e-cooking devices, energy consumption, and waste management. The FGDs were conducted with individuals who have experience using e-cooking devices to gain insight into their perceptions, experiences, and challenges.

The duration of the data collection for this research study was from December 2022 to February 2023. One of the challenges faced during the data collection process was related to the accessibility and distance of the cluster of houses in both rural and urban areas. The research team had to navigate

through these challenges by carefully planning the travel routes and coordinating with local community members to identify the best ways to reach the target households. Additionally, the research team had to consider the cultural nuances of the areas they were visiting, including the proper way to greet and start conversations with individuals they encountered.

During the training provided to the enumerators, they were given specific instructions on how to approach households and start the conversation. This included understanding the household makeup of the individuals that could be found at the surveyed area, including age ranges and gender breakdown. This was to ensure that the appropriate questions were asked and to avoid any potential misunderstandings. Additionally, the enumerators were trained to use portable tablets with the Kobo Collect program, which allowed them to collect data in either Nepali, English, or the local language.

In order to ensure improved real-time monitoring and control, the research team also had two field supervisors who were responsible for collecting data from all of the interviewers. The enumerators and field supervisors were trained on the ethical guidelines for conducting in-person interviews, and all interviews were conducted by a member of the research team from Doko Recyclers. The use of the Kobo Collect program also allowed for the taking of images and recording of audio during the interviews, which provided additional data points for analysis. Overall, the training and use of technology helped to ensure that the data collection process was conducted in a consistent and effective manner, despite the challenges related to accessibility and cultural nuances.

4.8. Data Analysis

Quantitative data were analyzed using descriptive statistics to identify the factors that influence the adoption of e-cooking devices. Qualitative data were analyzed using thematic analysis to identify the key themes and issues that emerge from the KIIs and FGDs. The data from the different collection techniques were triangulated to gain a comprehensive understanding of the factors that influence the adoption of e-cooking devices in Nepal. The quantitative data collected in this research study was analyzed using descriptive statistics to identify the factors that influence the adoption of e-cooking devices. Descriptive statistics were used to summarize the data and describe the central tendency, variability, and distribution of the data. The quantitative data analysis process involved data cleaning, transformation, and exploration to ensure the quality and reliability of the data. The results of the quantitative data analysis were then compared and corroborated with the themes and sub-themes

identified through the qualitative data analysis. By triangulating the data from the different data collection techniques, the research study was able to provide a more comprehensive and nuanced understanding of the factors influencing the adoption of e-cooking devices in Nepal.

The qualitative data collected through the KIIs and FGDs were analyzed using thematic analysis. First, the audio recordings were transcribed verbatim and then coded into meaningful segments. The codes were then organized into themes and sub-themes based on their relevance to the research questions. The themes and sub-themes were reviewed and refined to ensure that they accurately represented the data. The identified themes were then used to support and supplement the quantitative data findings. Through this process, a comprehensive understanding of the factors influencing the adoption of e-cooking devices in Nepal was gained.

4.9. Ethical Considerations

When conducting research involving human subjects, ethical guidelines are crucial to ensure the safety and well-being of the participants. In this study, the researchers obtained informed consent from all participants before data collection. This means that the participants were informed about the purpose of the study, what would be expected of them, and any potential risks or benefits associated with their participation. The informed consent process also gave the participants the opportunity to ask questions and decide whether or not they wanted to participate in the study.

To ensure the confidentiality and anonymity of the participants, the researchers did not collect any personal identifying information. The participants were assigned a unique identification number that was used to link their responses to the survey questionnaire or the results of the key informant interviews or focus group discussions. All data collected from the study was stored securely, and only members of the research team had access to it. This helped to protect the privacy of the participants and prevent any unauthorized access to their personal information.

Maintaining ethical standards in research involving human subjects is essential for building trust and credibility with the community being studied. It helps to ensure that participants are treated with respect and dignity, and their rights are protected. In addition, ethical guidelines also help to prevent any harm or negative consequences that may arise from the research. By following ethical guidelines,

the researchers were able to conduct their study in a way that was respectful, transparent, and responsible, and which minimized any potential risks or negative impacts on the participants.

4.10. Limitations

The limitations of the study could affect the generalization of the findings to other areas of Nepal, particularly rural areas that may have different access to electricity and cooking practices. The results of the study may not be applicable to other countries or regions with different cultural, economic, and social contexts. It is important to note that the study did not investigate the impact of e-cooking devices on health or the environment, which could be areas for further research.

The study attempted to mitigate the limitations by using a purposive sampling method that accounted for diversity in terms of ethnicity, religion, geography, remoteness, household decision-making power, and income level. However, the sample size may not be sufficient to capture the diversity of opinions and experiences related to e-cooking devices in Nepal. Moreover, relying on self-reported data from households may have limitations in terms of accuracy, as respondents may have different levels of understanding and interpretation of the questions.

The study team attempted to minimize the limitations by using a structured survey questionnaire to ensure consistency in the data collected. They also conducted extensive training for data collectors and took measures to ensure confidentiality and anonymity of the participants. However, the study may still be subject to social desirability bias, as respondents may provide socially desirable answers rather than their actual practices or opinions. Future studies may benefit from using a mixed-methods approach that includes both quantitative and qualitative data to provide a more comprehensive understanding of e-cooking device usage in Nepal.

5. Findings and Result – Demographic Profile

5.1. Type of Household Area

The data shown in table 7 and in figure 8 represents the percentage of households in each area, Rural and Urban area, of four different municipalities in Nepal, out of a total of 268 households surveyed. Among the surveyed households, 58% (155) were from urban areas while 42% (113) from rural areas. Aurahi and Mahankal are rural municipalities where all respondents are from rural settings.

Table 7 Type of household in surveyed area

Municipality	ARM	JSMC	KMC	MRM	Total	%
Rural	40	13	-	60	**113**	42%
Urban	-	55	100	-	**155**	58%
Total	**40**	**68**	**100**	**60**	**268**	**100%**

Kathmandu is a metropolitan city with all respondents from urban settings. Janakpur is a sub-metropolitan city which was recently declared as sub metropolitan by adding nearby villages hence the respondents are distributed in urban and rural areas. This data provides an overview of the distribution of households surveyed across different areas and municipalities in Nepal, which can be useful for understanding the geographical coverage of studies and interventions related to various issues, including e-cooking devices.

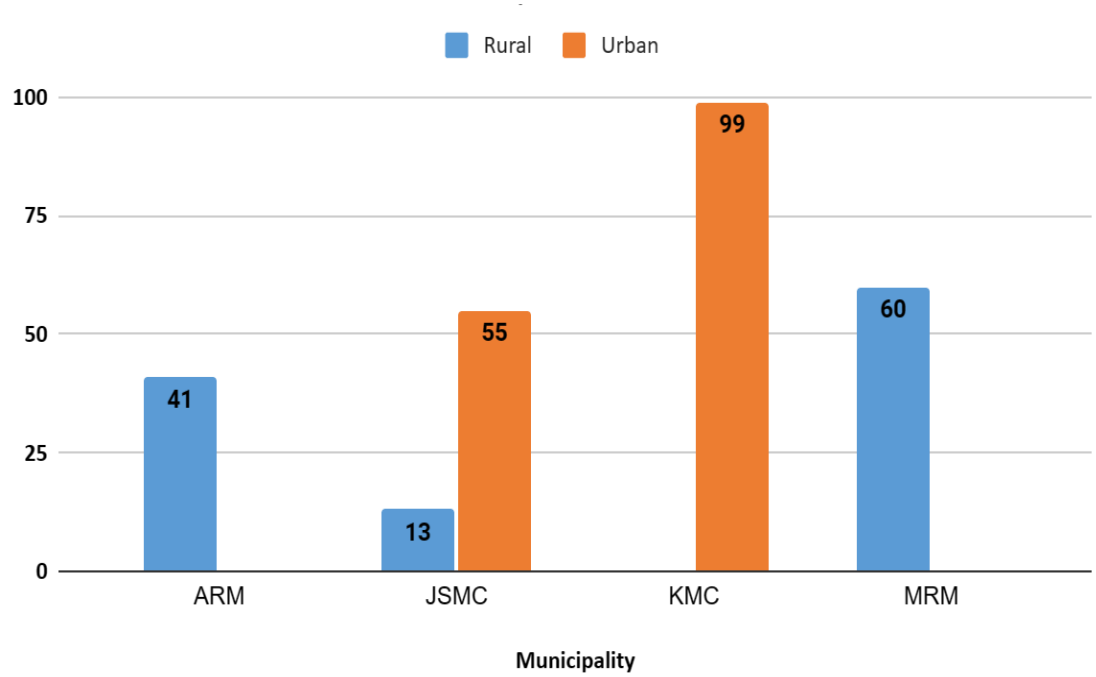

Figure 8 Type of household in surveyed area

5.2. Respondent as Primary Cook and their Gender

Table 8 presents data on the primary cook in households in four different municipalities in Nepal. The respondents were asked if they were the primary cook in their household, and the results show that a majority of respondents across all four municipalities answered in the affirmative. In particular, Mahankal Rural Municipality had the highest percentage of respondents who were the primary cook at

82%, while Janakpurdham had the lowest at 74%. Overall, the total percentage of respondents who were the primary cook was 76%.

Table 8 Primary Cook as the Respondent

Respondent's as primary cook	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Yes	28	68%	53	78%	74	74%	49	82%	203	76%
No	12	32%	15	22%	26	26%	11	18%	65	24%
Total	**40**	**100%**	**68**	**100%**	**100**	**100%**	**60**	**100%**	**268**	**100%**

This data, shown in figure 10, provides insights into the gendered division of responsibility in Nepalese households. Traditionally, women are expected to perform household duties, including cooking. The high percentage of female respondents who were the primary cook in all four municipalities suggests that this gendered division of labor remains prevalent in Nepalese households. This data can be useful for policymakers and organizations working on gender equity issues in Nepal to design programs and policies that promote gender equality and empower women. Additionally, understanding who the primary cook is in households can inform targeted marketing and outreach strategies for e-cooking devices and other household appliances that aim to reduce the workload of cooks and promote energy efficiency.

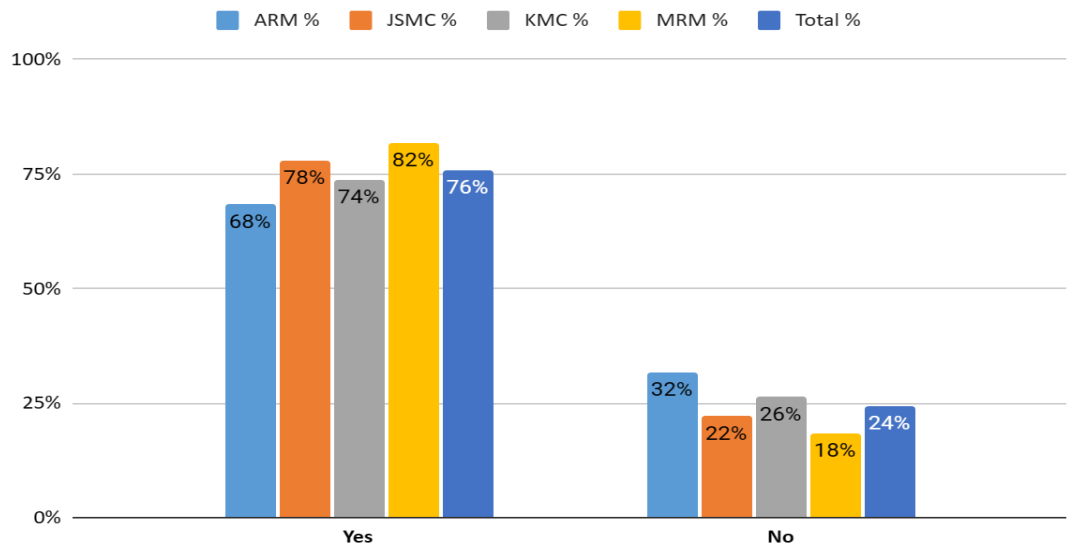

Figure 9 Distribution of respondents as primary cook

The data above represents responses to the question, "Is the respondent the primary cook?" in four different locations in Nepal. Out of 268 respondents, 203 (76%) respondents are primary cooks with dominant female (92%) as primary cook compared to only 8% male respondents as primary cook.

Table 9 and figure 10 show the gender of the primary cook in the households surveyed. Out of the 268 households surveyed, 203 (75.75%) indicated that they have a primary cook, with 186 (91.63%) of those primary cooks being female and only 17 (8.37%) being male.

Table 9 Gender of Primary Cook

Primary Cook	Yes	Yes%	No	No%
Female	186	92%	11	17%
Male	17	8%	54	83%
Total	**203**	**100%**	**65**	**100%**

In contrast, out of the 65 households that did not have a primary cook, 54 (83.08%) were male-headed households. This data suggests that in the studied population, cooking is largely a female-dominated activity, with women taking on the primary responsibility for preparing meals. This finding is consistent with gender norms and expectations in many cultures, where women are expected to perform domestic duties, including cooking and cleaning. However, it is also notable that there are households where men are the primary cook, indicating that gender roles in the household may be shifting.

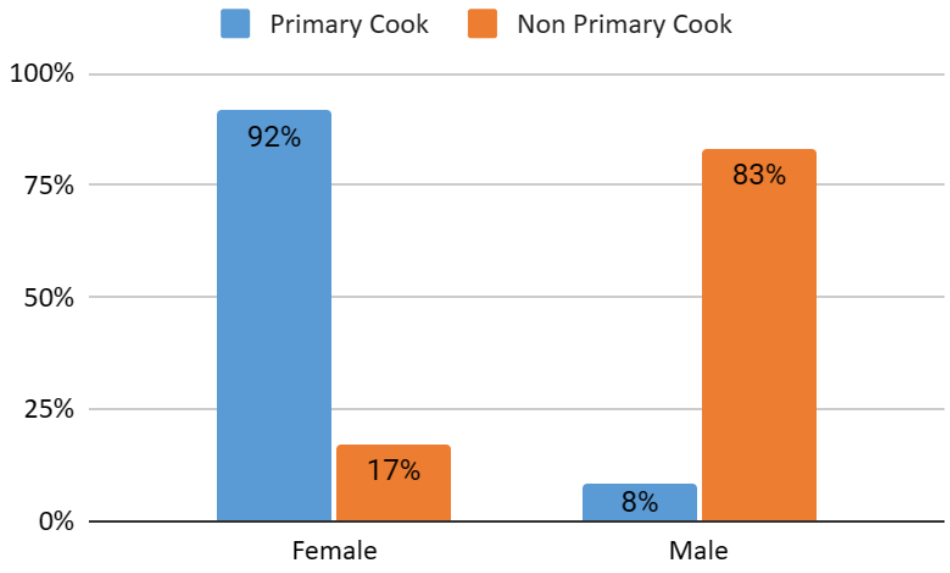

Figure 10 Gender of Primary Cook

This trend of dominant females as primary cooks prevailed in rural municipalities. This gender distribution may reflect the fact that in Nepal, cooking is traditionally considered to be a female responsibility. The results suggest that women are the primary users and decision-makers when it

comes to household cooking appliances. It is important for manufacturers and marketers of home appliances to take this into account when designing products and creating marketing campaigns.

When the question was asked about the decision makers for purchase of electronics appliances, small items related to cooking devices (mostly non-electronics like utensils), decisions taken by females while male take decisions for large items like TV, freeze, Induction stoves etc. During disposal activity, the majority of decisions are taken by females as they use these devices for most of the time and also females are responsible to manage storage space, cleanliness of the house. One of the other reasons to make females mainly responsible for disposal is their availability in homes (non-working).

5.3. Age Group

The data shown in Table 9 and figure 11 shows the distribution of age groups among respondents in the four study areas. Among the total 268 respondents, the majority fall in the 20-40 years age group with 51% of respondents on average. The 40-60 years age group accounts for 36% of respondents. 60 and above age group accounts for 12% of respondents.

Table 10 Age Group of Respondents

Age Group	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Average %
< 20 Years			2	3%					2	1%
20 - 40 Years	21	53%	36	53%	50	50%	31	52%	138	51%
40 - 60 Years	17	43%	26	38%	35	35%	19	32%	97	36%
> 60 Years	2	5%	4	6%	15	15%	10	17%	31	12%
Total Respondent	**40**	100%	**68**	100%	**100**	100%	**60**	100%	**268**	100%

The majority of the respondents fall in the younger age groups, indicating the possibility of more openness to new technologies and sustainable practices. It is essential to consider the age group while designing policies and programs to promote sustainable end-of-life management of electronic items.

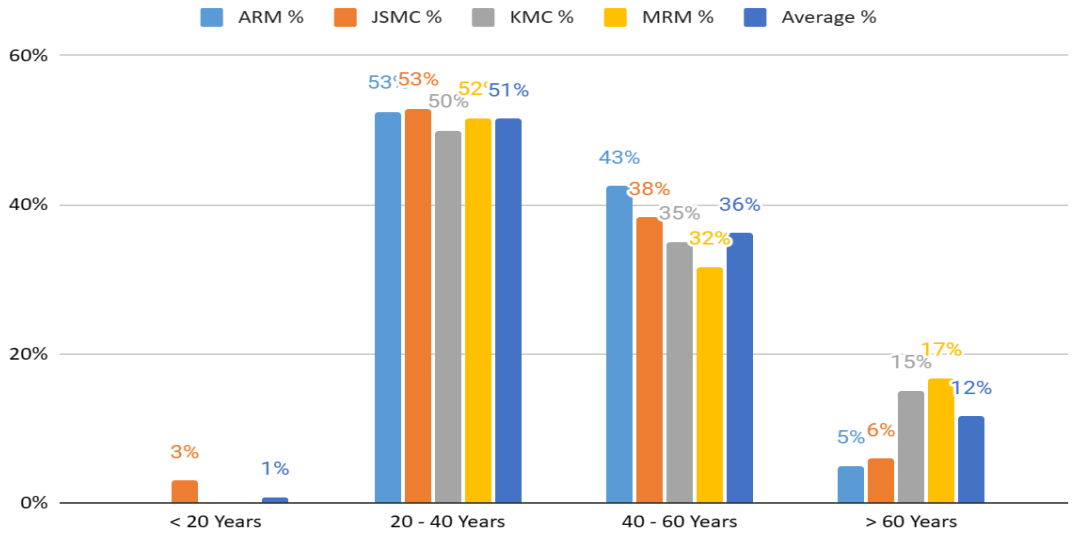

Figure 11 Age group distribution of respondents

5.4. Type of Family

Based on the members of respondent family living and the number of kitchens to cook food under one roof, the types of family were categorized into four categories.

a. Student / Single: Living single in own home or rented house as student or unmarried single
b. Nuclear family: also known as elementary families, consist of two parents (usually married or common law) and their children.
c. Joint Family: living with parents, married or unmarried immediate adult brother and sisters and with children's together under one roof and using one kitchen. The common trend of family in terai region where brothers (married or un-married) lives together with their children and share common kitchen.
d. Extended Family: Big families living together still with grandparents, uncle and aunty their children's under one roof and cooking in one kitchen. This is also trend of terai region where many siblings lives together including grandparents, parents, brothers and sisters, grandsons and daughters. This is not common trend but mostly found in family whose main income source is farming and inherits large farmlands from previous generations.

Table 11 and figure 12 presents data on the respondent family type. The majority of respondents belong to nuclear families, accounting for 53% of the total sample. This finding is consistent with the trend of a growing number of nuclear families in Nepal, primarily in urban areas. Joint families were the second most common family type, accounting for 39% of the total sample. This family type is still

prevalent in rural areas of Nepal, where family members live together in the same household, often with multiple generations.

Table 11 Respondents Family Type

Type of Family	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Nuclear Family	11	28%	30	44%	68	68%	34	57%	143	**53%**
Joint Family	17	43%	30	44%	32	32%	26	43%	105	**39%**
Extended Family	12	30%	6	9%	0	0%	0	0%	18	**7%**
Student / Single	0	0%	2	3%	0	0%	0	0%	2	**1%**
Total	**40**	**100%**	**68**	**100%**	**100**	**100%**	**60**	**100%**	**268**	**100%**

Extended families were the least common family type, accounting for only 7% of the total sample. This family type involves living with other relatives outside the nuclear or joint family structure, such as grandparents, uncles, or cousins. Interestingly, none of the respondents belonged to a student/single family type, which suggests that the survey targeted mostly households with multiple members and single living is not common in rural areas.

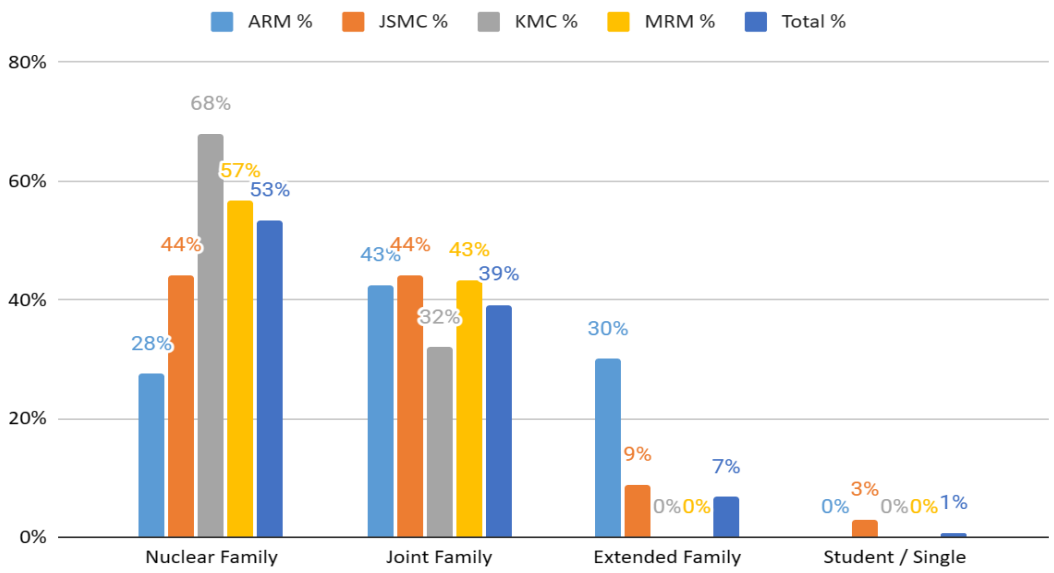

Figure 12 Family Type of Respondent

With the data presented above, it is found out that the southern part of Nepal has more Joint families compared to the Northern part. There is also a trend of more extended families in rural areas compared to urban areas. The main reason might be the cultural background as well as area of residence. Most of the houses in villages have larger areas which accommodate more family members while people living in densely populated urban areas choose to live as nuclear. The highest percentage of extended family

was found in Aurahi (with 30%) followed by Janakpur (9%). Surprisingly there is no extended family in Mahankal and Kathmandu. With changing living styles, the study found nuclear families in rural areas as well.

The results suggest that the majority of the households in the sample areas are nuclear families (53% of total), which could have implications for their energy consumption and waste management practices. Understanding family structures and dynamics is essential in designing and marketing home appliances that meet the specific needs of different family types. Manufacturers and marketers should consider the different family types' living arrangements and social norms to ensure that their products meet the diverse needs of households.

6. Findings and Result – Home Appliances and Warranty

6.1. Available Home Appliances

This study collected data about general electric and electronics home appliances that are used in households. Following appliances were on focus - Rice cooker, Television, Fan, Water Kettle, Refrigerator, Room Heater, Mixer Grind, Induction / Infrared Cooktop, Washing Machine, Geyser, and Microwave Oven. Table 12 and figure 13 provides information on the availability of electrical and electronic home appliances in the households of the respondents. Among the listed appliances, the most commonly available were televisions (90%), refrigerators (60%), and rice cookers (45%). Fans were also widely available (72%), which is understandable considering the hot and humid climate of Nepal.

Table 12 Available Electrical and Electronic Home Appliances at Respondents Household

Available Home Appliances	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Average %
Rice Cooker	11	28%	33	49%	65	65%	12	20%	121	45%
Television	33	83%	63	93%	96	96%	49	82%	241	90%
Fan	40	100%	68	100%	80	80%	5	8%	193	72%
Water Kettle	8	20%	39	57%	80	80%	22	37%	149	56%
Refrigerator	11	28%	43	63%	94	94%	12	20%	160	60%
Room Heater	2	5%	11	16%	51	51%	6	10%	70	26%
Mixer Grinder	14	35%	42	62%	86	86%	19	32%	161	60%
Induction / Infrared Cooktop		0%	4	6%	65	65%	51	85%	120	45%

Washing Machine	2	5%	5	7%	50	50%	2	3%	59	22%
Geyser		0%	9	13%	24	24%	1	2%	34	13%
Microwave Oven		0%	1	1%	33	33%		0%	34	13%
Total Respondent	**40**		**68**		**100**		**60**		**268**	

On the other hand, geysers and microwave oven were relatively rare and available only in a small percentage of households. Other appliances such as mixers, room heaters, and water kettles were available in moderate to high percentages. It is interesting to note that induction or infrared cooktop were not available in any of the households surveyed in the ARM district, while they were available in relatively high percentages (65% and 85%) in the KMC and MRM districts, respectively.

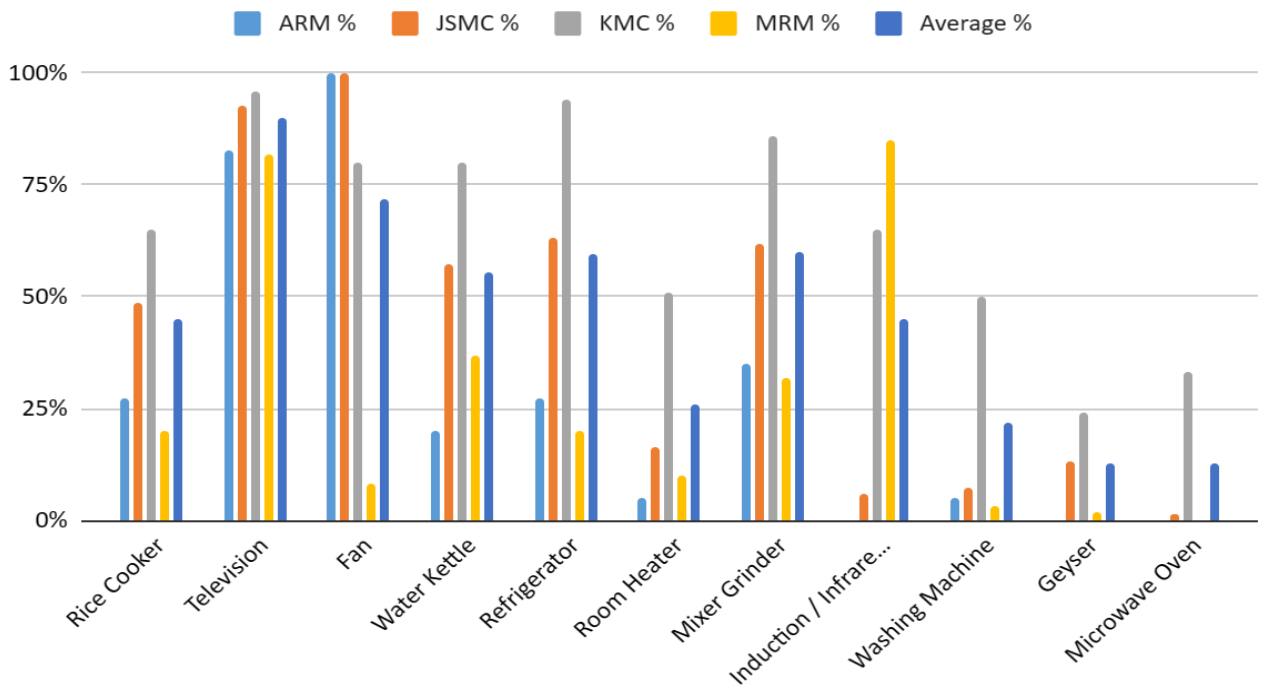

Figure 13 Available Electrical and Electronic Home Appliances at Respondents Household

Almost 90% of households have television sets available. 100 % of households in Aurahi and Janakpur (Southern part of Nepal) have fans due to being tropical zone. On average 45% of households have some electric cooking appliances available. Mahankal has the highest percentage of Induction stove. This is due to the distribution of the Induction stove in each household under one donation program. Microwave oven and Washing machine is still not so common even in urban area. This might be due to appliances being expensive.

Out of these items, small household items like rice cooker, electric kettle, fan, etc have less usable life hence tends to be as e-waste in a short span of time. Secondly, due to low purchase cost and high

repairing cost, these items are found more as scrap in comparison to bigger and expensive items like freezer, Television, washing machine etc. The data highlights the need for manufacturers and marketers of home appliances to consider the availability and usage patterns of different types of appliances in different regions of Nepal when designing and promoting their products.

6.2. Warranty on Home Appliances

The data in table 13 shows that the majority of respondents have received a warranty for their home appliances, with a total of 66% responding positively. The highest percentage of respondents who received a warranty is from the JSMC with 84%, followed by KMC with 73%. ARM and MRM have 45% and 48% respondents respectively, indicating a relatively lower percentage of rural people receiving warranties for their home appliances. On the other hand, a significant percentage of respondents (26%) replied that they did not know if their home appliances came with a warranty. This highlights a need for more information and clarity on warranty policies among the general public. Only a small percentage of respondents (8%) reported not having a warranty for their home appliances.

Table 13 Respondents have received warranty on Home Appliance

Warranty in Home Appliances	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Yes	18	45%	57	84%	73	73%	29	48%	177	66%
No	4	10%	1	1%	10	10%	7	12%	22	8%
Don't know	18	45%	10	15%	17	17%	24	40%	69	26%
Total Respondent	**40**		**68**		**100**		**60**		**268**	

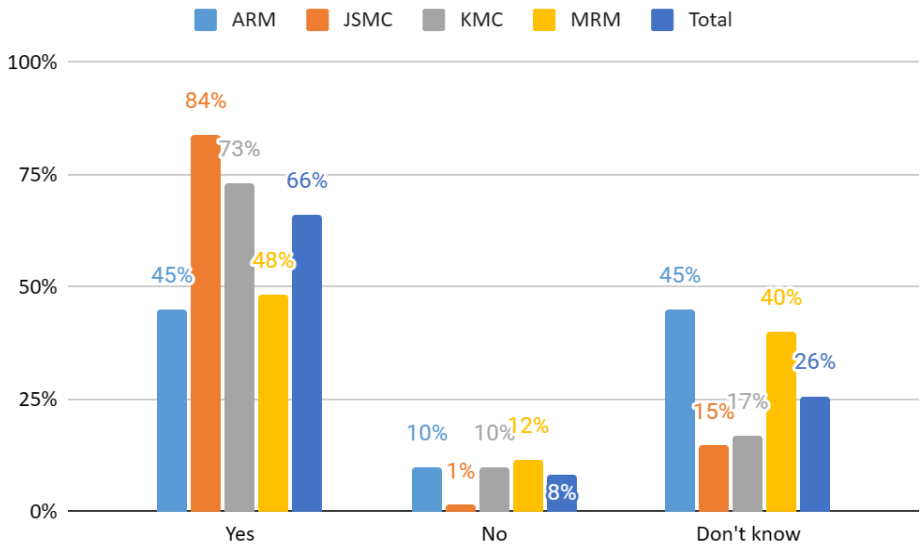

Figure 14 Information about warranty in household appliances

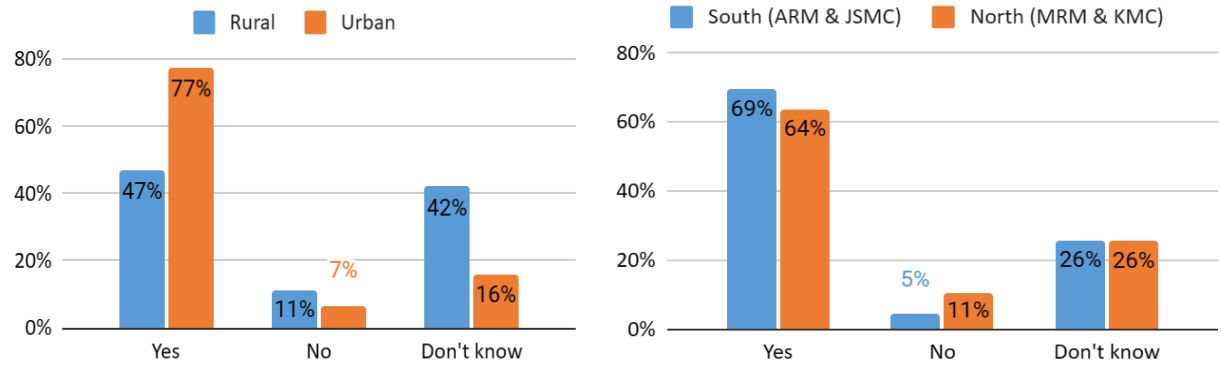

Figure 15 Comparative data of warranty for Rural vs. Urban and South vs. North

Further analysis of data based on rural vs. urban settings, it was found that a higher percentage of buyers in urban areas (77%) receive a warranty with their purchase in comparison to those in rural areas (47%). Additionally, a significant proportion of rural residents (42%) either does not possess knowledge about or do not consider warranties when purchasing appliances, in contrast to their urban counterparts.

When examining data from both the northern and southern zones, the responses are nearly identical in both contexts. This indicates a significant finding that warranties and their services are more relevant to those with an educated, urban lifestyle.

The results indicate that a significant number of people in Nepal are aware of the warranty policies for their home appliances. A warranty provides a sense of security to consumers, knowing that if something goes wrong with their appliance within a certain period, they can have it repaired or replaced without incurring extra costs. The data suggests that manufacturers and sellers are providing warranties for their products, which can improve consumer trust and confidence in their products. However, the proportion of respondents who were unsure about their warranty status indicates a need for better communication from manufacturers and sellers. Providing clear and concise warranty information during the point of sale can help ensure that consumers are aware of their rights and options in case of any defects or damages to their appliances.

6.3. Satisfaction with Warranties

The data in table 14 presents the satisfaction level of the respondents with the warranties provided by the brands of electronic devices. A majority of the respondents from all four locations reported that they were satisfied with the warranties provided, with a total of 59% answering "Yes". JSMC had the highest satisfaction level with 81% of the respondents being satisfied with the warranties provided compared to metro city KMC with only 68%. Aurahi and Mahankal had relatively lower satisfaction level of 30 % and 38 % respectively. On the other hand, there are a big percentage of respondents (40%), who reported that they didn't know about the warranties provided by the appliances. Meanwhile, the warranties provided by the brands were deemed unsatisfactory by only 1% of the respondents.

Table 14 Respondent Satisfaction with Warranties

Satisfaction with warranty	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Yes	12	30%	55	81%	68	68%	23	38%	158	59%
No	0	0%	0	0%	0	0%	2	3%	2	1%
Don't know/ No response	28	70%	13	19%	32	32%	35	58%	108	40%
Total Respondent	**40**		**68**		**100**		**60**		**268**	

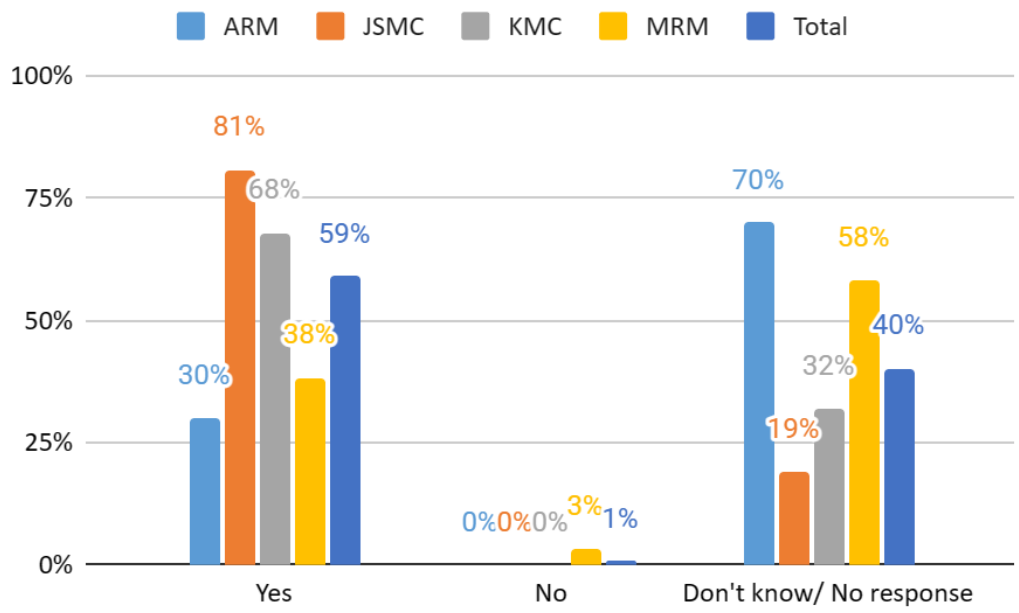

Figure 16 Satisfaction level with warranty

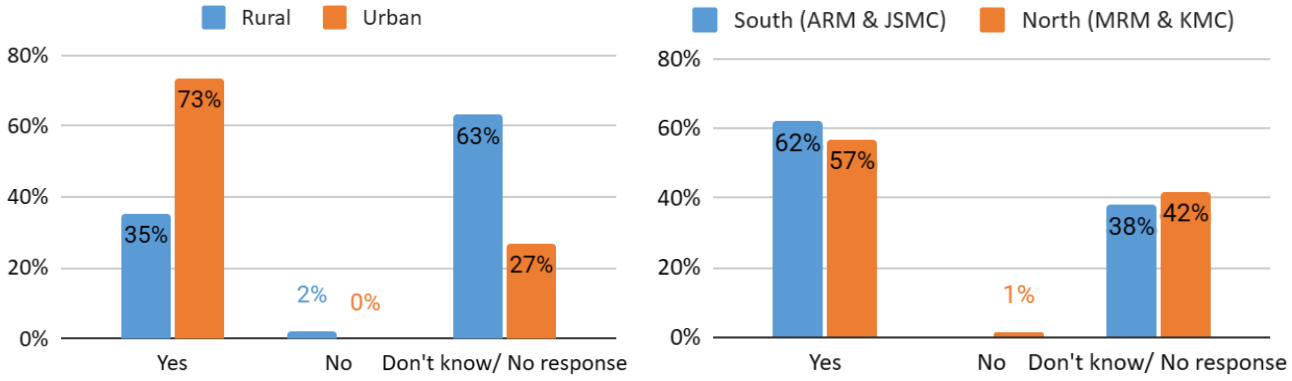

Figure 17 Comparative chart for satisfaction level in rural vs. urban setting and south vs. north zone

Comparing the satisfaction level of respondents in different scenarios, from above chart, it was found that the level of satisfaction from warranty is relatively higher in urban people (73%) compared to rural (35%). There is also majority of respondents who don't know or don't have any answer related to warranty satisfaction and this percentage is higher in rural settings. Comparing north vs. south don't have much difference showing almost equal response in both context. The level of satisfaction for warranty also seems to be factor of availability of service centers as urban area does have provision of service centers which support in claiming of warranty for repair in case of faulty.

6.4. Importance of warranty

From the data tabulated in table 15 shows the importance of warranty while purchasing new appliances in various municipalities. 42% of respondents considered warranty as very important decision factors while 25% consider it as just important but not mandatory. 31% of respondents don't know or doesn't matter if the products come with a warranty or not while purchasing goods. Among all four municipalities, respondents from Janakpur prefer products with warranty (60%) followed by Kathmandu (53%). Residents of Aurahi least bother about product with warranty with only 18% taking as warranty as very important.

Table 15 Importance of Warranty to Respondent

Importance of warranty	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Very Important	7	18%	41	60%	53	53%	12	20%	113	42%
Important	11	28%	17	25%	24	24%	15	25%	67	25%
Less Important			1	1%	1	1%			2	1%
Doesn't mater			2	3%			2	3%	4	1%
Don't know	22	55%	7	10%	22	22%	31	52%	82	31%
Total Respondent	**40**		**68**		**100**		**60**		**268**	

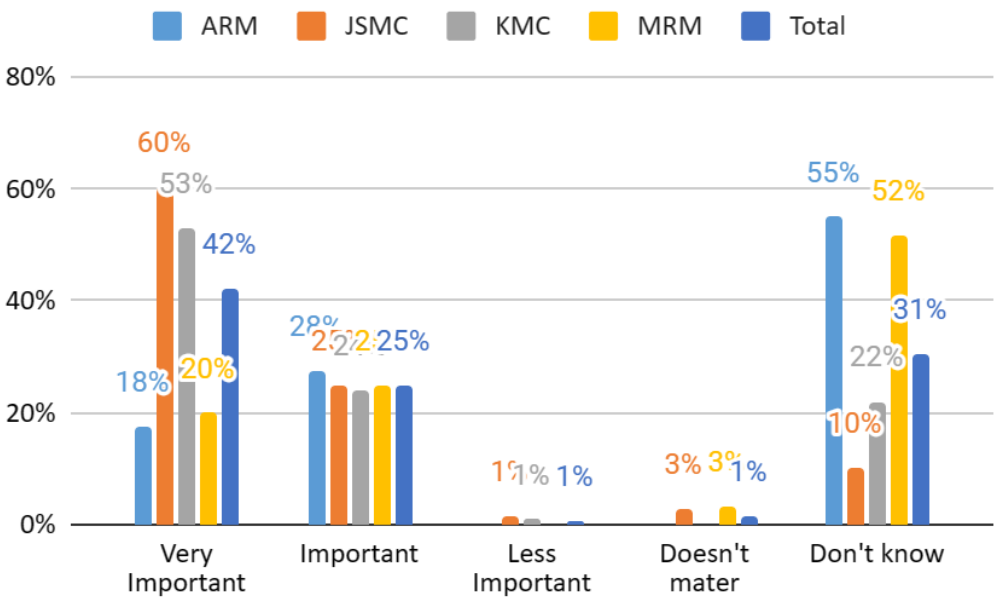

Figure 18 Importance of warranty while buying new appliances

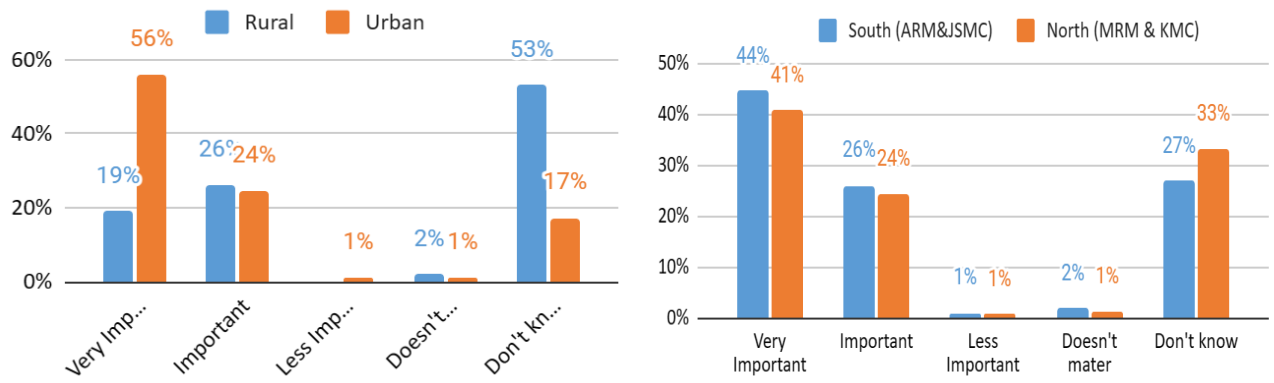

Figure 19 Comparison chart for importance of warranty in Rural vs. Urban and North vs. South

The comparison chart for the importance of warranty in rural vs. urban settings, 56% of urban residents consider warranty as a very important decision factor compared to only 19% of rural households. Similarly 53% of rural respondents don't care about warranty in products compared to only 17% urban people.

In a similar comparison of North zone vs South zone, the importance of warranty remains almost the same. 44% of southern respondents take warranty as a very important decision factor while 41% of respondents from north region consider it as very important. The collected data trend clearly shows warranty as one of the important factors in decision making for purchase of new products.

6.5. Electricity supply issue

Nepal relies on electricity generated from Hydropower and distributed by Nepal Electricity Authority (NEA). NEA is the sole authority for the source of electricity. Due to various technical reasons, Nepal faces various issues with electricity throughout the year. Most common issues are frequent power cut without any prior information, irregular / fluctuating voltage, high current flow etc. (table 16 and figure 20). Though this is not directly linked with cooking behavior but during survey and KII, it was found one of the issues people are reluctant to use e-cooking devices by self-purchase. The problem with electricity is also linked with the life of electronic devices. As explained by local residents, there were many occasions where high voltage transmission damages their electrical and electronic devices and some damages are beyond repair.

Table 16 Respondent who faced Electricity Problem

Electricity Problem	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Average %
Frequent Power Cut	26	65%	17	25%	20	20%	26	51%	89	33%
Voltage Issue	9	23%	4	6%	2	2%		0%	15	6%
House Wiring issue	9	23%	4	6%	3	3%	1	2%	17	6%
No issue	10	25%	6	9%	73	73%	33	65%	122	46%
Total Respondent	**40**	100%	**68**	100%	**100**	100%	**51**	100%	268	100%

Same location has multiple electricity issues as well like frequent power cuts and low voltage is a major issue in rural areas. 45% of respondents indicated some sort of issue with electricity. The table 20 presents information on the electricity problems faced by the respondents in different areas of the study. Out of the total 268 respondents, 33% reported frequent power cuts as an electricity problem. The ARM area had the highest percentage of respondents facing frequent power cuts (65%), followed by MRM (51%) and JSMC (25%). On the other hand, 15 respondents reported voltage issues, with ARM having the highest number of respondents facing this problem (23%). 17 respondents reported house wiring issues, with ARM again having the highest number of respondents (23%) facing this problem. In contrast, 73% of respondents from KMC reported no electricity issue. These results suggest that frequent power cuts are a significant problem in the study area, particularly in ARM, and voltage and house wiring issues are also a concern for some respondents.

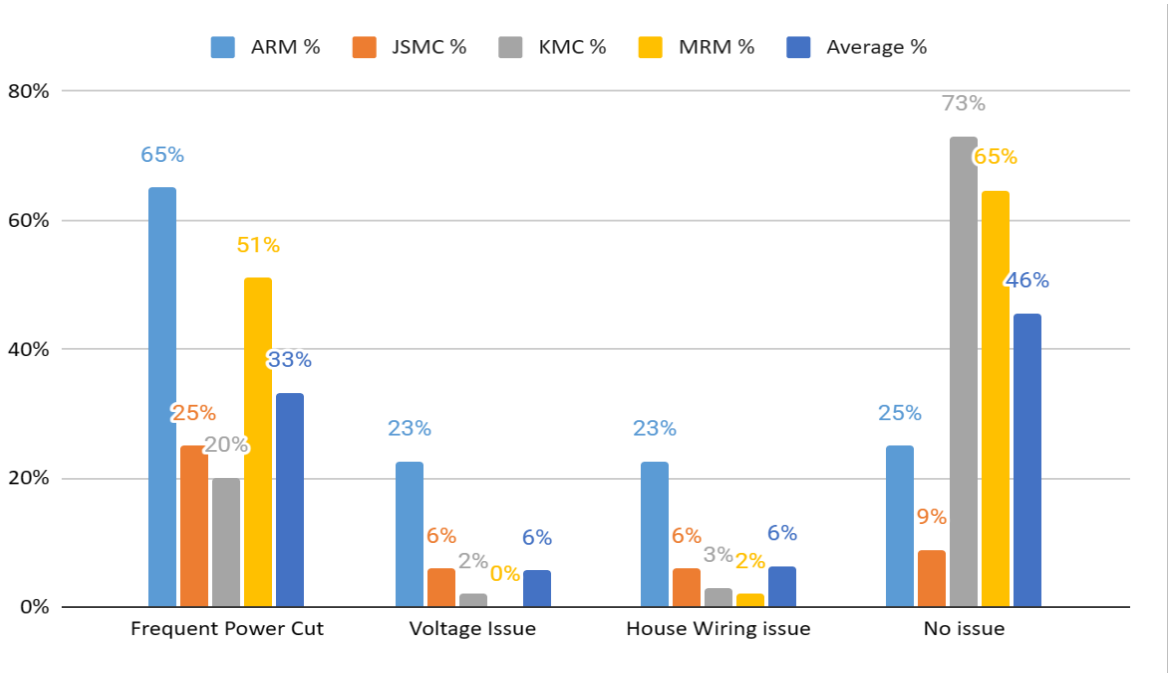

Figure 20 Respondent face Electricity Problem

Nepal's electricity sector has undergone significant developments in recent years. According to the Ministry of Energy, Water Resources and Irrigation, Nepal's installed electricity capacity stands at approximately 1,900 MW as of 2021 (Ministry of Energy, Water Resources and Irrigation, 2020) . This is a result of the country's ambitious focus on electricity production, including hydropower, solar power, and wind power. In 2014, Nepal signed a Power Trade Agreement with India to import and export electricity (MoEWRI, 2014). The agreement has helped Nepal to balance its electricity supply and demand, especially during dry seasons when hydropower generation decreases. Furthermore, the country has set an ambitious target of producing 15,000 MW of electricity by 2030, as outlined in its revised Nationally Determined Contributions in 2020 (The Kathmandu Post, 2020). This target includes an increase in hydropower, as well as the development of other sources such as solar and wind power.

Despite these developments, Nepal's electricity sector still faces several challenges. One of the main issues is the lack of access to electricity in rural areas, where approximately 11.2% of the population lives without access to electricity (The World Bank, 2020). Another challenge is the high cost of electricity, which can be a barrier to electricity usage for low-income households. Furthermore, there are issues with power outages and load shedding in certain areas, which can disrupt daily life and business operations. The high tariff rate of electricity can be addressed through time dependent rate

and subsidy for households in rural areas promoting e-cooking. Though some incentives are announced in the recent budget (2023-24) in electricity tariff for small household users to promote electric cooking but this is not enough.

7. Findings and Result – Cooking Devices & Medium

7.1. Main Cooking Device and Cooking Medium

The majority of respondents in all four municipalities use LPG stoves as their main cooking device or alternate cooking device, with a total percentage of 96%. The second most commonly used cooking medium is different in different settings and geography as shown in figure 21. As firewood remains second popular in rural settings (Aurahi and Mahankal) while electric cooking devices is second common in urban settings (Janakpur and Kathmandu). Mahankal is exception for e-cooking device due to distribution of induction stoves by donor agency. Biogas is not a popular choice among respondents, with zero usage in three out of the four municipalities. Electric cooking devices are used by 51% of respondents, with the highest usage in KMC (67%). Cow dung cakes are used by 12% of respondents, mainly in ARM and JSMC.

Table 17 Main Cooking Devices used by Respondents

Major Cooking Medium	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
LPG Stove	35	88%	66	97%	99	99%	58	97%	258	96%
Firewood	39	98%	25	37%	0	0%	33	55%	97	36%
Electric cooking device	4	10%	28	41%	67	67%	37	62%	136	51%
Biogas	0	0%		0%			7	12%	7	3%
Cow dung cake	25	63%	7	10%			1	2%	33	12%
Kerosene	0	0%		0%			1	2%	1	0%

In all surveyed households, they use more than one cooking device and medium. LPG stove is used by almost every household (96% of households) as primary cooking device or alternate cooking device. Cooking in firewood is common in rural areas as the primary method of cooking. 98% households in Aurahi use firewood as primary cooking medium while 55% in Mahankal use firewood also for cooking. Surprisingly 37% of households in urban settings of Janakpur also use firewood as a cooking medium but it is not the primary source. Residents of Kathmandu use both LPG (99%) and Electric (67%) cooking medium as primary source. The household of Mahankal also uses electricity as one of

the frequently used cooking devices (62%). Most of the households of Mahankal area received an Induction Stove in one donation program. Mahankal do witness Biogas (12%) also as an alternate cooking medium.

Firewood is one of the major cooking medium in rural settings while urban area witness increase in electric cooking medium as shown in figure 13. When analyzing the data for northern area vs southern area of Nepal, cow dung is only used in southern part (Terai region) of Nepal and firewood again remains major cooking medium in southern zone (59%) compared to northern zone (21%). Northern part of Nepal has more e-cooking medium (65%) compared to southern part (30%).

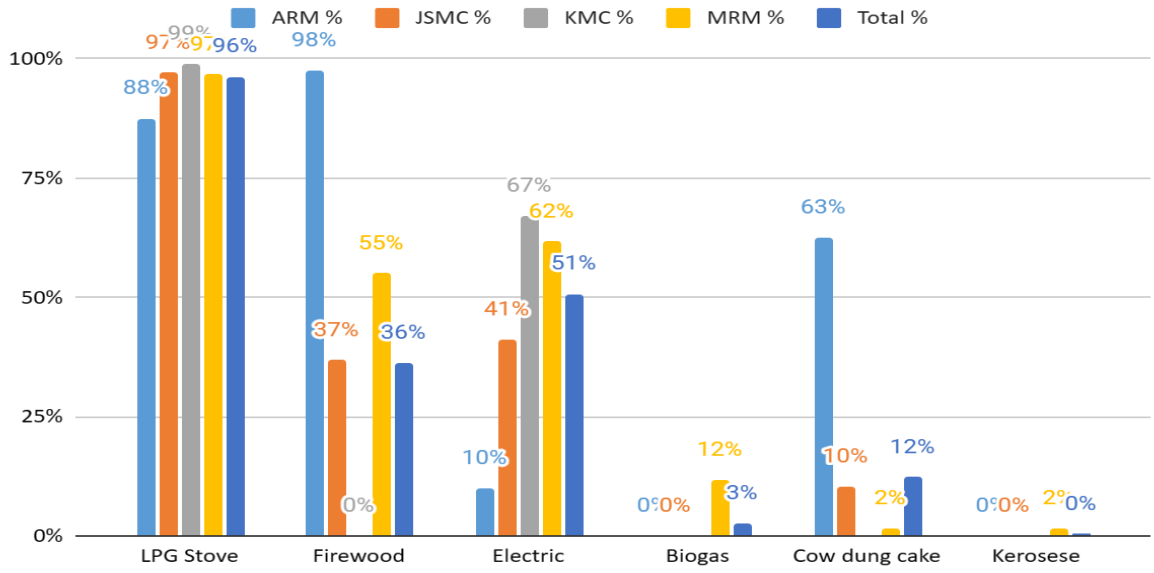

Figure 21 Main cooking device used by Respondents in the survey area

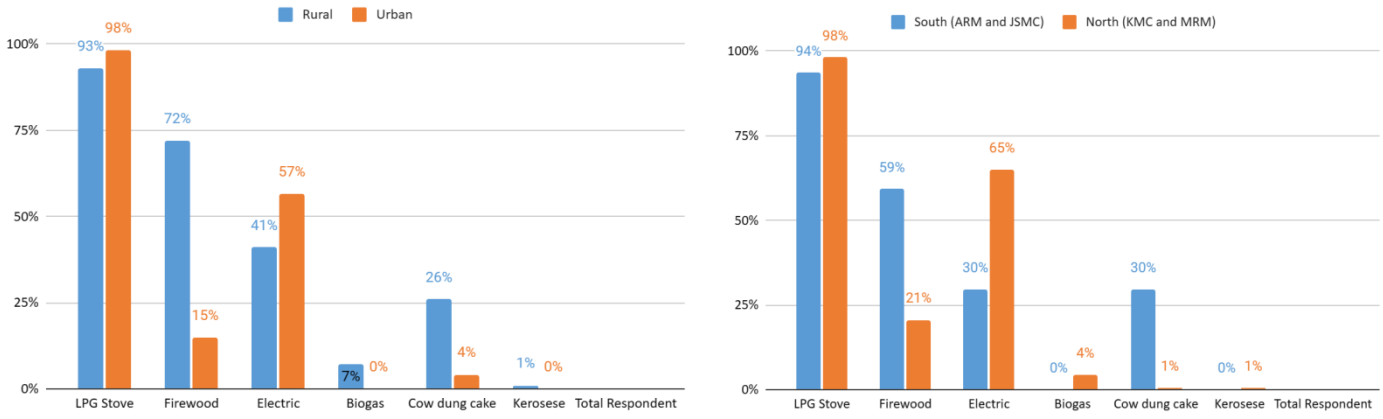

Figure 22 Major cooking medium in rural vs. urban settings and south vs. north

Alternative to firewood, 63% of respondent's households of Aurahi municipality also use Cow /Buffalo Dung Cake (dried form) which is considered better than firewood a shown in figure 24. Even 10% of Janakpur residents also use these kinds of cake for burning. The preference for LPG stoves may be due to their ease of use and convenience, while the continued use of firewood and cow dung cakes could have environmental and health impacts. The data suggest that there may be opportunities to promote the use of sustainable cooking technologies, such as electric cooking devices, in these rural areas.

Figure 23 Cow dung cake as fuel

In the southern geographical context of Nepal (Aurahi and Janakpur), the cooking medium also changes on different occasions. Firewood is used for cooking in festivals and in feast (e.g. marriage ceremony). Choice of firewood is also seasonal. People tend to use more firewood cooking during the winter season to keep surroundings warm. Overall, the data suggests that LPG is the most popular cooking fuel among households in these districts, followed by electricity and firewood. It is important to note that the usage of different cooking fuels can have significant implications for both the environment and human health, particularly in terms of indoor air pollution and deforestation. Further research could explore the factors driving household choice of cooking fuels and the potential for promoting more sustainable and healthy cooking practices. Though most of the households have various cooking mediums available, their use depends on geography, family size, culture etc. Around 60% of respondents use firewood or solid fuel (Cow dung cake) for cooking lunch and dinner in Aurahi, Janakpur and Mahankal. Similarly, 30% of respondents from Aurahi and Mahankal mentioned that they use firewood for fodder preparation (Cooked food for domestic cattle like cow, buffalo, goat etc).

The residents in rural areas (Aurahi and Mahankal) use LPG to cook tea, breakfast, snacks and light meals while urban residents use it for cooking almost all meals. Looking into data, cooking patterns with electric cooking devices also vary randomly based on demography and geographical location. Using a rice cooker is common in all locations while using an induction stove was prevalent in Mahankal and Kathmandu. Water heater is another common device used mostly in urban areas for heating, drinking and bathing water. With information collected from KII, it was found that firewood and other solid fuels are mostly stacked in rural areas as preparation for the rainy and winter season. Both rural areas (Aurahi and Mahankal) homes have enough space to store firewood and cow dung cake. In urban areas, most of the households keep two LPG cylinders (one as backup).

7.2. Source of acquiring e-cooking devices

The survey identified three main mediums of acquiring e-cooking devices (such as induction stove, rice cooker, microwave oven) through a case study examining how households acquire them.

a. **Donation:** Refers to free distribution of e-cooking device under some projects from donor agency or government program
b. **Self-Purchase:** Refers to purchase by the Owner
c. **Gifted:** Refers to those received in gift from some relatives or friends

Out of the total respondent, only 67% have some form of e-cooking device namely Rice cooker, Induction stove and Microwave oven. Table 18 and figure 24 shows the source of acquiring e-cooking devices among the respondents. In the KMC, most of the respondents (82%) reported purchasing the devices themselves, while in the JSMC; the majority (49%) received them as gifts. In the ARM, the most common method of acquiring e-cooking devices was through donations (55%). A significant proportion of respondents in the MRM (13%) reported not having e-cooking devices. These findings suggest that access to e-cooking devices varies across different municipalities, with different methods of acquiring them prevailing in different areas. With the question to understand how people get the e-cooking devices in different locations, except Mahankal, all other place respondent's buy those devices looking into their personal interest. In Mahankal, there was one donation program named "One house, One induction stove" executed by "Gramin Bidhyut Shakahari Sansthan" which distributed induction stove in various wards through municipality and ward office.

Table 18 Source of getting the e-cooking device

Acquiring Method of E-cooking device	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Average %
Donation							33	55%	33	12%
Self-Purchased	11	28%	33	49%	82	82%	15	25%	141	53%
Gifted					2	2%	4	7%	6	2%
Don't have e-cooking device	29	73%	35	51%	16	16%	8	13%	88	33%
Total Respondent	**40**		**68**		**100**		**60**		**268**	

It is important for policymakers and organizations to consider these factors when implementing programs aimed at promoting the use of e-cooking devices in households. The respondents in rural area are reluctant to invest in new cooking device hence donation, subsidy will be best to increase the use of electric cooking device.

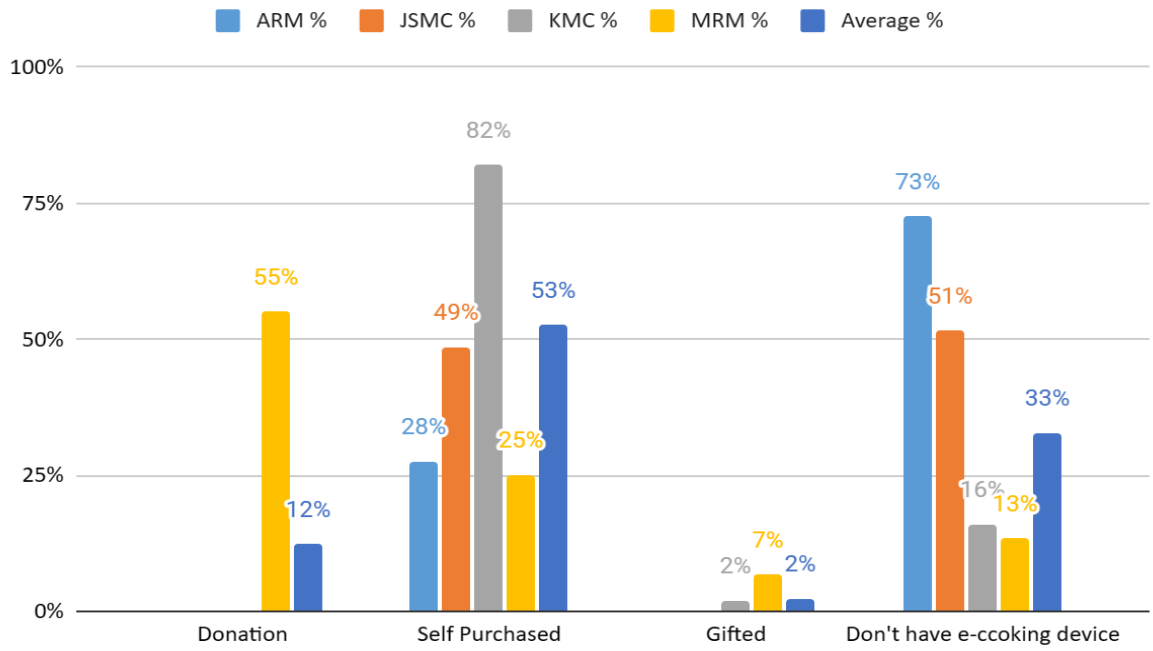

Figure 24 Source of getting the e-cooking device

In summary, the data shows that a majority of households in all four regions of Nepal have acquired E-cooking devices through self-purchase in urban area while donation in rural area. However, it is worth noting that the percentage of E-cooking devices acquired through donations in MRM is significantly higher compared to other regions.

7.3. Complementary Cooking Devices for Induction Cook top

This part of the survey intended to find the appropriate complementary cooking utensils required to use with Induction stove. The complementary utensils are Pressure Cooker with Induction base, frying pan, Saucepan, Deep Pan etc. This information only focused on the households which have Induction stove available.

Table 19 and figure 25 shows the complementary cooking utensils used with induction cooktop. Out of the 4 respondents from JSMC, all of them have complementary cooking utensils for their induction cooktop. In KMC, 65% of the respondents have complementary cooking utensils, while in MRM, 81% of the respondents have complementary utensils. No respondents from ARM have complementary cooking utensils for induction cooktop. Instead, all respondents from ARM try to use regular utensils with a flat bottom. Overall, 43% of the respondents have complementary utensils for induction cooktop, while 5% of the respondents try to use regular utensils.

Table 19 Complementary Cooking device present for Induction Cooktop

Complementary Cooking Utensil	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Average %
Yes	0	0	4	100%	60	92%	33	65%	97	81%
No	0	0	0	0%	2	3%	14	27%	16	13%
Try to Use Regular Utensil (With flat bottom)	0	0	0	0%	3	5%	4	8%	7	6%
Total Respondent	**0**	0	**4**	100%	**65**	100%	**51**	100%	120	100%

The findings suggested that though people have got Induction stoves either by self-purchase or donation, many people don’t have appropriate cooking utensils. Most of the respondents who got the stoves in donation or gift lack complementary utensils.

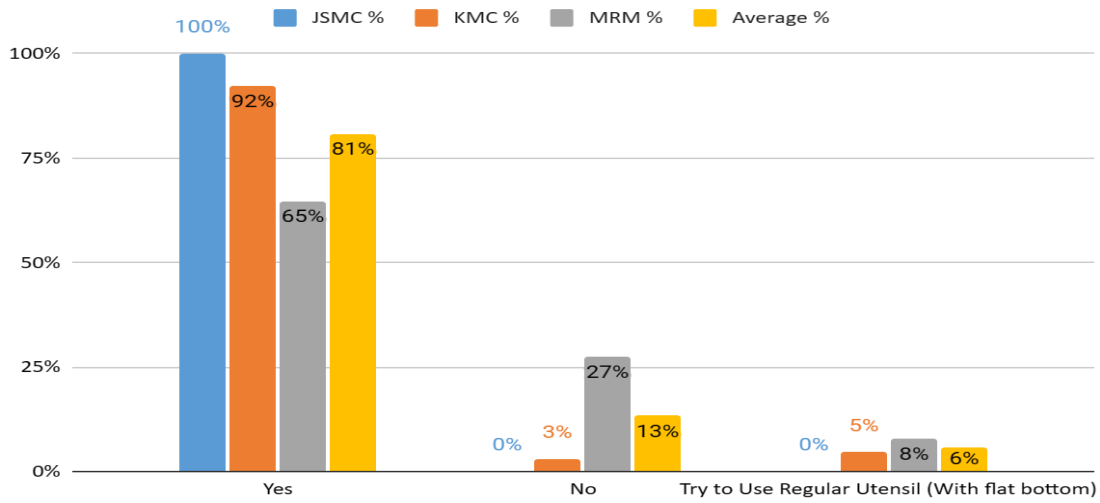

Figure 25 Complementary Cooking device present for Induction Cooktop

According to the data, the majority of households in surveyed municipalities have some complementary cooking utensils for induction cooktop. The most common complementary cooking device for all surveyed municipalities is a pressure cooker, with JSMC and KMC having the highest percentage of households (100% and 92%) using this device. Some households who have received an induction stove but couldn't buy other utensils still use it from available flat bottom utensils that can stay on top of the induction stove.

Overall, these findings suggest that households in these surveyed municipalities have a variety of complementary cooking devices for induction cooktop, with differences in usage patterns across the municipalities. It may be important for policymakers and manufacturers to consider these patterns when developing policies and designing complementary devices for induction cooktop to ensure that households can access and use these devices effectively.

7.4. Satisfaction using Induction Cook top

Overall satisfaction rate with e-cooking devices is excellent (80%) with highest satisfactory rate in Mahankal (93%). The trend of satisfaction level suggests the potential of expanding e-cooking medium in urban as well as rural areas. Looking into the data of urban vs. rural and north vs. south, the overall perceptions of respondent are positive towards using of e-cooking devices.

Table 20 and figure 26 provides data on the satisfaction level of individuals using Induction Cooktop in four different areas (ARM, JSMC, KMC, and MRM) of Nepal. Overall, the satisfaction level of people using Induction Cooktop seems to be very high across all areas.

Table 20 Respondent satisfaction on using Induction Cook Stove

Satisfaction with E-cooking Devices	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Excellent	3	50%	20	69%	47	81%	28	93%	98	80%
Good	3	50%	8	28%	4	7%	0	0%	15	12%
Satisfatory	0	0%	1	3%	7	12%	1	3%	9	7%
Poor	0	0%		0%		0%	1	3%	1	1%
Total Respondent	**6**		**29**		**58**		**30**		**123**	

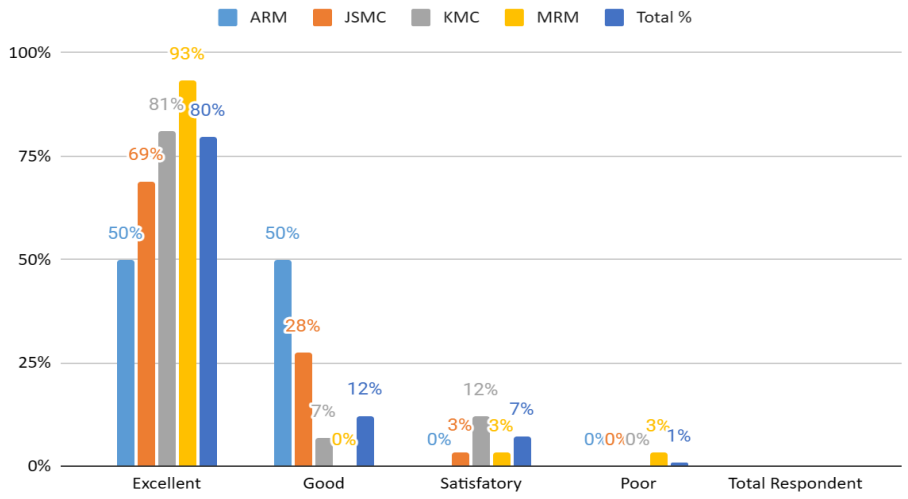

Figure 26 Respondent satisfaction on using Induction Cook Stove

7.5. Initial reason to use E-cooking devices

The initial reasons for acquiring e-cooking devices have mixed multiple responses from respondents. Most respondents (71%) acquired e-cooking devices for their ease of use and functionality. While 54% of respondents relied on e-cooking devices due to frequent shortages of other fuels, such as LPG, which are imported by Nepal Oil Corporation, especially in urban areas. Table 21 shows the initial reasons for using e-cooking devices among the four different regions. Energy efficiency was also a significant factor for some respondents, with 29% citing this as the initial reason for using an e-cooking device.

Table 21 Initial reason for using E-cooking device

Initial reason for buying e-cooking devices	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Functionality and Ease of Use	4	67%	13	45%	49	88%	18	64%	84	71%
Cheap Cooking medium			8	28%	9	16%	5	18%	22	18%
Shortage of other Fuel	2	33%	12	41%	40	71%	10	36%	64	54%
Energy Efficiency	2	33%	14	48%	17	30%	1	4%	34	29%
Low Buying Cost	1	17%	8	28%	5	9%	14	50%	28	24%
Avoidance of Smoke			9	31%					9	8%
Maintenance & Services			4	14%	4	7%			8	7%
Total Respondent	**6**		**29**		**56**		**28**		**119**	

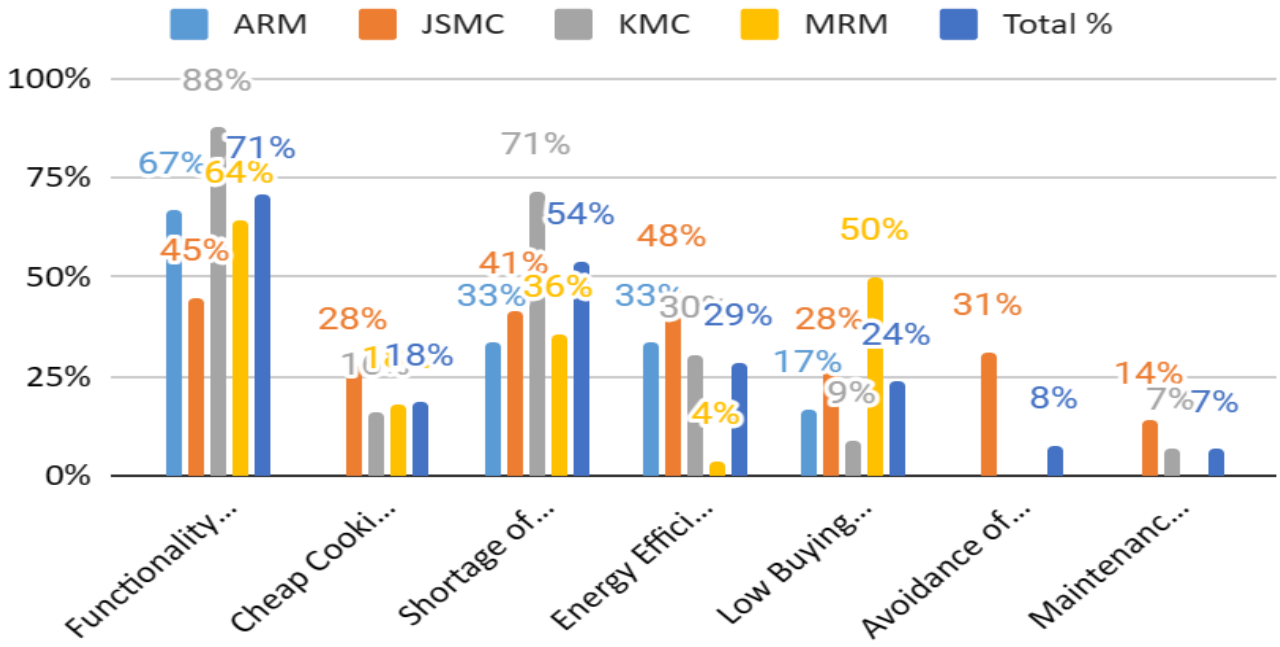

Figure 27 Initial reasons for using e-cooking devices

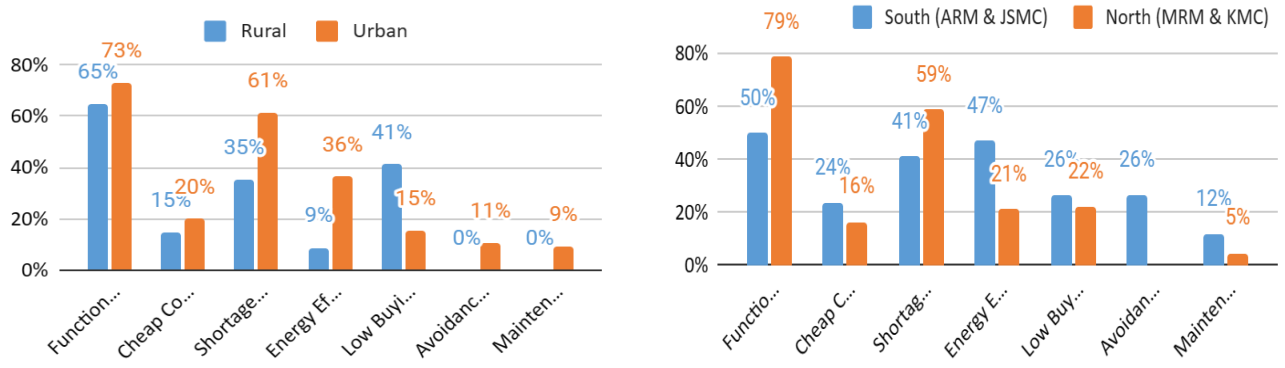

Figure 28 Comparison of behavior for using e-cooking devices in Rural vs. Urban and South vs. North

A comparison of e-cooking device usage in rural and urban areas reveals that urban users (73%) prefer it more for its functionality and ease of use compared to rural users (65%). Moreover, urban areas face a higher scarcity of fuel (61%) than rural areas (35%). This is mainly due to the fact that firewood is the primary cooking fuel in rural areas, making them less prone to fuel shortages.

Comparing the data of north (Mahankal and Kathmandu) vs. south (Aurahi and Janakpur), the southern people feel it is a cheaper medium of cooking (24%) compared to northern zone (16%). Use of e-cooking devices to avoid smoke is only found in the southern part.

8. Findings and Result – End of Life and Final Disposal

8.1. Frequency of scrap collectors visit

Out of four municipalities surveyed, three municipalities have easy access by scrap collectors. Mahankal witnesses scrap collectors in certain time interval (once or twice in month) being remote area and far from nearest market. On average 62% respondents mentioned that scrap collectors visit their locality daily. Aurahi has the most frequent scrap collector visit (93%) due to location nearby India boarder.

The data in table 22 shows the frequency at which scrap collectors come to collect old appliances in different regions of Nepal. Scrap collectors in Mahankal visit once in a month from Kathmandu and tends to collect scraps from different locality.

Table 22 Frequency of Scrap Collector Visit

Frequency of Scrap Collectors Visit	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Daily	37	93%	58	85%	67	67%	4	7%	166	62%
Twice a Week	2	5%	7	10%	12	12%	4	7%	25	9%
Once a Week	1	3%	3	4%	14	14%	19	32%	37	14%
Once a Month					7	7%	28	47%	35	13%
Sometimes in year							5	8%	5	2%
Total Respondent	**40**		**68**		**100**		**60**		**268**	

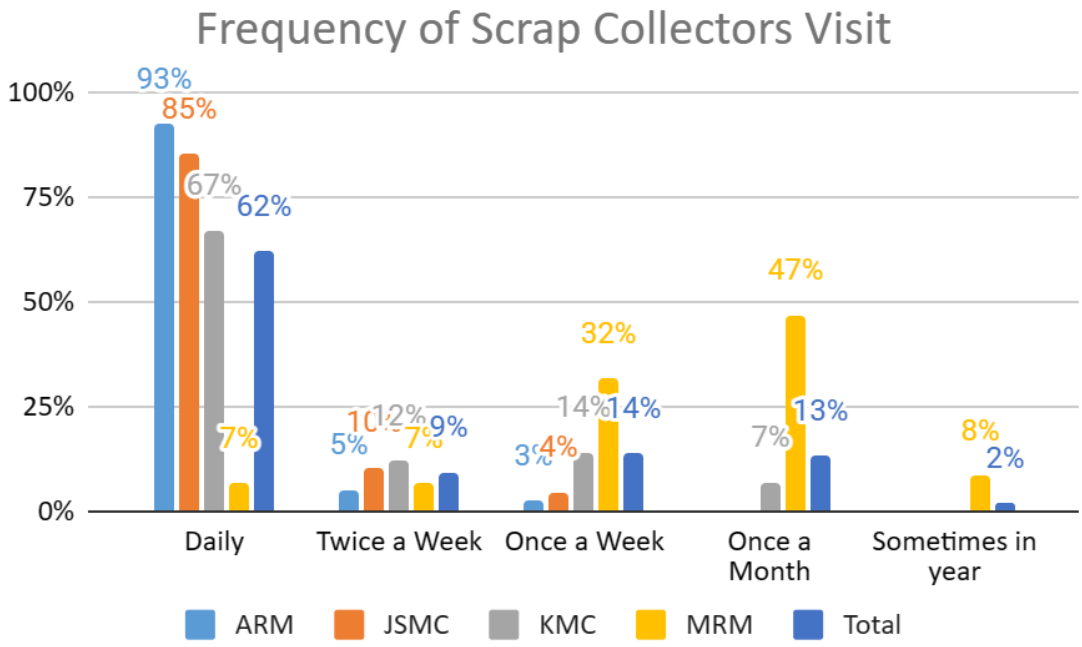

Figure 29 Chart for frequency of scrap collectors visiting

The data suggests that the majority of households in Nepal rely on scrap collectors to manage their old or non-working appliances. The high frequency of collection reported by households reflects the importance of scrap collectors as a means of disposal for old appliances in Nepal. However, the variation in the frequency of visits by scrap collectors across different regions of Nepal suggests that there may be some disparities in the availability of scrap collectors in different areas.

8.2. End of life management

To understand the end-of-life handling method of various e-waste generated in all surveyed areas, a question was asked “How do you manage your non-working electronic and electrical appliances?” The answer parameter was given as options below which are common practices in Nepal for end-of-life handling. A description of the end-of-life disposal is depicted in table 23 and figure 30.

a. Sell to scrap collectors
b. Through along with municipal waste
c. Repair / Second hand shop
d. Open Burning
e. Open / River Dumping
f. Up-cycling
g. Donation
h. Retailer / Distributors exchange offer

i. Formal recyclers

Table 23 Choice of End-of-Life disposal based on priority

EoL Disposal Method	ARM	ARM %	JSMC	JSMC %	KMC	KMC %	MRM	MRM %	Total	Total %
Scrap Collector	39	98%	67	99%	84	84%	39	65%	229	85%
Municipal Waste Collector		0%	25	37%	75	75%		0%	100	37%
Repair / Second Hand Shop	10	25%	8	12%	36	36%	20	33%	74	28%
Open Burning	8	20%		0%	2	2%	39	65%	49	18%
Open / River Dumping	13	33%		0%		0%	29	48%	42	16%
Upcycling		0%		0%	7	7%	17	28%	24	9%
Donation	2	5%	1	1%	16	16%	1	2%	20	7%
Retailer / Distributor (Exchange Offer)	5	13%		0%	6	6%	2	3%	13	5%
Formal Recycler		0%		0%	1	1%		0%	1	0%
Total Respondent	**40**	100%	**68**	100%	**100**	100%	**60**	100%	268	100%

The response was quite interesting based on the availability of disposal services vs. rural and urban settings. The responses analysis shown below is not as total respondent's sum but single respondent has multiple options based on availability.

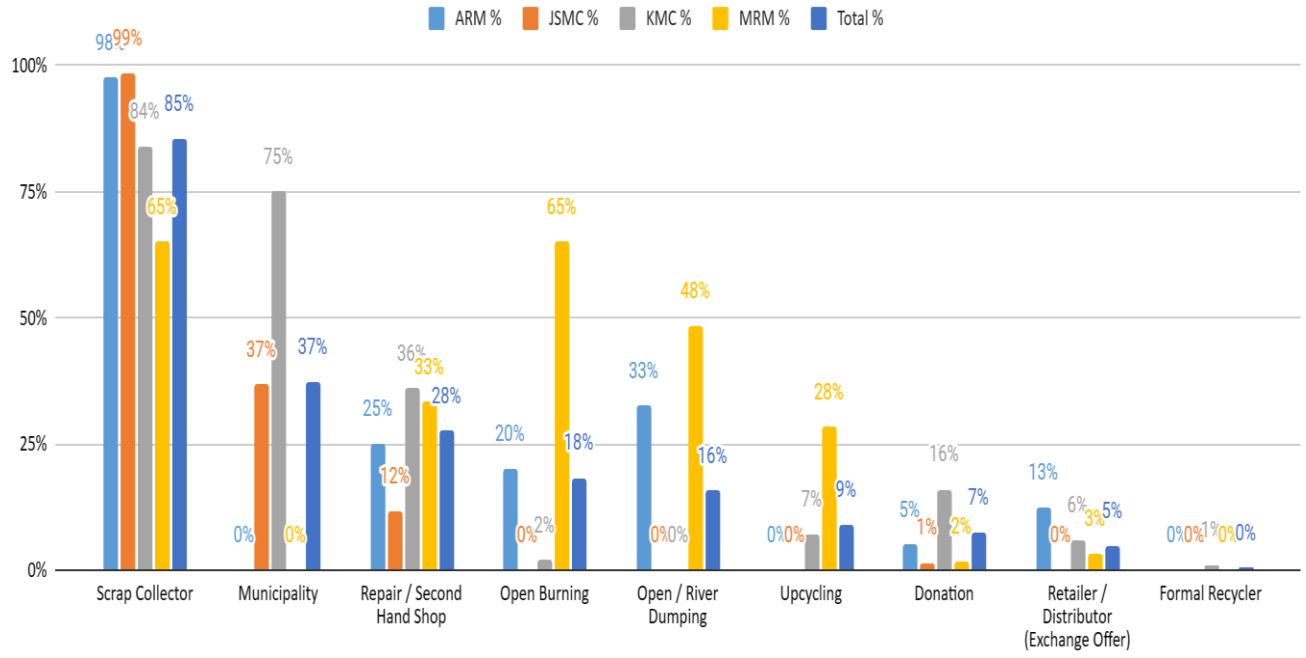

Figure 30 Options available for End-of-Life management of E-waste in surveyed area

Figure 31 shows a conceptual flow diagram depicting preferred EoL disposal methods among the respondents based on priority. The majority of respondents from all four municipalities (ARM, JSMC, KMC, and MRM) preferred to sell their e-cooking devices to scrap collectors, with an average

percentage of 85%. The option with the second highest preference is to dispose through the regular municipal solid waste collectors in landfills, with an average percentage of 37%. Repair or second-hand shops were found as the third most preferred option, with an average percentage of 28%. Open burning and open/river dumping are the least preferred options, with an average percentage of 18% and 16%, respectively. Up-cycling, formal recycling and retailer/distributor (exchange offer) are rarely preferred choices for any of the respondents. This can be attributed to the presence of easily accessible scrap collectors and a lack of awareness or absence of organized means to pursue up-cycling or formal recycling options.

There was one interesting discovery in Mahankal for EoL disposal. They collect the e-waste items which were not taken by scrap collectors and wait for the monsoon season. Once the water flow in the nearby river increases and is sufficient to wash out heavy items, they throw un collected e-waste (CRT TV, lamps etc) into the river. This leads to conclusion about strong need for awareness among residents about hazards of e-waste dumping in river.

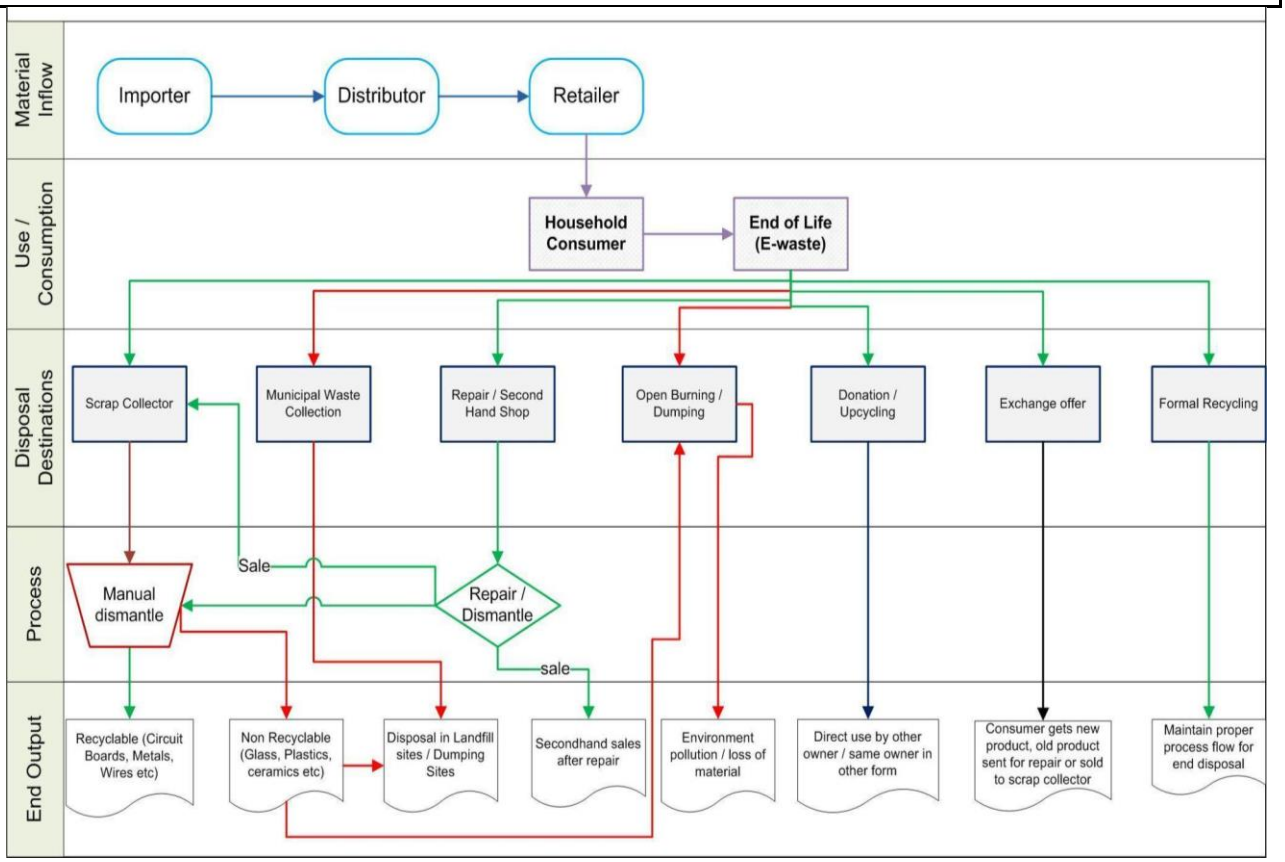

Figure 31 End of Life Management Scenario in Surveyed Area

The majority of respondents' first choice remains selling their unused appliances to scrap collectors (85%). If the items are not taken by scrap collectors (e.g. CRT screens, mercury lamps, etc), residents choose other easily available options. As rural municipalities (ARM and MRM) don't have a municipal waste collection system, open burning and dumping prevails in those areas while in urban municipalities (JSMC and KMC) the second choice is throwing it along with municipal waste. Throwing the low value e-waste along with municipal waste is dominant in KMC (75%) as the second choice. These results indicate that most respondents prefer to sell their e-cooking devices to scrap collectors, followed by disposing of them at the municipality, and repairing or selling them at second-hand shops. These results highlight the need for proper disposal and recycling mechanisms for e-waste management in the country.

There is also a strong trend of repairing old items and leaving it behind in the same shop if the repair cost exceeds certain expectations. There are no exclusive second-hand shops in all surveyed areas but all repair shops tend to sell second hand items which the original owner left behind there. Residents in Kathmandu also donate items to their servants and marginalized workers which is less popular in other surveyed areas. Ironically, only one respondent used to handover the e-waste to a formal recycler in Kathmandu. This clearly shows the lack of formal recyclers as well as awareness of formal recycling requirements of e-waste.

8.3. Reason for selling e-waste

To analyze the major reasons for choosing the option of final disposal method of e-waste, the study team probed this question. The results have identified major four reasons based on geographical locations. The major reasons were

1. Getting rid of appliances,
2. Scrap Value,
3. Lack of storage space,
4. Health Conscious.

Table 24 and figure 32 shows the major reasons for selling old broken devices by different municipalities. Out of the total respondents, 18% of ARM, 34% of MRM, 28% of JSM, and 32% of KMC cited "Getting Rid" as the major reason for selling e-waste. 0% of ARM, 36% of MRM, 6% of JSM, and 52% of KMC mentioned "Lack of Storage Space" as the reason for selling old devices. "Scrap Value" was another significant reason cited by the respondents, with 83% of ARM, 13% of

MRM, 66% of JSM, and 8% of KMC stating this as their primary reason. "Health Consciousness" and "Not Sold any Device" were not significant reasons, with only a few respondents mentioning them. Overall, the results indicate that most municipalities sell their e-waste to get rid of it, followed by the need for storage space and the scrap value of the materials.

Table 24 Reason for selling old broken devices by municipality

Major Reasons to sell E-waste	ARM	ARM %	MRM	MRM %	JSM	JSM %	KMC	KMC %	Total	Total %
Getting Rid	7	18%	16	34%	19	28%	29	32%	71	**29%**
Health Conscious		0%	3	6%		0%		0%	3	**1%**
Lack of storage space		0%	17	36%	4	6%	48	52%	69	**28%**
Scrap Value	33	83%	6	13%	44	66%	7	8%	90	**37%**
Not sold any device		0%	5	11%		0%	8	9%	13	**5%**
Total	**40**	**100%**	**47**	**100%**	**67**	**100%**	**92**	**100%**	**246**	**100%**

The presented data in figure 33 represent unique behavior for the Southern part and Northern part irrespective of Rural and Urban settings. Both surveyed areas in the southern part show getting scrap value is more important (ARM - 83% and JSM - 66%) compared to northern habitat (MRM - 13% and KMC - 8%). Similarly Urban settings also showed a different behavior towards the reason for disposing e-waste due to lack of storage space. KMC being the most densely populated urban settlement with small apartments, getting rid from e-waste due to lack of storage space is more prevalent (KMC- 52%). Surprisingly few respondents from Mahankal (6%) showed interest about hazards of e-waste and health-consciousness.

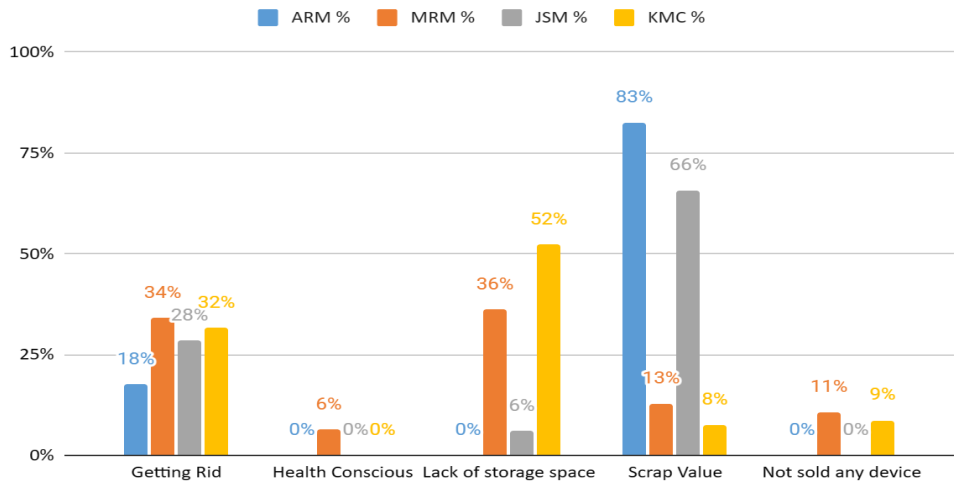

Figure 32 Reason for selling old broken devices by reasons

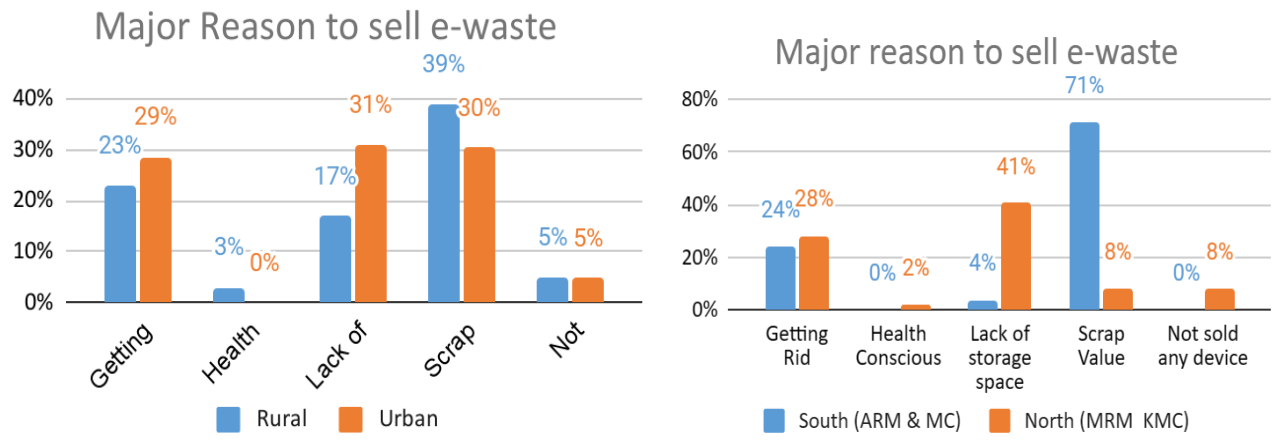

Figure 33 Comparison chart of Major Reason for Selling E-waste

8.4. Issue to dispose non-working appliances

With the survey questionnaire “Is there any issue getting rid of old non-working devices?”, the study team related this with the e-waste disposal issue. Table 25 and figure 24 presents the respondents' responses to the issues they face when getting rid of old appliances. In ARM, a quarter of the respondents (25%) reported facing difficulties when disposing of old devices, while the majority (68%) answered "No," and 8% did not have knowledge on the matter. In MRM, 47% of the respondents answered "Yes," 37% answered "No," and 17% did not have knowledge about it. In JSMC, 41% of the respondents faced issues in getting rid of old devices, while 56% said "No," and 3% went for the third option. Finally, in KMC, 22% of the respondents answered "Yes," while 59% said "No," and 19% did not know. Across all the surveyed regions, 33% of respondents faced issues getting rid of old appliances, while 54% did not face any issues, and 13% did not know. The data suggests that while a significant number of respondents face issues regarding the disposal of old appliances, a higher number do not face any issues.

Table 25 Issues regarding getting rid of old devices

Issue in getting rid of old appliances	ARM	ARM %	MRM	MRM %	JSMC	JSMC %	KMC	KMC %	Total	Total %
Yes	10	25%	28	47%	28	41%	22	22%	88	33%
No	27	68%	22	37%	38	56%	59	59%	146	54%
Don't know	3	8%	10	17%	2	3%	19	19%	34	13%
Total	**40**	**100%**	**60**	**100%**	**68**	**100%**	**100**	**100%**	**268**	**100%**

54% of total respondents don't have any issue to get rid of their old devices but the pattern is different for different geographical locations. The respondents from Mahankal municipality (47%) find it more difficult to get rid of old devices followed by respondents of Janakpur municipality (41%) and Aurahi municipality (25%).Scrap collectors in Mahankal come from far (either from Kathmandu or lalitpur), they tends to buy only high value items due to high transportation cost from Mahankal to Kathmandu It is also seen that it is easy to dispose of e-waste in the southern part of Nepal due to near and easy access to the scrap market from neighboring country India. Out of 88 responses for getting rid of old appliances, there was one major reason for "Emotional Attachment" with old devices. 25% said that they would like to keep old devices till there is enough space available to store them. 5% of them find it hard to dispose of as they couldn't find any place to throw or dispose. 5% of respondent's didn't dispose of it due to low scrap value offered by scrap collectors. 38% of respondents find it hard to get rid of old devices but there are no specific reasons provided (e.g., hard to repair, have plenty of storage area available, no one ready to take it, etc.).

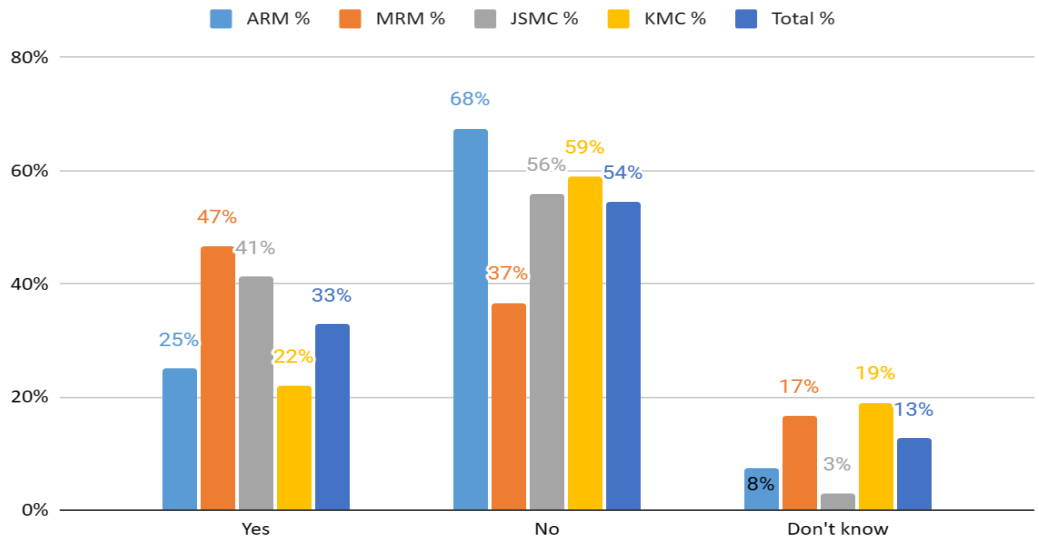

Figure 34 Issues regarding getting rid of old devices

8.5. Repair Culture

This study also focused on the repair behavior of the respondent towards electronics appliances as shown in table 26 and figure 35. The findings have mixed outcomes depending on the geographical locations (Southern Nepal vs. Northern Nepal) and habitat settings (Rural vs. Urban). The data in Table 25 and figure 25 indicates that a majority of respondents from all municipalities prefer repairing broken appliances over replacing them. Among the respondents, 58% from ARM, 90% from MRM,

and 92% from JMC expressed a preference for repairing appliances, while 96% of respondents from KMC favored this option.

Table 26 Repair behavior of Respondents

Do you prefer repairing broken appliances	ARM	ARM %	MRM	MRM %	JMC	JMC %	KMC	KMC %	Total	Total %
Yes	23	58%	54	90%	61	92%	94	96%	232	**88%**
No	11	28%	3	5%	4	6%	4	4%	22	**8%**
Don't know	6	15%	3	5%	1	2%	0	0%	10	**4%**
Total	**40**	**100%**	**60**	**100%**	**66**	**100%**	**98**	**100%**	**264**	**100%**

On the other hand, a relatively small percentage of respondents indicated that they do not prefer repairing broken appliances. Among the respondents, 28% of respondents from ARM, 5% from MRM, 6% from JMC, and 4% from KMC stated that they do not prefer repairing appliances. The primary reasons of the highest percentage in ARM can be attributed to the limitation of repair services in the study area and the strong preference for new, high-quality devices over regular maintenance. Additionally, a small percentage of respondents across all municipalities indicated that they did not know if they preferred repairing appliances. Overall, the data suggests that there is a general preference for repairing broken appliances over replacing them among the respondents.

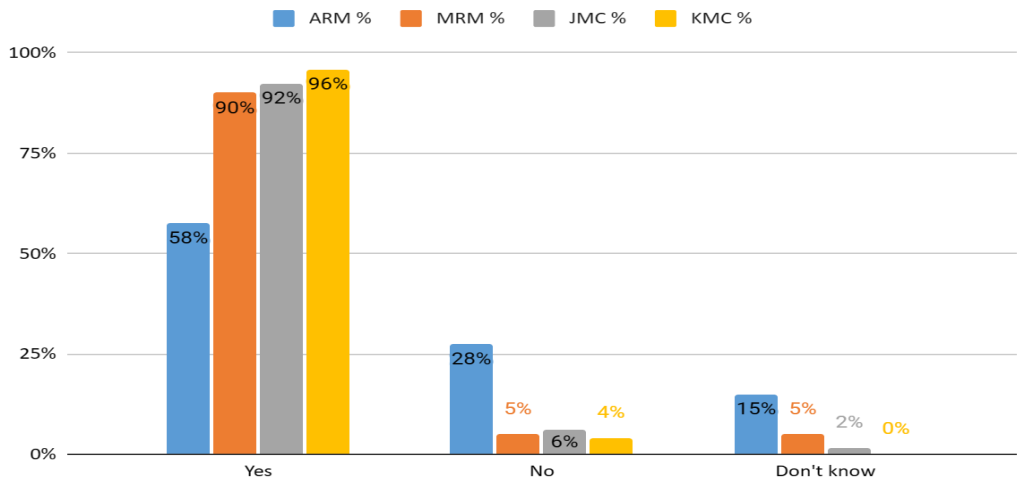

Figure 35 Repair behavior of Respondents

Overall response for repair behavior is positive except Aurahi Rural Municipality where only 58% respondents are interested in repairing compared to average of 88%. All three locations showed quite interest (above 90%) for repairing if it can be done at a cheaper price and with quality. The respondents choose to repair or not choose to repair on following factors from all locations.

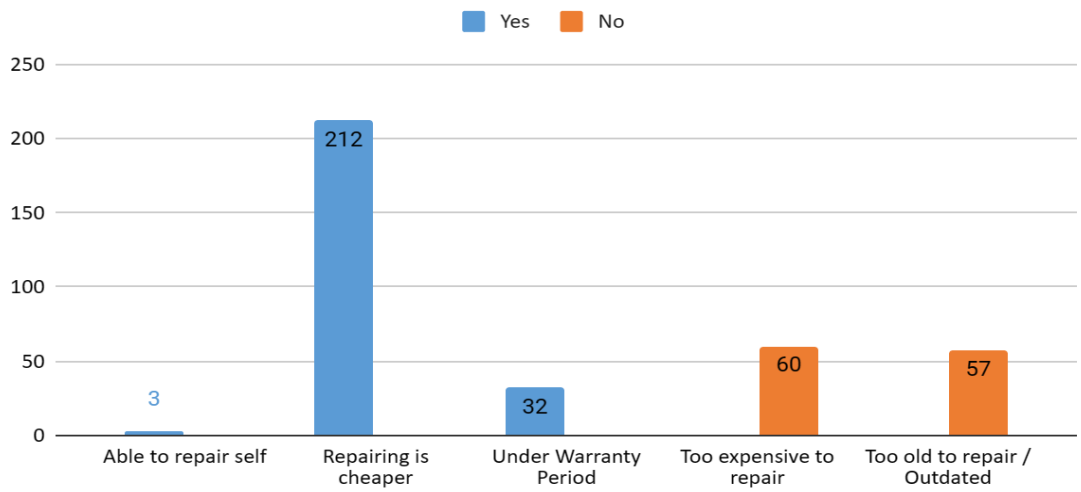

Figure 36 Reasons to choose to repair or not to repair by respondent

The main reason to choose repairing is if it is cheaper or under warranty. The respondents also highlighted that if the appliances are too old then they prefer not to repair. Few respondents mention the reason as "Emotional Attachment" to keep repairing old appliances. From various data, it was clear that if appliances can be repaired at lower cost, then people still tend to repair their devices. Few responses pointed out the need for good repair centers nearby as they failed to repair locally and finally decided to buy new.

9. End of Life and Material Flow

9.1. End of Life and Material Flow in Aurahi Rural Municipality

In Aaurahi, the main end consumers for electronic devices are households, corporations, government offices, health posts, institutions and other establishments as shown in Annex 3. Despite limited e-waste generation in this area, the main collector of e-waste is informal scrap collectors from India as shown in figure 37. End consumers who go to repair shops to fix their electronic devices also leave some e-waste that can be used as components. However, most of the electronic devices received by repair shops are in bad condition, beyond repair, as youth from this area often work abroad and remittances are used to buy new electronic items rather than repairing them locally. The repair shops keep these broken items for components that can be used in other repairable devices. Additionally, the repair shops store other e-waste collected from end consumers in local warehouses or shops, which are either sold to scrap dealers or thrown away into nearby rivers.

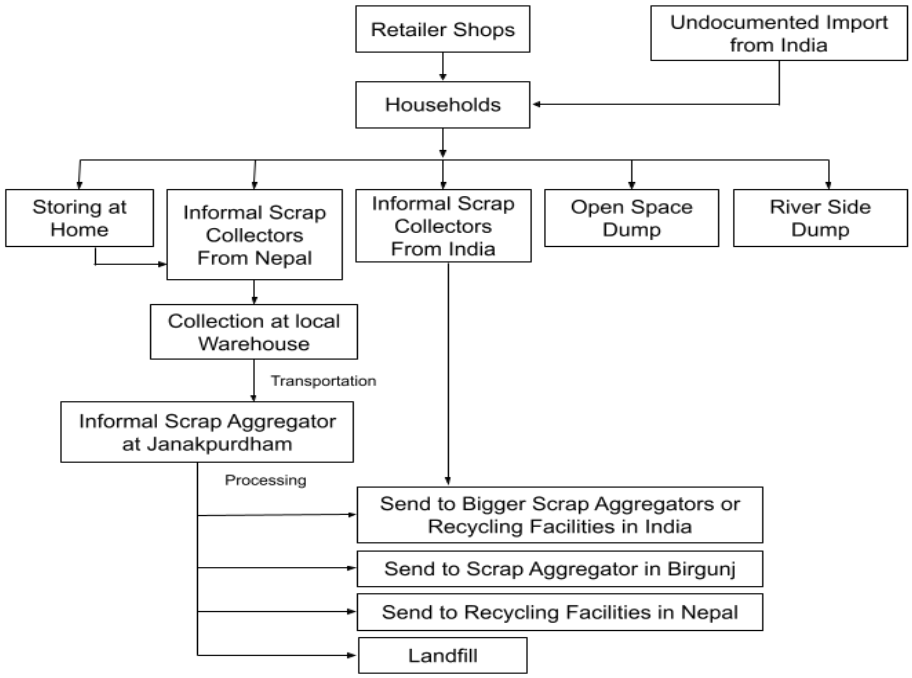

Figure 37 Aaurahi Rural Municipality End of Life and Material flow Chart

Informal scrap collectors from India collect most of the e-waste generated by households, which is then transferred to local collection points or warehouses for a short period of time and later exported to India. At the local collection point, the collected e-waste is separated based on their types. The e-waste is then transported to bigger scrap aggregators in India, where dismantling and processing begin. Some e-waste is also collected by informal scrap collectors in Nepal and transferred to the bigger scrap aggregator in Janakpurdham via local collection points, where it is segregated based on type. The dismantling and processing process involves manual separation of valuable items like copper, brass, iron, steel, aluminum, and plastic components, using tools such as hammers, pliers, and screwdrivers. These separated items are then sent to bigger aggregates in Janakpurdham Sub-Metropolitan City or sent to recycling facilities in Nepal. Non-recyclable parts generated during the dismantling process are either sent to landfill sites via municipal waste management process or openly dumped or burned.

Most households in this area prefer to repair their electronic devices by themselves, but if it's beyond their capacity and cannot fix it, they take it to the local repair shop. It is worth noting that most of the repair works for electronic devices are done at repair shops which are usually located in India. It is because the end consumer thinks it is cheaper to repair in India and is not far and easily accessible. If the device is non-repairable, households tend to keep it at home until there is enough space to store unwanted items or get good scrap value from informal scrap collectors that come to purchase it. Small

e-waste items are sometimes burned nearby or openly dumped into nearby rivers by the end consumers.

9.2. End of Life and Material Flow in Janakpurdham Sub-metropolitan City

Janakpurdham has various end consumers for electronic devices, such as households, corporate and governmental offices, businesses, hospitals/health posts, and institutions as shown in Annex 4. The end consumers in this area have various methods of disposing of their e-waste as shown in figure 38. The main collectors of e-waste in this area are informal scrap collectors who collect e-waste door-to-door from households and sell it to scrap aggregators. The collected e-waste is then stored at the collection point or warehouse of the scrap aggregator and separated based on types such as boiler, TV, fridge, etc. The collected e-waste is then put through the dismantling, burning, and other fundamental processing processes, which are performed manually using hammers, pliers, and screwdrivers to separate valuable items like copper, brass, iron, steel, aluminum, and plastic components, as well as non-recyclable items. These dismantled and separated items are then either sent to larger aggregators within Janakpurdham Sub-Metropolitan City or sent to recycling facilities in Nepal. Some items are also transported to larger aggregators in India via Birgunj, another nearby place and a hub for import and export in Nepal. The non-recyclable parts generated after the dismantling process that are of no value to the scrap aggregator are either sent to landfill sites via municipal waste management processes or openly dumped or burned.

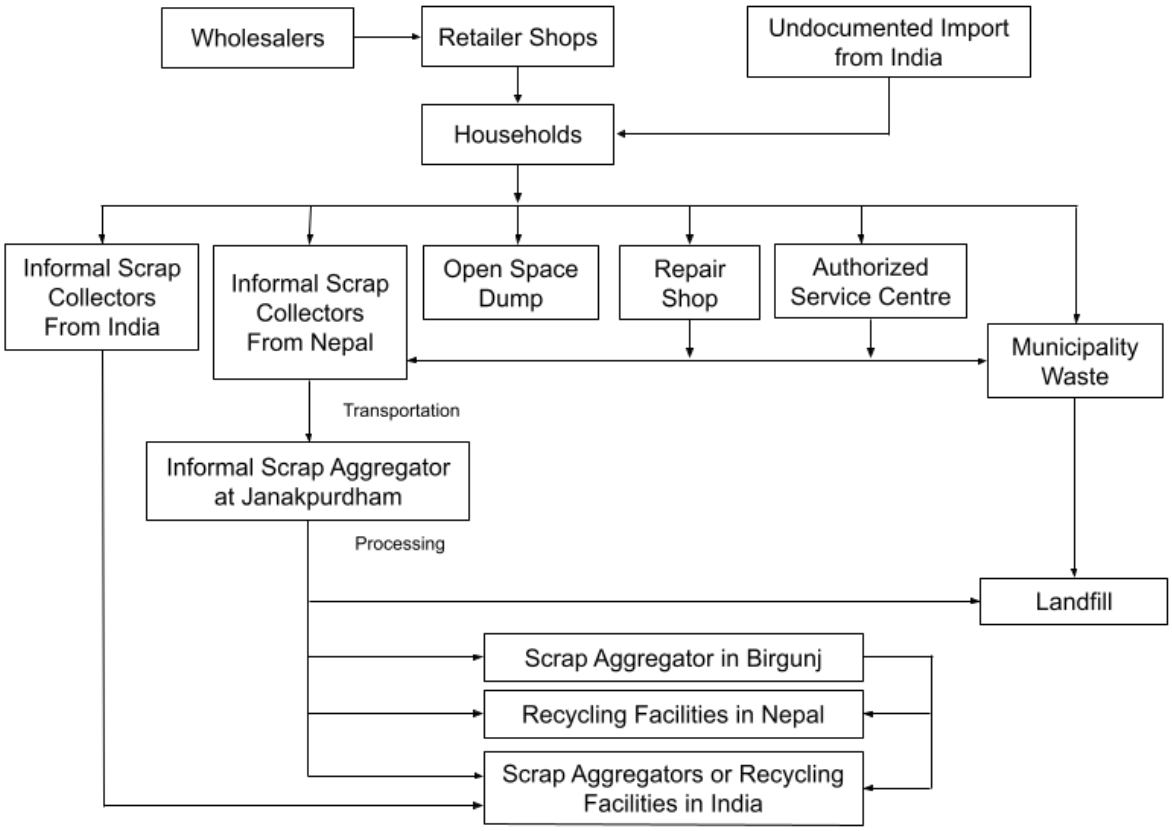

Figure 38 Janakpurdham Sub-Metropolitan City End of Life and Material Flow Chart

Repair shops, where end consumers go to repair their electronic devices, also collect e-waste that can be used as components. Most of the electronic devices collected by repair shops are in repairable condition and are mostly repaired and reused. Repair shops do not actively collect electronic devices from households. Instead, many end consumers choose to repair their broken devices and if a device remains unrepaired, a majority of consumers opt to leave them at repair shops. Most of the parts of those unrepaired electronic devices could be reused to repair other repairable devices. Consequently, repair shops often accumulate a significant number of broken devices, exceeding their available storage space over time. To address this issue, shop owners resort to selling some of the stored broken devices to scrap collectors, obtaining some value in the process or it is either thrown away at the landfill through municipal waste management.

Among these, households are the primary end consumers for electronic devices, and they mostly repair their devices by themselves for minor issues. If they cannot repair the devices by themselves, they take them to the nearby local repair shops. If the devices are under warranty, they are repaired at repair shops in India, where they were bought from. If the device is not repairable, the household consumer

usually keeps it at home until the informal scrap collectors come and purchase it. Some small e-waste items generated by households are openly dumped nearby, but the generation of e-waste in this area is limited.

It is evident that the informal sector plays a significant role in managing e-waste in Janakpurdham Sub-Metropolitan City. However, this informal sector is not without its problems. The manual dismantling and separation process of e-waste are hazardous and expose workers to toxic chemicals and materials. The burning of e-waste releases toxic chemicals into the environment, causing air and water pollution. Additionally, the open dumping of non-recyclable e-waste and burning of e-waste are not environmentally sustainable practices and can have severe long-term consequences.

9.3. End of Life and Material Flow in Mahankal Rural Municipality

In Mahankal Rural Municipality, the primary end consumers of electronic devices are households and governmental institutions as shown in Annex 6. Although the e-waste generation in the area is low, the main collectors of e-waste are informal scrap collectors who come from nearby areas like Chapagaun or Lele as shown in figure 39. They collect e-waste from the area and store it at a collection point or their local warehouse. These items are then transferred to the informal scrap aggregator at Chapagaun or Lele using small vehicles along with other recyclable items. Once the scrap is received at the warehouse, it is sorted based on its type and then sent for dismantling and processing. In the dismantling process, the scrap collectors manually dismantle the e-waste into various valuable items like copper, iron, steel, brass, and aluminum, and non-valuable items like plastic. These valuable items are then sent to bigger aggregates within the Kathmandu valley or to recycling facilities within Nepal. However, the non-recyclable parts generated after the dismantling process are either sent to a landfill site through municipal waste management processes or are openly dumped or burned.

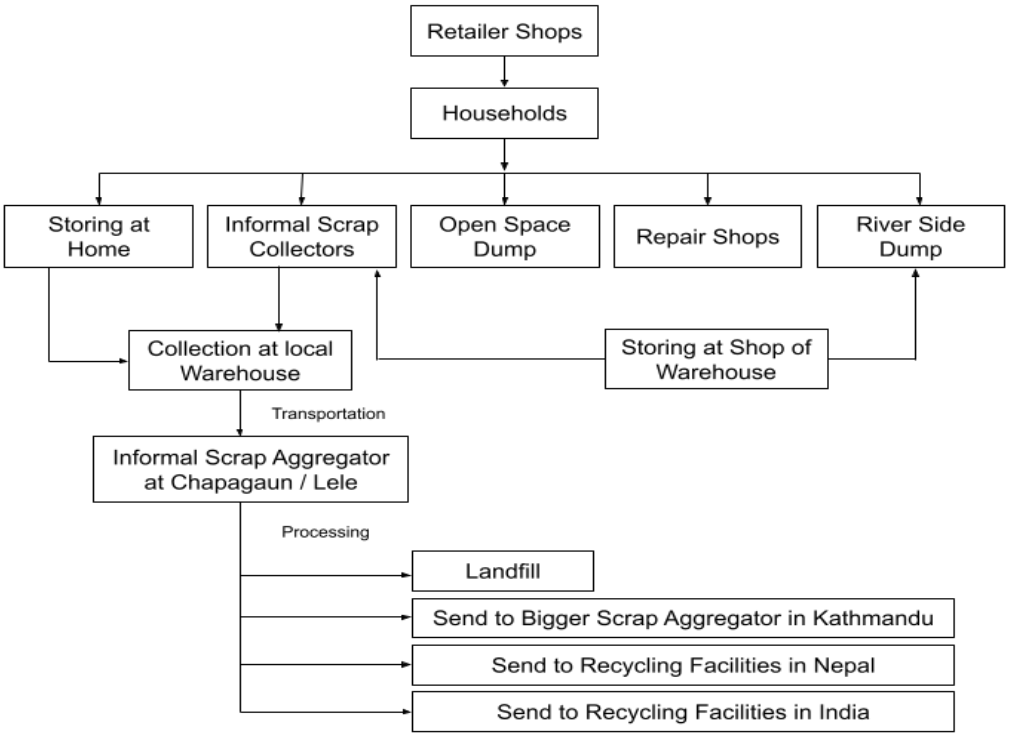

Figure 39 Mahankal Rural Municipality End of Life and Material Flow Chart

When household consumers face issues with their electronic devices, they tend to either fix them on their own or take them to local repair shops for assistance. If the device is beyond repair, they keep it at home until the rainy season and then dispose of it in the river, a practice also followed by repair shops for all electronic items that are not taken by informal scrap collectors. The repair shops store non-valuable e-waste collected from household consumers and non-valuable items from broken devices in their shops, which are disposed of in the river during the rainy season if end consumers don't want them.

It is important to note that the current method of e-waste management in Mahankal Rural Municipality is unsustainable and has negative environmental and health impacts. The improper disposal of e-waste can release hazardous chemicals and pollutants into the environment, which can harm human health and the ecosystem. Therefore, it is crucial to develop a proper e-waste management system that promotes the reduction, reuse, and recycling of electronic devices and ensures the safe disposal of e-waste.

9.4. End of Life and Material Flow in Kathmandu Metropolitan City

In Kathmandu Metropolitan City, the primary end consumers for electronic devices are households, corporate offices, government offices, businesses, hospitals/health posts, and institutions as shown in Annex 5. Various methods are used by households to dispose of their e-waste as shown in figure 40. However, due to high purchasing power, the generation of e-waste in this area is more significant, and informal scrap collectors are the main collectors of e-waste. These collectors roam door-to-door to collect e-waste from households, which is then sold to the scrap aggregator and stored at a collected point or warehouse. The collected e-waste is separated based on types, such as boilers, TVs, fridges, etc.

The informal scrap aggregator then performs dismantling, burning, and other fundamental processing procedures manually, using hammers, pliers, and screwdrivers to separate valuable items like copper, brass, iron, steel, aluminum, plastic components, and other non-recyclable items. These dismantled and separated items are sent to bigger aggregates within the Kathmandu Metropolitan City or to recycling facilities in Nepal. Some items are also transported to bigger aggregators in India. The non-recyclable parts that have no value to the scrap aggregator and generated after the dismantle process are sent to landfill sites through municipal waste management processes or openly dumped or burned.

Repair shops are another source of e-waste collection. When end consumers visit repair shops to fix their electronic devices, the shops collect some e-waste that can be used as components. Most electronic devices collected by repair shops are in repairable condition, which are mostly repaired and reused. Only the broken items that are beyond repairable are kept for their components, which can be used in other repairable devices. The repair shop stores the non-valuable scrap components and other non-valuable e-waste collected at the shop, which is either sold to scrap dealers after dismantling or thrown away at landfills through municipal waste.

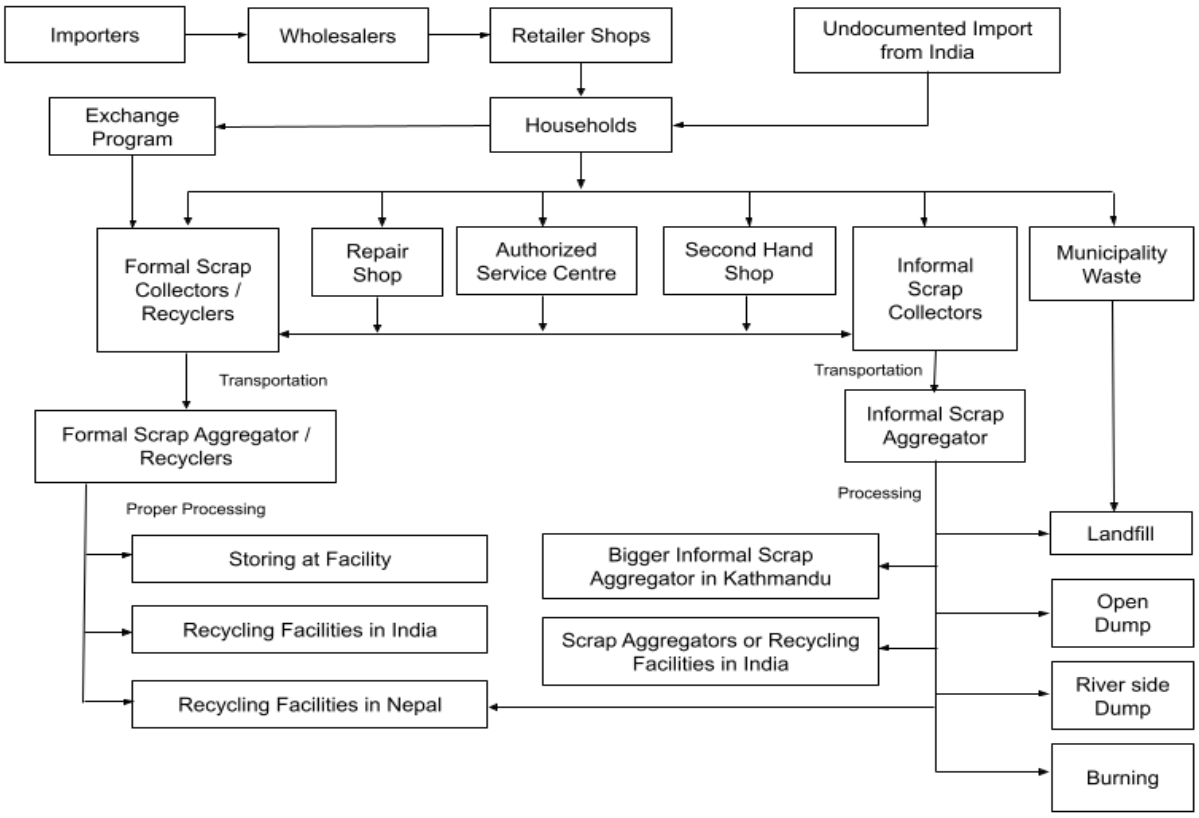

Figure 40 Kathmandu Metropolitan City End of Life and Material Flow Chart

When electronic devices require minor repair, households prefer to take them to authorized showrooms under warranty or to a repair shop. If the device is not repairable, households usually keep it at home until they find a storing option or until they get a good value from informal scrap collectors who come to their houses and buy them. However, small quantities of e-waste generated by households are managed through municipal waste and end up in landfills.

In summary, in Kathmandu Metropolitan City, households, corporate offices, government offices, businesses, hospitals/health posts, and institutions are the primary end consumers for electronic devices. The generation of e-waste is more significant due to high purchasing power, and households use various methods to dispose of their e-waste. Informal scrap collectors collect most e-waste, which is then sold to scrap aggregators and separated based on types. After dismantling and separation, valuable items are sent to bigger aggregates or recycling facilities in Nepal or India, while non-valuable parts are either sent to landfill sites or openly dumped or burned. Repair shops also collect e-waste and store it at the shop, selling the non-valuable scrap components and other non-valuable e-waste to scrap dealers or throwing them away at landfills through municipal waste.

10. Case Study of a Formal E-waste Management Company

10.1. Introduction

Kathmandu-based Doko Recyclers is a formal organization that prioritizes handling recyclable waste, including e-waste, in a responsible and sustainable manner since 2017 AD. For the efficient end-of-life management of various electrical and electronic devices, they have developed a methodology in collaboration with Myclimate, Netherland and validated by EMPA, a Swiss agency responsible for setting standards.. Doko Recyclers has created a thorough and effective e-waste management system that includes everything from collection to dismantling and component extraction, based on information gathered from their workers and their Standard Operating Procedures (SOP) manual. The diagram in figure 42 shows a flowchart illustration of their procedure and stages and can be divided into the following steps for the management of e-waste:

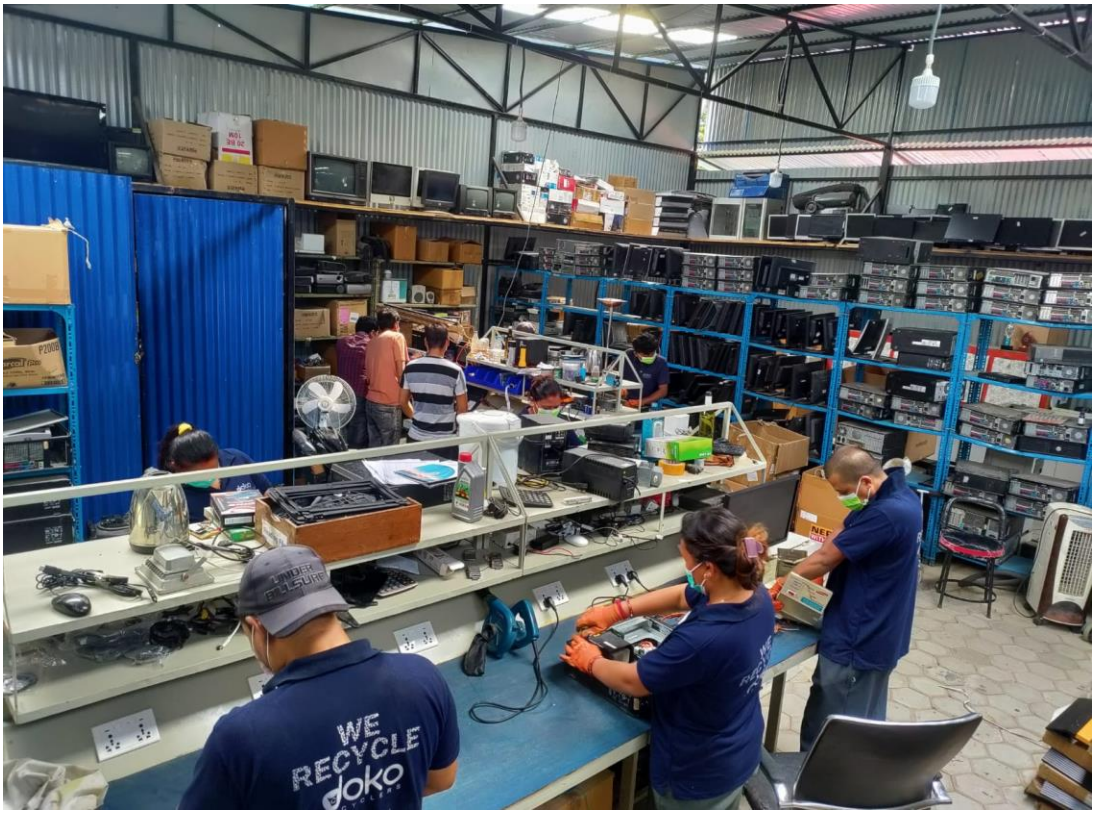

Figure 41 Doko E-waste repair and dismantling section

10.2. Method of formal handling

Doko recycler has developed a scientific methodology to manage e-waste in efficient manner with available limited infrastructure and technology. Doko works in entire value chain of e-waste management from collection till end disposal focusing on resource recovery and safe environment practice.

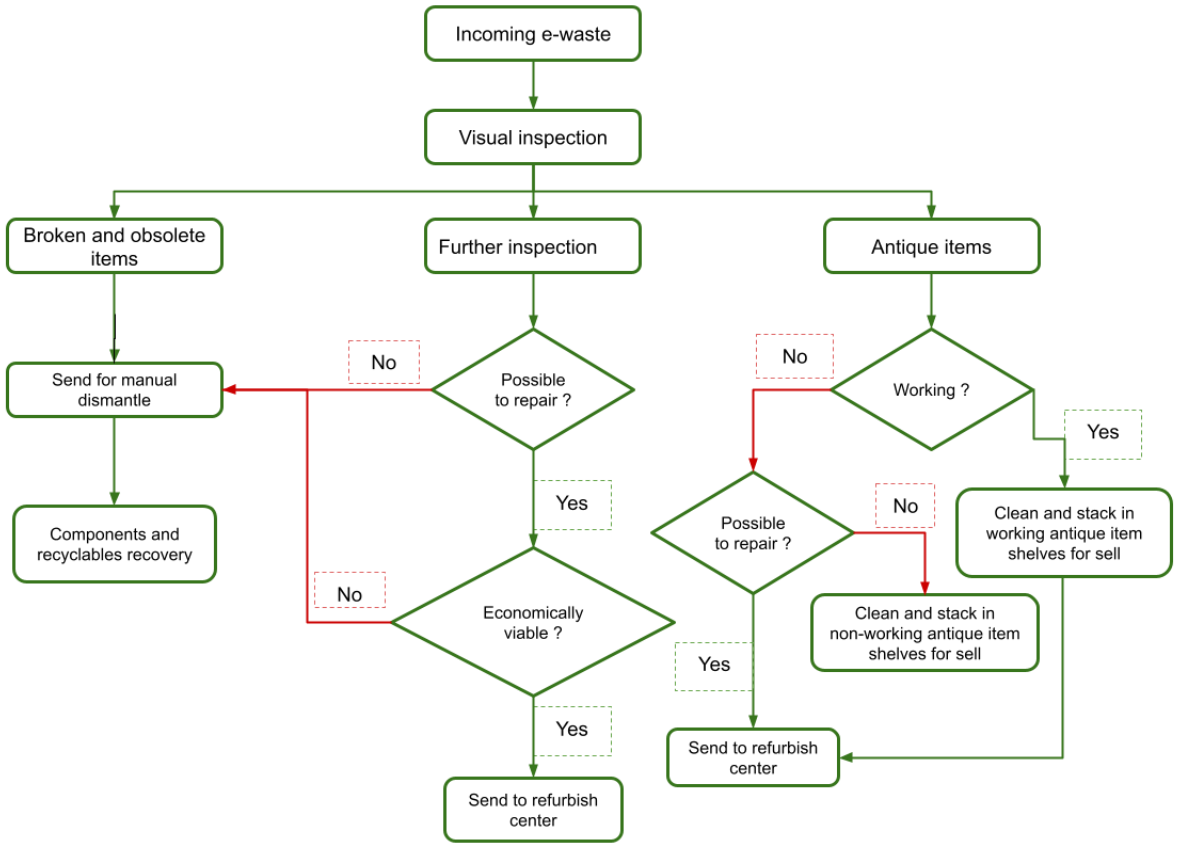

Figure 42 Material flow and handling process of E-waste in Doko Recyclers

10.2.1 E-waste Collection

E-waste collection is an essential first step in managing electronic refuse efficiently. Electronic waste is gathered by Doko Recyclers using a variety of collection methods from different sources, including homes, businesses, nonprofit organizations, banking and educational institutions. Contacting Doko Recyclers to request a planned scheduled pickup is a straightforward way to collect e-waste from household customers. Corporate customers can request a bulk pickup service from Doko Recyclers for electrical and electronic products that are only partly functional. The Doko Recyclers also receives electrical and electronic items from wholesalers and/or importers of household appliances in Nepal. Doko Recyclers partners in continuing initiatives like exchange programs with collaborators like Chaudhary Group (CG), HIM Electronics, and Big Digital to promote the recycling of e-waste.

Additionally, individuals can deliver their electronic trash right to the Doko Recyclers location. The organization is committed to ensuring that electrical debris is disposed of in a manner that is environmentally friendly. The organization is committed to making sure that electronic waste is disposed of in a manner that is secure for the earth and advantageous to the community. The organization keeps accurate records of all inbound e-waste through manual input in an Excel file and an online dashboard.

10.2.2 Screening Process

A vital part of managing e-waste is the screening procedure. After being collected, the e-waste is screened at Doko Recyclers to ascertain its state. This screening process includes looking for physical damage, checking whether it is powered on, and looking for any missing or broken components. Doko Recyclers sorts the electronic devices into different groups based on the results of the screening, essentially including working condition items, partly working condition items, vintage items, and dismantling items. When devices are determined to be in working order, Doko Recyclers refurbishes them inside the facility and makes possible repairs that may be necessary before selling them directly to customers, secondhand sellers, and other potential bulk buyers. Dismantling is the process of separating non-repairable things into various groups, such as copper, plastics, PCBs, wires, and glass, using either human or automated methods. These products are distributed to recycling centers or a larger aggregator, who then sends them to centers for recycling. The antique things are maintained on-site for display so that future generations can see and learn about the antiquated technology. The large quantities of waste electrical and electronic equipment that Doko Recyclers receive fall into the dismantling category and are sent right away for deconstruction, which is then sent back to the recycling channels.

10.2.3 Refurbish and Dismantle

Maximum resource recovery and adding life to the devices is core concept in Doko Recyclers. It has created a strong team and process flow for repair and refurbishment. Electric and electronic devices which are feasible to repair commercially (whose repair cost justify the selling price) are taken in priority and send to repairing division. The repaired goods are thoroughly checked for quality inspection before keeping it on sale. IT equipments (Laptop, desktop, printers), large household items (TV, Refrigerators, and Washing machine), small items (water heater, room heater etc) are few items which are being repaired and sold back in market.

If the equipment is not possible to repair commercially, they are sent to dismantle division where components (Capacitor, coils, motors switches, sensors etc) are recovered and recyclables(metals, coppers, plastics etc) are sent for recycling.

10.2.4 Categorization and Selling

Based on categorization according to flowchart, the items are placed in different sections allotted in Doko E-waste MRF (e.g. vintage section, refurbished or ready to sell, components sections etc). Before being sold, reconditioned electronics are put through a rigorous quality inspection by specialists to make sure they are in good shape. Electronic devices that can be refurbished receive quick fixes and go through another round of quality inspections before being sold. .Parts from obsolete electrical trash, such as washing machine boards, pipes, gaskets, and glass bowls, are kept segregated so they can be used as parts for other comparable repairable items. Similar to this, laptop and desktop parts like screens, boards, keyboards, SSDs, and HDDs are typically offered as parts of recently refurbished goods made at the Doko Recyclers facility. The recyclables resources recovered are segregated into different grades of metals like copper, brass, iron, and aluminum, plastics and PCB components, then sold to different recycling facilities.

10.3. In-flow volume of e-waste in Doko

Table 27 presents data on the volume of e-waste collected at Doko Recyclers from 2017 to 2022. The volume (in kg) of e-waste collected is represented in six categories, namely batteries, household appliances, IT equipment, large household appliances, miscellaneous items, and printed circuit boards (PCBs). The data shows an increase in e-waste collection over the years, with the total volume of e-waste collected in 2022 reaching 58,357 kg, a significant increase from the 1,427 kg collected in 2017. The highest volume of e-waste collected was in 2021, with a total of 91,022 kg except the volume of batteries which was at lowest level. The data reveals significant increase in collection of all of the e-wastes in 2021 except for the batteries which is heavily influenced by their prevailing scrap market prices in India. In contrast to the informal sector, which often sends batteries across borders for higher prices, Doko Recyclers choose to sell batteries to the industries in Nepal, which typically offer lower prices than India. As a result, it leads to receiving fewer batteries when prices in India rise. The two largest contributors to e-waste were household appliances and large household appliances, accounting for 32,598 and 36,578 kg, respectively. The data reveals a notable rise in the volume of IT equipment

and PCBs collected in 2021, with 16,407 and 431 kg, respectively. This increase in the collection of IT equipment and PCBs suggests a growing trend in the generation of electronic waste, indicating a need for more sustainable e-waste management practices.

Table 27 Volume of E-waste collected at Doko Recyclers

Year	2017	2018	2019	2020	2021	2022
Batteries		606	9,779	2,272	4,621	12,103
HH Appliances	546	3,768	4,536	15,200	32,598	16,095
IT	261	754	2,250	1,356	16,407	5,902
Large HH	620	650	31,068	9,173	36,578	24,117
Misc	-	-	1,245	2	387	57
PCB	-	37	788	29	431	83
Grand Total	1,427	5,815	49,666	28,032	91,022	58,357

(The figures are in kg)

The trend of e-waste collection in Doko Recyclers reveals that household appliances, both large and small, account for a significant proportion of the total volume of e-waste collected as shown in table 27 and figure 43. This suggests that households are major contributors to the generation of electronic waste, and there is a need for increased awareness and education about sustainable e-waste management practices. Despite the high volume of e-waste collected, Doko Recyclers has been able to manage 234 tons of electronic waste to date. The company's priority is to refurbish and add life to end-of-life electronics, contributing to sustainable e-waste management practices. This approach helps to reduce the volume of electronic waste sent to landfills and minimizes the negative impact on the environment and public health. Doko Recyclers has developed separate infrastructure focusing on the refurbishment of all commercially possible electric and electronic items, providing a second life to products that would otherwise be disposed of. This helps to reduce the demand for new products and conserves natural resources while contributing to a circular economy.

Over the past five years, Doko Recyclers has been able to refurbish and sell a range of electronic items back into the market. This approach not only contributes to sustainable e-waste management practices but also helps to provide affordable electronic items to consumers who may not be able to purchase new products. Doko Recyclers' approach to e-waste management through refurbishment and resale of end-of-life electronics contributes to sustainable e-waste management practices. This approach helps to reduce the negative impact of e-waste on the environment and public health while promoting a

circular economy. The company's commitment to sustainable e-waste management practices highlights the importance of collective action to promote sustainable e-waste practices.

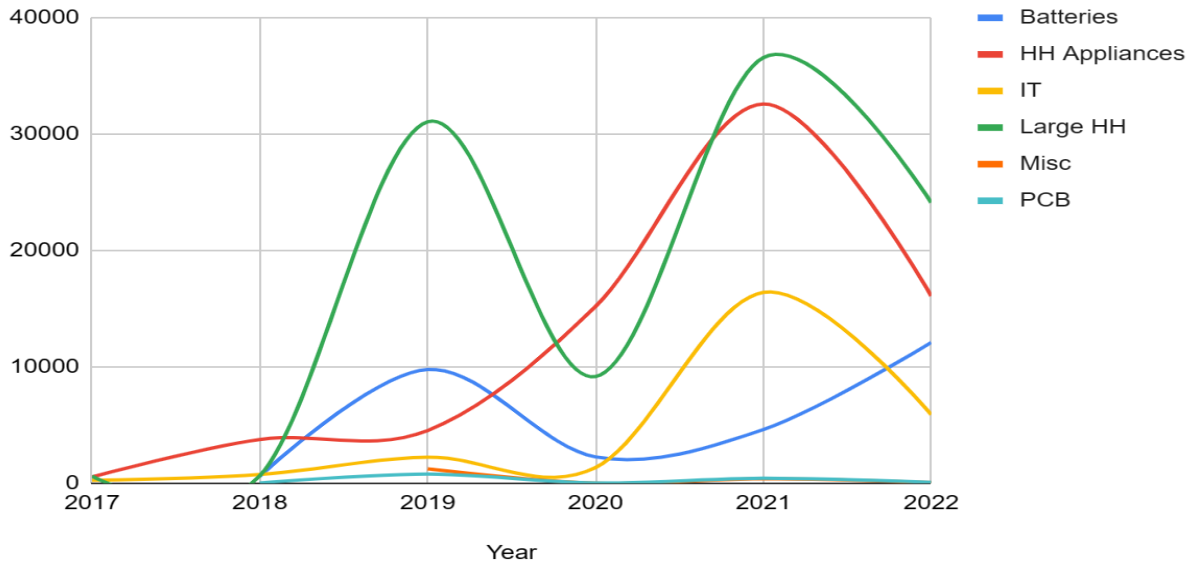

Figure 43 Volume of E-waste collected at Doko Recyclers (in Kgs)

The case study of Doko Recyclers highlights the effectiveness of their e-waste management system, ensuring proper screening, processing, and disposal of collected electronic waste in an environmentally responsible manner. This approach reduces the negative impact of e-waste on the environment, while also extracting and selling valuable components. Doko Recyclers' approach is not only commendable for its environmental friendliness and responsibility but also its economic sustainability. Their multi-faceted approach includes collecting, screening, refurbishing, dismantling, component recovery, recycling, and disposal of e-waste.

Doko Recyclers' commitment to sustainability and responsible e-waste disposal is exemplary and can inspire other organizations to adopt similar measures in managing e-waste. The company's convenience for individuals and organizations to dispose of their electronic waste responsibly makes it easier for people to make a difference in protecting the environment. Overall, Doko Recyclers set a positive example in e-waste management, demonstrating that it is possible to reduce the impact of electronic waste while making a profit through the recovery and sale of valuable components.

10.4. Out-flow volume of recyclables from Doko

Doko Recyclers maintain certain level of data for material outflow as a whole output. The output are mainly divided into broadly 6 categories, Refurbished, Component, Recyclables, Batteries (Lead Acid), Vintage and Misc.

Refurbished: Old devices especially IT equipments (Laptop, Desktop, Monitors etc), Large Household appliances (freeze, Washing machines). Small household appliances (water heater, Room heater, mixer grinder) after repairing are sold as refurbished products

Component: After dismantle, components which has potential of selling as spare parts are kept aside and sold as components like motors, switches, relay etc

Recyclables: All the items recovered after dismantling and possible to recycles are sold as recyclables like metal, copper, aluminum etc

Batteries: Lead acid batteries are recorded separately as it doesn't have to go under any dismantling process

Vintage: Few antique pieces like old cassette players, which are 3-4 decade old items are sold as vintage products irrespective of its working or non working

Misc: Items which doesn't fall under above category are sold under misc heading like wires, Ethernet cables, etc

The tentative data for all these categories for last two year 2021 and 2022 are presented below.

Table 28 Annual output from Doko Recyclers

Items	2021	2022
Refurbished	409 Pcs	729 Pcs
Components	7,135 Pcs	9,845 Pcs
Recyclables	63,829 Kgs	34,964 Kgs
Batteries	4,228 Kgs	10,874 Kgs
Vintage	78 Pcs	92 Pcs
Misc	910 (Pcs)	1,183 (Pcs)

The breakdowns of items obtained after dismantling of major household appliances are mentioned in **Annex 7.**

11. Key Stakeholders Mapping

Based on the surveyed data and the information from KII and FGD, various stakeholders are identified, as shown in Annex 2, who is involved in the management of e-waste in the surveyed area. Based on that information, the stakeholders map is created and are separated into categories that have direct or indirect impact in the management of e-waste. The table present at Annex 2 is a comprehensive list of external stakeholders involved in the e-waste management system in the surveyed area. The actor's column in the table refers to the specific organizations or groups that represent each stakeholder type. For example, the actors for the retail shops stakeholder type are the various retail shops that are involved in selling electronic products to end consumers. The actions column in the table outlines the specific activities or roles that each stakeholder type plays in the e-waste management system. For example, the formal and informal scrap collectors and aggregators are responsible for collecting and aggregating e-waste from various sources such as households, manufacturers, and retailers. The results column in the table describes the outcomes of the actions taken by each stakeholder type. For instance, the recycling factories and facilities stakeholder type is responsible for processing and recycling e-waste into new products, thereby reducing the amount of e-waste that ends up in landfills.

The function, location, size/capacity, ownership or accountability, and materials flow volume columns in the table provide additional information about each stakeholder type, including their specific function in the e-waste management system, their location, the size or capacity of their operations, their ownership or accountability structure, and the volume of materials they handle. Based on those criteria the stakeholders are separated into three types i.e., Primary Stakeholders, Secondary Stakeholders and External Stakeholders. Overall, the table highlights the diverse range of stakeholders involved in the e-waste management system in the surveyed area and their various roles and responsibilities. It also highlights the need for effective collaboration and coordination among these stakeholders to ensure the proper management and disposal of e-waste in the surveyed area. A conceptual mapping of key stakeholders is shown in figure 44.

The stakeholders are mainly divided into three categories, i.e., Primary stakeholders, Secondary stakeholders, and External stakeholders as shown in figure 44. This categorization helps to identify the roles and responsibilities of each stakeholder group in managing e-waste, thus facilitating effective

collaboration among stakeholders towards a sustainable e-waste management system. The primary stakeholders consist of entities that have a direct impact on the generation, collection, and disposal of e-waste. These stakeholders include repair shops; refurbish shops, reselling shops, households, end consumers, formal scrap collectors, formal scrap aggregators, informal scrap collectors, and informal scrap aggregators. These stakeholders play a crucial role in the management of e-waste by either repairing and reselling old electronic items or collecting and recycling e-waste. For example, repair shops, refurbish shops, and reselling shops can reduce the need for new product purchases by repairing and reselling old electronic items. Similarly, formal scrap collectors and aggregators can ensure safe and responsible collection and transportation of e-waste items for recycling and management. Their actions result in reducing the need for new product purchases, extending the life of old electronic items, and reducing environmental pollution and health hazards associated with e-waste.

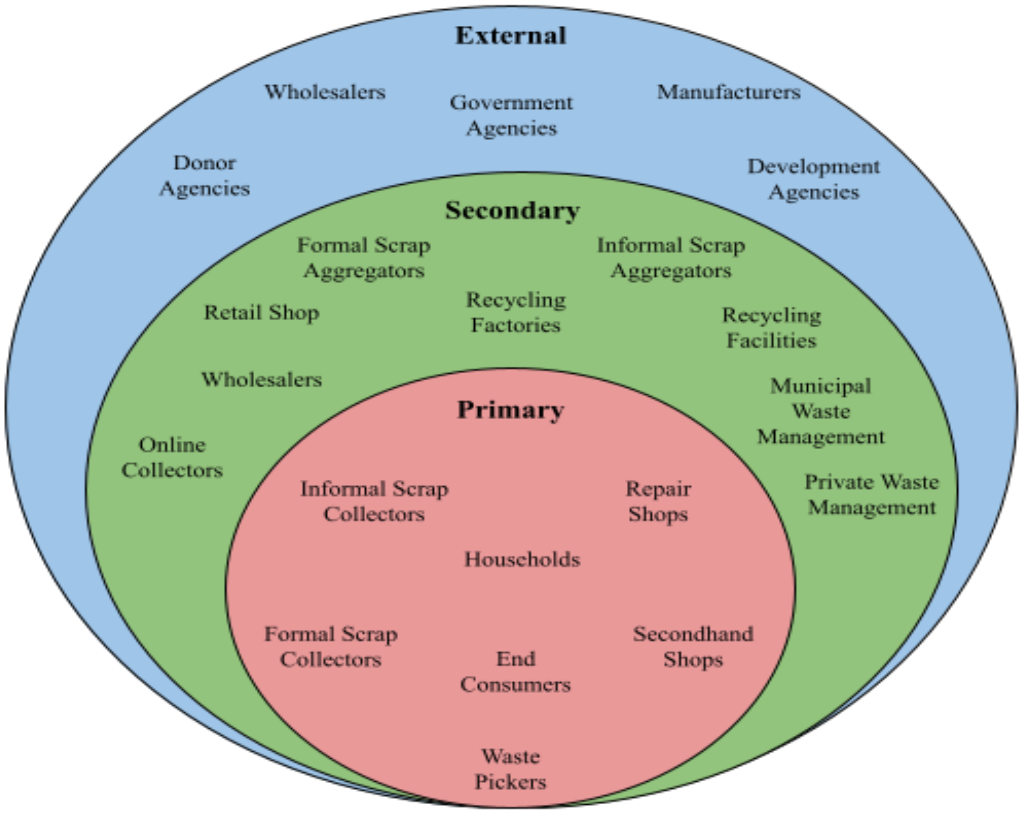

Figure 44 Key Stakeholders involved in the management of E-waste in Surveyed Area

The secondary stakeholders are those that are indirectly involved in the e-waste management process but still play a significant role. These stakeholders include online collectors, recycling factories, recycling facilities, and waste pickers. These stakeholders may not be directly responsible for the collection or disposal of e-waste, but they have a crucial role to play in the management of e-waste, as

they help in the processing and recycling of e-waste products. For example, online collectors are entities that collect e-waste products through online channels. They provide a convenient way for consumers to dispose of their e-waste, which in turn reduces the amount of e-waste that ends up in landfills or is improperly disposed of. The external stakeholders consist of entities that have a regulatory or monitoring role in the management of e-waste. These stakeholders include manufacturers, importers, wholesalers, retail shops, the government of Nepal, donor agencies, development agencies (NGO's / INGO's), municipal waste management, and private waste management. These stakeholders have an indirect interest in e-waste management as they are responsible for promoting responsible production, distribution, and disposal of e-waste products, developing policies and regulations for e-waste management, providing financial and technical support for e-waste management initiatives, and ensuring the safe and responsible collection and disposal of e-waste.

12. E-waste Management Process

The survey conducted in the area did not reveal any official or standardized number of stages for e-waste management. There is no any specific information and awareness about e-waste to local residents, scrap collectors and aggregators. Scrap collectors and aggregators consider e-waste also as normal scrap and handle it for valuable extraction only. Based on the information gathered from the survey, as well as from KII and FGD, the e-waste management process can be broken down into mainly five stages as described below. Figure 45 represents these stages, with arrows indicating the volume flow of the e-waste or its components. The size of the arrow represents the relative volume flow, with larger arrows indicating a greater volume flow and smaller arrows indicating a smaller volume flow.

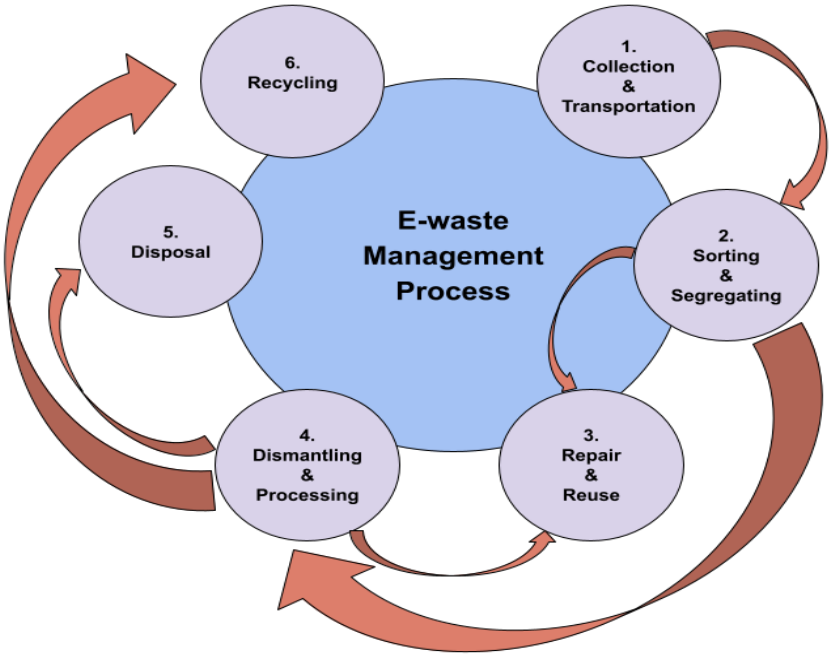

Figure 45 E-waste Management process

12.1. Collection and Transportation

The first stage involves the collection of e-waste from various sources such as households, institutions, and businesses. Informal sector collectors and scrap dealers are often involved in this stage, and they mainly use bicycles or small vehicles to collect and/or transport their collected scrap with recyclable items. E-waste collection can be done through different means such as door-to-door collection, collection from transfer stations, and collection from public dump. This collected e-waste is then transported to a local warehouse or collection point for further processing. The transportation of e-waste is a crucial step in the process, and it is done without any care or safety which increases the risk of breakage or damage to the equipment. In many cases, people may discard their old electronic devices by throwing them in the trash or leaving them on open space, and the informal sector may collect these items for extracting valuable resources e.g., copper, circuit boards, metals etc and leave behind the non-recyclable and low value items e.g., glass, ceramics, plastics, foams etc. This process is also known as “Cherry Picking”.

12.1.1 Door-to-door collection

Door-to-door collection is a common method for e-waste collection in the informal sectors in the surveyed area. Informal scrap collectors usually collect e-waste and other recyclable items using

bicycles, while sometimes they use small vehicles to collect the e-waste and other recyclable items from households and offices. The collected e-waste is then transported to their sorting or storage facilities, where they separate it from other recyclable materials. The separated e-waste is then sold to bigger scrap aggregators or recycling facilities.

12.1.2 Collection from Transfer Stations

Collection from transfer stations is another method used by informal scrap collectors to collect e-waste. In some areas where municipal waste is collected at transfer stations and sorted before being transported to a landfill, informal scrap collectors sometimes collect e-waste along with other recyclable items. They transport the collected e-waste to their facilities, where it is sorted and separated from other recyclable materials. The separated e-waste is then sold to bigger scrap aggregators. This method is convenient for informal scrap collectors as they can collect some amount of e-waste from a single location.

12.1.3 Collection from Dumping or Landfill Sites

Collection from dumping or landfill is another method used by informal scrap collectors in some surveyed areas. In the surveyed areas, people dispose of their waste in public places or at landfill, and informal scrap collectors walk around these areas to collect e-waste and other recyclable items. The collected waste is then separated and sold to larger scrap aggregators at that same or nearby location. This method is not only unhygienic but also poses health hazards for scrap collectors as they have to sift through waste to find e-waste and recyclable items.

12.1.4 Repair & Second-Hand shops

Repair, refurbish, and second-hand shops are significant sources of e-waste for the informal sectors in the surveyed area. These shops often receive old or broken electronic devices from customers who no longer find them worth repairing or are looking to upgrade to new ones. As a result, these shops accumulate a significant amount of e-waste over time, which can be sold or disposed of to informal scrap collectors or formal recyclers. This collection of e-waste from repair and refurbish shops is a common practice among the informal sector.

12.1.5 Auctions

Similarly, auctions organized by various governmental and non-governmental organizations are another source of e-waste for both the informal and formal sectors. These auctions typically involve the sale of old or outdated electronic devices, which are no longer needed by the organization. The informal and formal sector participates in these auctions to acquire e-waste, which can be sold or disposed of for recycling purposes. The collection of e-waste from auctions is also a common practice among the informal sector, which operates in a decentralized and unregulated manner.

In rural areas, the collection of e-waste is less organized, and the informal scrap dealers mostly collect e-waste using door-to-door collection methods by their hired scrap collectors or from designated collection sites or through other scrap aggregators. They mainly use a bicycle to collect e-waste, or sometimes use small trucks to collect the e-waste and recyclable items. In urban area, the formal sector collects the e-waste in a more organized manner using scheduled door-to-door collection methods or from designated collection sites. They mainly use small vehicles or trucks to collect the e-waste with recyclable items and safely transport it to their warehouse. But still in the urban areas, the informal sector uses the same unorganized method to collect e-waste.

In the surveyed area, both informal and formal sectors offered incentives such as cash or discounts on new electronic devices to encourage people to give their e-waste. This e-waste can contain a variety of components, such as metals, plastics, glass, and printed circuit boards. Both, informal and formal sectors, workers in Nepal typically dismantle these devices to extract valuable and reusable components, such as copper wires, aluminum, brass and plastic components. The items collected by both informal and formal sectors in the surveyed area can vary depending on the type of e-waste available. However, some of the common items collected by informal and formal sector workers include:

1. Mobile phones
2. Computers
3. Laptops
4. Printers
5. Televisions
6. Refrigerators
7. Air conditioners

8. Washing machines
9. Radios
10. DVD players
11. Wires
12. Boiler / Kettle

With information obtained from KII and FGD, scrap collectors only collect items with value. Following are the e-wastes that are not collected by informal scrap collectors and aggregators and they throw the non-recyclable items as well. Following are some of the items that are not collected by informal scrap collectors.

1. Glass items
2. Mercury lamps
3. Optical fibers
4. Glass and plastic from CRT Television
5. Decoration lights with thin wires
6. Small mobile accessories like ear phones, charger cables etc.

Overall, the informal sector in Nepal collects e-waste from a variety of sources, and lack of proper regulations and infrastructure often leads to the unsafe handling and disposal of e-waste. It is important to note that while these collection methods may help to divert e-waste from landfills and promote recycling, the methods used by informal scrap collectors may not be sustainable or environmentally friendly. Therefore, there is a need for proper regulations and infrastructure to promote safe and sustainable e-waste management practices in the surveyed area, including formal collection methods and the establishment of recycling and processing facilities.

12.2. Storage of e-waste

The informal or formal sector workers in the surveyed area often store e-waste in their warehouse or temporary storage facilities within the residential area. The e-waste may be stored in open spaces or covered with tarpaulins or with temporary structures, which can lead to soil and water contamination. The workers may also store e-waste in small shops or rented spaces. Similarly, the informal sector workers in the surveyed area who collect and dismantle e-waste typically store the extracted items in their shops or warehouses before selling them to other bigger informal scrap aggregators or formal recycling facilities or manufacturers. The storage methods used by these workers can vary depending

on the type and quantity of e-waste collected. Some workers may store the extracted items in open piles or bags, while others may use more organized storage methods such as racks or shelves. The storage areas are often located in open or poorly ventilated spaces, which can lead to environmental contamination and health hazards.

Figure 46 E-waste storage in outside area

The extracted items are typically categorized and stored separately based on their type and value. For example, copper wires may be separated from circuit boards or plastic components. The workers may also store functional components such as batteries and screens separately from non-functional parts. The storage of e-waste extracted items by the informal sector workers in the surveyed area is often unregulated and lacks proper safety measures. This can lead to environmental contamination and health hazards for workers and nearby communities.

12.3. Sorting and Segregation

Once the e-waste has been collected, it is sorted and segregated into various categories based on the type of material and the components present. This stage is important for effective recycling and recovery of valuable materials. For example, computers, laptops, and mobile phones can be separated into different categories for proper recycling. However, the sorting and segregation process is often fundamental and not optimized for maximum resource recovery.

12.4. Repair & Reuse

In some cases, e-waste may still be functional or can be repaired for further use. The repair and reuse is the next stage which is highly practiced in Nepal in the context of the household and formal sector. But for the informal sector, it is not widely practiced as they receive the broken items which are beyond repair. This stage involves repairing and refurbishing the equipment for reuse or sale by formal sectors. Reusing e-waste can be a sustainable option, as it can reduce the amount of new equipment that needs to be manufactured, thereby conserving resources and reducing the environmental impact of e-waste.

12.5. Dismantling and Processing

After collecting e-waste, the informal and formal (aggregator) sector workers in the surveyed area typically dismantle the electronic devices to extract valuable components such as copper, aluminum, plastic components, and brass. They use various methods to disassemble the devices, depending on their resources. The methods used depend on the type of e-waste and the resources and equipment available to the workers. Here are some common extraction methods.

12.5.1 Mechanical extraction

This method involves dismantling the e-waste using mechanical methods that include using machines to grind, cut, crush or stripping. The workers may use these machines tools to disassemble the device and separate the different components.

Figure 47 Cable granulator machine used for copper and aluminum extraction

12.5.2 Manual extraction

This method involves manually separating different components of e-waste basic hand tools such as hammers, chisels, screwdrivers, and pliers. The workers may use knives, scissors, or other tools to cut and separate different parts. For example, they may separate plastic components from metal components.

Figure 48 Manual Dismantle

12.5.3 Burning

Some informal sector workers in surveyed areas use crude methods such as open burning to extract valuable components from electronic devices. Burning is a common method used to extract copper from wires where workers may burn the wires to remove the plastic insulation, leaving behind the copper wire. There are various items that are extracted from e-waste by informal and formal sectors in the surveyed area. Some of the most common recyclable and non-recyclable items that are extracted using specific method are summarized in the following table 29.

Figure 49 Cable burning by informal sector

Table 29 Valuable Components Extraction Methods from E-waste

S.N.	Items	Type	Extraction Method
1	Copper Wires	Recyclable Items	Manual
2	Aluminum	Recyclable Items	Manual
3	Plastic components	Non-recyclable Items	Dumping
4	Glass	Non-recyclable Items	Dumping
5	Iron/ Steel	Recyclable Items	Manual
6	Printed circuit boards (PCBs)	Recyclable Items	Manual (Sent to India)
7	Batteries (Lead acid)	Recyclable Items	Manual
8	Mercury-containing components	Non-Recyclable Items	Dumping
9	Fluorescent tubes	Non-Recyclable Items	Dumping
10	Refrigerant gasses		Release to environment

The workers may also resell functional parts such as batteries, chargers, and screens. These parts are typically sold to repair shops, refurbish shops, or retailers. The remaining parts that cannot be reused or recycled are often disposed of in landfills, river dump, or open dumping. These disposal methods can lead to environmental contamination and health hazards for workers and nearby communities. Open burning of e-waste releases toxic substances such as dioxins and furans, which can cause respiratory problems, cancer, and other health hazards.

12.6. Recycling

Informal sector workers in Nepal also use recycling as a method of managing valuable items collected from e-waste. The workers extract valuable materials such as metals and plastic components, and sell them to recyclers or manufacturers. However, the recycling methods used by the informal sector may not be sustainable or environmentally friendly, and workers may not have access to proper safety equipment. In addition, the recycling process can produce harmful waste products, such as acid sludge, which can cause environmental pollution and health hazards if not managed properly.

12.7. Trans boundary Exporting

Informal sector workers in Nepal may export e-waste to India, where it can be processed or disposed of. However, this can lead to illegal dumping and environmental pollution in the receiving countries. The workers may also be exposed to health hazards during the transportation and handling of e-waste. Circuit boards, li-ion batteries, Lead acid batteries, and other valuable items are transported to India via open porous borders. Though Nepal and India both are signatory country of BASEL convention which restricts transboundary movement of e-waste, but due to open boarder, it is a challenge to restrict these kinds of movement.

12.8. Disposal of Non-Recyclable Materials

The disposal of e-waste is a significant challenge in Nepal, where there is a lack of proper infrastructure and regulations for e-waste management. The informal sector workers play a significant role in e-waste management, but their practices are often unregulated and can lead to environmental and health hazards. It is important to note that some of these extraction methods, such as burning, can be hazardous and can cause environmental pollution and health risks. Therefore, there is a need for proper regulations and infrastructure to promote safe and sustainable e-waste management practices.

Informal sector workers in Nepal use a variety of methods for the management and disposal of e-waste, some of which are not sustainable and can lead to environmental pollution and health hazards. After extracting the valuable components, the remaining e-waste is often disposed of in open dumping sites or landfills. In some cases, the components e-waste may also be exported to India, where it is further processed. Here are some common methods used by informal sector workers.

12.8.1 Landfill

Landfill is a method of disposing of e-waste in which the waste is buried in open dumps or landfills. In Nepal, informal sector workers may collect e-waste and dispose of it in open dumps or landfills, which can cause environmental contamination and health hazards. The toxic substances present in e-waste can leach into the soil and water, polluting the environment and affecting human health. Land filling also leads to the wastage of valuable resources that could be recycled or reused.

12.8.2 Open burning

Open burning of e-waste is a common method used by informal sector workers in Nepal to extract valuable metals such as copper from wire or to dispose of the waste. However, this method can release toxic fumes and chemicals into the air, causing health hazards for workers and nearby communities. The smoke from open burning can contain harmful chemicals such as dioxins and furans, which are known to cause cancer and other health problems.

13. Discussion

The data presented in the survey on the use of E-cooking devices provides useful insights into the current trends and patterns of household energy use in four different cities in Nepal. In this discussion section, we will analyze and interpret the data presented in the survey, highlight key findings, and draw conclusions based on these findings.

13.1. Present Cooking Mediums

The data shows that in the surveyed localities, all households have more than one cooking medium. Most households in rural area still use traditional cooking methods, such as solid fuel (firewood, agriculture residue, cow dung cake) for major cooking need (lunch, dinner, fodder for animals etc) while use other cooking medium like LPG, electricity for lighter meal (tea, breakfast, snacks etc). Residents of urban areas use LPG as the dominant medium for cooking followed by e-cooking

devices. Use of LPG stoves and induction cooktop is gradually increasing, especially in urban areas. This suggests that there is a growing awareness of the benefits of cleaner and more efficient cooking technologies. However, there are still some challenges to be addressed in terms of affordability and accessibility of these technologies for households in rural areas.

The cooking medium also changes based on geographical and demographic distribution. Shifting of the cooking system from firewood towards LPG and now slowly towards electric system shows the changing behavior due to increase in income source, ease of availability of fuel (it is getting harder to get firewood these days), government incentive programs to promote use of electric cooking stoves etc. Even in rural areas, it was found that cooking in LPG is easier in comparison to firewood but at same time there was hesitation in buying new medium i.e. electric cooking devices. If they can get it for free, they are happy to use an e-cooking device.

The data indicates that the use of e-cooking devices, such as electric rice cookers and induction cooktop, is still relatively low in rural areas of terai among the studied municipalities. The higher percentage of induction stove in Mahankal is due to free distribution. With discussion with civil society in rural areas, people are interested to use Induction stove and other e-cooking devices but are reluctant to invest money in purchasing. If there is any donation program, they are happy to use it. In urban areas, residents are slowly adding e-cooking devices in stream along with LPG and ready to make investment in e-cooking devices. However, there is a growing interest in these devices, especially among households in urban and peri-urban areas. This suggests that there is a potential market for these devices, provided that they are affordable and accessible to households in these areas. Additionally, the data shows that refrigerators and televisions are the most commonly owned home appliances in the studied municipalities.

13.2. Challenges and Barriers to adaptation

The adaptation of induction cooktop in Nepal faces several challenges and barriers that need to be addressed. Some of the several challenges and barriers to the adaptation of induction cooktop in Nepal are as follow.

13.2.1 Lack of awareness and understanding

One of the primary challenges is the lack of awareness and information about the energy-saving benefits and cost-effectiveness of induction cooktops. Many Nepalese consumers are not aware of the

advantages of using induction cooktop and believe that there is no significant difference in cooking time and cost compared to LPG gas stoves.

13.2.2 High cost

High costs associated with purchasing an induction cooktop can also be a significant barrier, particularly for those on a tight budget. Furthermore, some Nepali consumers may be resistant to change and hesitant to adopt new technology, especially if they are used to cooking with traditional gas stoves.

13.2.3 Availability of suitable cookware

Another significant barrier is the availability of suitable cookware, as induction cooktop require flat base utensils made of ferromagnetic materials such as cast iron or stainless steel. This requirement can add to the overall cost of switching to induction cooktop, especially for households that do not have such utensils.

13.2.4 Power outages

Power outages and electricity shortages are common in Nepal, and this can affect the cooking process, making it difficult to rely solely on induction cooktop. Moreover, traditional cooking methods in Nepali cuisine, which often involve cooking over an open flame or wood fire, can be difficult to replicate on an induction cooktop. This may lead to reluctance among some consumers to switch to the new technology, especially if they prioritize taste over efficiency.

13.2.5 Traditional cooking methods

Nepali cuisine often involves cooking food over an open flame or wood fire, which can be difficult to replicate on an induction cooktop. This can lead to reluctance to switch to the new technology, especially for those who prioritize taste over efficiency.

13.2.6 Resistance to change

Some Nepali consumers may be resistant to adapting to new technology, especially if they are used to cooking with traditional gas stoves. This can make it difficult to fully embrace induction cooktop, even if they are more energy-efficient and cost-effective.

13.2.7 Infrastructure challenges

The distribution system of electricity in Nepal may not be able to support the widespread use of induction cooktop, especially if all consumers were to use them at the same time. This can limit the practicality of the technology, especially in areas where the infrastructure is weaker.

Addressing these challenges and barriers will be essential in promoting the adoption of induction cooktop in Nepal. This can be done through awareness campaigns, providing subsidies or financing options to help with the cost, encouraging the development of suitable cookware, improving the power infrastructure, and addressing the challenges of adapting traditional cooking methods to the new technology. By doing so, more Nepali consumers can benefit from the advantages of induction cooktop and move towards a more sustainable and efficient mode of cooking.

13.3. Buying Behavior

The study found that the most important factor for households when purchasing cooking devices was durability (26.2%), followed by energy efficiency (22.6%) and cost (21.7%). When it comes to the choice of brand, the study found that households in KMC and JSMC were more likely to choose a brand based on its reputation, while households in ARM and MRM were more likely to choose a brand based on its price.

The study found that households in the studied municipalities prioritize durability, energy efficiency, and cost when purchasing cooking devices. The reputation of the brand was a more critical factor for households in KMC and JSMC, while households in ARM and MRM were more likely to consider the brand's price. Furthermore, the data suggests that households in the studied areas purchase their appliances from local retailers and wholesalers indicating the importance of building strong relationships with local retailers and wholesalers to promote the adoption of cleaner and more efficient technologies.

However, the cost remains a crucial factor that can affect the buying behavior of Nepalese consumers. Many households in Nepal are on a tight budget, and the perceived cost of induction cooktop may deter them from purchasing the technology. Therefore, manufacturers and retailers should consider offering affordable pricing options or promotional discounts to make the technology more accessible to a wider range of consumers.

The perceived benefits of induction cooktop, such as energy efficiency and cooking speed, are also essential factors that can influence the buying behavior of Nepalese consumers. To encourage adoption, manufacturers and retailers should focus on promoting the energy-saving benefits of induction cooktop and educate consumers on the long-term cost benefits of using the technology. Additionally, manufacturers and retailers should provide guidance on the types of cookware that can be used with induction cooktop and ensure that the necessary cookware is readily available.

13.4. Behavior on Warranties

The majority of households (89.3%) reported being satisfied with the warranties provided by cooking device brands. However, a significant proportion of households (9.6%) reported not knowing whether they were satisfied or not, and a small proportion (1.1%) reported being dissatisfied. The study also found that warranties were considered very important by the majority of households (60.8%), while a smaller proportion (36%) considered them important.

The data indicates that households in the studied municipalities place a high value on warranties when purchasing appliances. This suggests that warranties can play an important role in promoting the adoption of cleaner and more efficient technologies, as they provide households with a sense of security and protection against unexpected costs. Additionally, the data shows that most households are satisfied with the warranties provided by the brands they purchase, indicating a potential opportunity for brands to differentiate themselves by offering strong warranty programs.

13.5. Repair Behavior

The study revealed that the majority of households (88%) preferred to repair their electronic devices instead of buying new ones. Relatively Aurahi shows less inclined towards repair culture. The main reason behind this is lack of repair shops, costly to repair, and influx of remittance. Households in Aurahi find getting new small electronics is cheaper and better compared to repairing broken ones. Though they only tend to repair expensive items like Television, freeze etc. The most common reason for repairing cooking devices was to save money, while the most common reason for buying new ones was to upgrade to better technology.

IT was also found that repairing is not an easy task due to various reasons. Cost remains the most important factor to repair or not to repair. The decision also depends on the original buying cost of

appliances. People tend to repair expensive items a few times before discarding them completely. There is a big gap in the repair ecosystem of repairing which if can be addressed can increase the life of electric and electronic appliances, hence decreasing e-waste. The study highlights that the majority of Nepalese households prefer repairing their electronic devices instead of buying new ones, with 88% of respondents indicating a preference for repair. However, this repair behavior is not uniform across all municipalities, with households in Aurahi being less inclined towards repair culture due to a lack of repair shops and the high cost of repair. Nevertheless, households in Aurahi tend to repair expensive items like televisions and refrigerators. The most common reason for repairing electronic devices is to save money, while the most common reason for buying new ones is to upgrade to better technology.

The research study also found that repairing electronic devices is not an easy task and that cost remains the most important factor in deciding whether to repair or not. Nepalese consumers tend to repair expensive items a few times before discarding them completely, and there is a significant gap in the repair ecosystem that, if addressed, can increase the lifespan of electronic appliances and reduce e-waste. Furthermore, the repair behavior of Nepalese consumers can also impact the adoption of induction cooktop. Consumers' perceptions of the durability and reliability of the technology can affect their willingness to purchase and use it. The availability and cost of repair services can also impact the overall cost-effectiveness of using induction cooktop. Therefore, it is essential for manufacturers and retailers to provide consumers with information about the durability and repairability of induction cooktop to encourage repair behavior. They should also ensure that repair services are readily available and accessible, and that the cost of repairs is reasonable.

To encourage more widespread adoption of induction cooktop in Nepal, it is crucial to address the lack of awareness about the reparability of the technology. Manufacturers and retailers should work towards promoting the durability and reparability of induction cooktop and provide guidance on compatible cookware. They should also take steps to ensure that repair services are accessible and affordable, which can help consumers make informed decisions about investing in the technology and encourage them to seek out repairs rather than replacing the entire appliance.

13.6. End of Life management Perspective

There is a big gap in understanding about e-waste in all surveyed areas. Even educated people are unaware about hazards of improper disposal of e-waste. The study found that the first priority of

managing the end of life of electric and electronic devices is selling it to scrap collectors and getting value for it. Second option is to throw it along with the municipal waste collection system (in a city where the municipal waste collection system exists) or throw it in an open place, on the bank of a river, or burn it in open space. Overall, the study highlights the need for effective waste management strategies and greater awareness of the environmental impact of improper disposal of cooking devices.

The data reveals that households in the studied municipalities are generally not aware of proper end-of-life management practices for their appliances. This suggests that there is a need for more education and awareness campaigns to promote responsible disposal and recycling of appliances. Additionally, there is a potential opportunity for businesses and organizations to develop recycling programs that can help households properly dispose of their appliances at the end of their useful life.

Lack of a formal collection and recycling system and with a dominant informal scrap collection system is a big challenge in closing the loop for e-waste management. In the southern part of Nepal close to Indian territory and with an open border, most of the valuable e-waste finds its way to India while non-recyclable and less valuable items still get dumped in open space. E.g. if scrap collectors get CRT television (old model televisions), they break it and only take copper coil and circuit boards along with them and throw the rest 90% non-recyclable and hazardous fraction (glass and plastics) either far from residents in open space, or on the bank of small streams. They even burn the wires to extract copper out of it. There is little difference in the scenario for end disposal in urban areas (JMSC and KMC). Some people are aware about hazards of e-waste but in absence of formal organization to manage e-waste, residents are left with no option apart from scrap collectors or municipal waste collection systems.

Lack of policy addressing the issue of e-waste management, formal e-waste management companies, lack of infrastructure in the value chain of e-waste disposal are important factors to look at. There is little to no action plan from the government to address this growing issue of e-waste. Few private companies came forward to start working formally in this sector but only limited to Kathmandu and also with very basic infrastructure which doesn't address all hazardous fraction of e-waste.

13.7. Key Stakeholders

Nepal is no exception for E-waste management, and there is a need to identify stakeholders who can help manage E-waste effectively. In this section, we will discuss the stakeholders that are being identified through Key Informant interviews and Focus Group Discussions.

13.7.1 Suppliers

According to our research investigation and key informant interviews, importers, wholesalers, retailers, and second-hand marketplaces are among the providers of electrical and electronic products that have been found in Nepali markets. The varieties and quantities of electrical and electronic goods that reach the Nepali market are significantly influenced by importers. These electrical and electronic goods are sold and distributed to customers by wholesalers and retailers. Used electrical and electronic devices that may or may not be in good working order or that may have lost some of their functionality i.e. obsolete, are sold in second-hand marketplaces.

13.7.2 End Users

Households and organizations are among the end-users of electrical and electronic goods, according to our study analysis and key informant interviews. By discarding their outdated or damaged electrical and technological goods, households create E-waste. Several institutional producers like, business offices, hospitals, telecom operators, internet service providers, importers and schools, produce a significant amount of e-waste. By using responsible disposal techniques, both households and organizations can play a significant role in controlling e-waste.

13.7.3 Collectors

Through our study and key informant interviews, we were able to identify a number of entities which are engaged in the collection of e-waste, including municipal waste collectors, repair businesses, second-hand markets, and informal and formal waste collectors and aggregators. Each of these entities has a specific part to perform in resolving the problem of having effective and sustainable electronic waste management practices in place. E-waste is collected from homes and companies by unregulated informal waste collectors and aggregators. Due to improper management and disposal methods, this industry is frequently linked to hazardous working conditions and environmental deterioration. Formal waste collectors and processors, on the other hand, are governed and provide reliable E-waste management services. They make sure that e-waste is gathered, transported, and disposed of in an environmentally friendly and secure way. Similarly, by fixing and refurbishing electronics for reuse, repair businesses and secondhand stores to prolong their useful lives and can help avoid devices from

becoming E-waste. In addition to cutting down on waste production, this gives those who can't buy new electronics more cheap choices. Municipal waste collectors contribute to the management of e-waste by gathering it and either selling some of it to unauthorized scrap collectors or dumping it at landfill.

13.7.4 Processing

Our research report findings and key informant interviews reveal that E-waste management involves both informal and formal sector stakeholders, including scrap aggregators. The primary responsibility of both informal and formal sectors is to sort and categorize E-waste based on their type during the initial stage. In the next step, the formal sector attempts to repair and refurbish the items that can be reused and resold to customers or second-hand shops. The remaining E-waste is then disassembled and dismantled by both formal and informal sectors using mechanical or manual methods. Dismantling results are categorized by materials, including valuable and less valuable ones. Sorting process used by both the informal and formal sector is a crucial stage in locating valuable materials that can be recovered and used again, such as metals. These procedures are essential for recovering priceless materials that can be repurposed and reducing the quantity of garbage that is burned or deposited in landfills.

13.7.5 Disposal

Based on our research survey and key informant interviews, the stakeholders in E-waste management employ various disposal methods that include recycling, burning, land filling, and dumping. Recycling facilities are the preferred method for managing E-waste by both informal and formal waste aggregators, as they can directly or indirectly send the extracted raw valuable materials for recycling facilities in Nepal and/or India. However, informal sectors use burning methods to extract valuable materials only, land filling, and/or dumping methods for the extracted non-valuable items for e-waste management. This can release toxic chemicals and pollutants, posing significant risks to the environment and human health. Managing E-waste requires the collaboration of multiple stakeholders. Identifying and engaging these stakeholders can help ensure the proper management of E-waste and prevent harm to the environment and human health. It is essential to adopt responsible E-waste disposal practices to protect our planet, minimize the negative impact and ensure a sustainable future.

14. Conclusion

End of Life for e-cooking devices and other e-waste streams is not taken as a serious matter to be addressed in all surveyed locations. There is a huge gap in understanding about e-waste and its hazards, methods of handling and disposal. The gap of awareness is almost equal in the city as well as the village area. There is a strong presence of informal scrap collectors in all surveyed areas who collect almost all kinds of e-waste (Except CRT TV, mercury lamps, dry cells, only screen etc) which has small value associated with it. The scrap collectors and dealers dismantle collected e-wastes without any safety concern. e.g., in Mahankal, people wait for monsoon season to throw their TV and other items (which are not taken by scrap collectors) into the nearby river so that it can be washed away.

The research study provides important insights into the current state of e-cooking devices in Nepal. The study highlights the increasing interest towards using e-cooking devices but with constraints like in rural area, people are willing to use it if getting it free while in urban area, people are shifting slowly towards e-cooking devices, which are seen as a cleaner, more efficient and convenient alternative to traditional cooking methods. The study has also identified several key challenges that are hindering the widespread adoption of e-cooking devices in the country.

Based on the findings of the study, it can be concluded that e-cooking devices have the potential to play a significant role in improving the cooking practices of households in Nepal. The study found that a large number of households are already using e-cooking devices, and the trend is expected to continue in the future. The increasing popularity of these devices is driven by several factors, including their ease of use, energy efficiency, and convenience. The study also found that the use of e-cooking devices has a positive impact on the health of households by reducing the exposure to harmful smoke and pollutants.

The study also identified several challenges that are hindering the widespread adoption of e-cooking devices in Nepal. One of the main challenges is the lack of awareness and information among households about the benefits of e-cooking devices. Many households are still not aware of the potential benefits of these devices and are therefore reluctant to adopt them. Another challenge is the high cost of these devices, which makes them unaffordable for many households, particularly those living in rural areas.

To address these challenges, the study recommends several interventions that can be undertaken by policymakers, manufacturers, and civil society organizations. Firstly, there is a need to raise awareness and educate households about the benefits of e-cooking devices. This can be done through targeted information campaigns, community outreach programs, and the involvement of local leaders and influencers. Secondly, there is a need to make these devices more affordable and accessible to households, particularly those living in rural areas. This can be achieved through government subsidies, incentives, and partnerships with the private sector.

In addition to these recommendations, the study also highlights the need for further research and data collection to better understand the current state of e-cooking devices in Nepal. There is a need to gather more comprehensive data on the usage patterns, preferences, and behaviors of households towards these devices. One of the major gaps related to EoL is lack of data for annual e-waste volume generation and illegal transport to India. Most of the high value items recovered from e-waste like circuit boards, copper, chips, laptop and mobile batteries are transported illegally to India and data for the same is missing. This is also an issue where the potential investors couldn't make calculation of their ROI with uncertainty about availability of volume which they can recycle. This can help policymakers and manufacturers to design more effective interventions and solutions to address the challenges and barriers hindering the adoption of e-cooking devices.

The research study provides important insights of present practice in end-of-life management in all surveyed areas. There is a huge gap in understanding about e-waste and its proper management practice. The lack of infrastructure, policy, awareness, collection and storage medium, processing centers all are challenges in the value chain of e-waste management. Effort from all stakeholders is required to address this growing issue. With the increasing trend of people inclining towards e-cooking devices, the volume of e-waste will increase proportionately even in rural areas.

15. Recommendations

The findings of the research study suggest that there is significant potential for e-cooking devices in Nepal, but there are also several challenges that must be addressed to promote their adoption and use. Based on these findings, there are several recommendations that can be made to improve the availability, affordability, and sustainability of e-cooking devices in Nepal. One of the most important recommendations is to increase awareness and education among consumers about the benefits of e-cooking devices, and to provide them with the knowledge and skills they need to use and maintain these devices properly. This can be done through targeted campaigns, workshops, and demonstrations, and can help to overcome the barriers to adoption that were identified in the research study. By educating consumers about the benefits of e-cooking devices, and how to use them effectively, we can help to promote their adoption and use in Nepali households.

Another important recommendation is to improve the availability of e-cooking devices in the market, particularly in rural areas where access to these devices may be limited. This can be done by encouraging more manufacturers and retailers to stock and sell e-cooking devices, and by providing incentives that make it easier for businesses to invest in these products. Better reach of after sales service, repair service and warranty claim service also generates one level of confidence among customer to move ahead with purchase decision. For example, the government could offer subsidies, tax incentives, and other measures that help to reduce the cost of manufacturing and distributing e-cooking devices, and make them more accessible to consumers. There should also provision of standardization of products to make easy availability of spare parts, easy EoL disposal and reuse of parts recovered from dismantling.

Affordability is another important consideration when it comes to promoting the adoption of e-cooking devices in Nepal. Many consumers may be reluctant to invest in these devices due to their high upfront cost, and may prefer to continue using traditional cooking methods. To overcome this barrier, we recommend offering financing options, subsidies, and other incentives that help to reduce the upfront cost of these devices and make them more accessible to low-income households. This can help to promote the adoption of e-cooking devices and ensure that they are accessible to all segments of the population.

Repair and maintenance services are also critical to promoting the adoption and use of e-cooking devices in Nepal. Many consumers may be reluctant to invest in these devices if they are not confident that they can be repaired or maintained effectively. To overcome this barrier, we recommend improving access to repair and maintenance services, particularly in rural areas where access to these services may be limited. This can be done by training local technicians and establishing repair centers in rural areas, and by providing incentives to businesses that invest in these services. Another way of promoting repair culture is support from manufacturer and importer to establish a common repair centers at various location of country as CSR activity hence generating rural employment. Educational institutes can start small repair lab as extracurricular activities in schools to promote basic repair skills that can be useful in repairing household appliances. E.g. Doko recyclers along with Karkhana Samuha (a stem education foundation) conducted repair culture trainings of 8 days in various public schools which trained more than 150 students of age group from 12-16 years under project RRW (Repair Revolution workshop supported by Prevent Waste Alliance, GIZ) and Sikaru Saathi (supported by Lang Civic Society, US)[1]. Additionally, we recommend investing in Research and Development activities. This includes academic or field research on behavior change communication, bringing the circular economy to the political agenda, and adapting imported technology to meet local needs. Such initiatives can help promote sustainable and effective usage of e-cooking devices along with proper end-of-life management for e-waste in Nepal.

Finally, we recommend developing a comprehensive plan for the end-of-life management of e-cooking devices, including recycling and disposal. This will help to minimize the environmental impact of these devices and ensure that they are disposed of safely and responsibly. The government and private companies should work together to develop policies and procedures for the recycling and disposal of e-cooking devices, and to promote the adoption of sustainable practices that minimize their environmental impact. Policy intervention along with infrastructure development is key for sustainable e-waste management. Both are complementary to each other. Without policy intervention, and investing in building infrastructure doesn't make this sustainable. The Policy should address the entire value chain of the e-waste cycle. Producers should be made accountable by introducing Extended Producer Responsibility (EPR) while collectors and recyclers should be made accountable by making them mandated to follow the standard guidelines of e-waste disposal. Policy makers should also

[1] https://karkhanasamuha.org.np/resources/sikaru-saathi-toolkit

develop standard guidelines for handling each category of e-waste in a scientific manner. With the intervention of policy, there should be a proper monitoring body. Government should also come up with a plan to motivate and incentivize the interested organizations who like to take the e-waste management forward. Implementation of Extended Producers Responsibility for importer and manufacturer, providing tax benefits to e-waste management company, incentivizing the actors of e-waste management value chain with financial benefits that might be collected from EPR fee, providing technical and financial assistance to private players interested in establishing and starting e-waste management operations, etc are few motivating factors to attract new actors in this sector. The policy should also mandate penalty clause to the producers throwing and burning e-waste.

The findings of this research study suggest that e-cooking devices have significant potential in Nepal, but there are also several challenges that must be addressed to promote their adoption and use. By increasing awareness and education, improving availability and affordability, providing access to repair and maintenance services, and developing a comprehensive plan for end-of-life management, we can help to overcome these barriers and promote the adoption of e-cooking devices in Nepali households. These recommendations should be implemented by the government, private sector, and civil society organizations working together to promote sustainable development and improve the lives of Nepali citizens.

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Annexes

Annex 1: E-cooking Devices Brands available in Nepal

S.N.	Brand Name	Induction Cooktop	S.N.	Brand Name	Induction Cooktop
1	Ascent	Yes	18	Koala	Yes
2	Bajaj	Yes	19	Lifor	Yes
3	Baltra	Yes	20	Midea	Yes
4	BETTER	Yes	21	Philips	Yes
5	CG	Yes	22	Pigeon	Yes
6	Colors	Yes	23	Prestige	Yes
7	Diamond	Yes	24	Sinbo	Yes
8	Diamond	Yes	25	Surya	Yes
9	E-chulo	Yes	26	Swifton	Yes
10	Electro Care	Yes	27	Tulip	Yes
11	Electron	Yes	28	Ultra Tec	Yes
12	Electron Mrc	Yes	29	Unirize	Yes
13	Geepas	Yes	30	Urban	Yes
14	Himstar	Yes	31	Usha	Yes
15	Hoffman	Yes	32	V-cook	Yes
16	IFB	Yes	33	Xurong	Yes
17	Khaitan	Yes	34	Yasuda	Yes

Annex 2: Key Stakeholders Identified at Surveyed Location for E-waste Management

Stakeholder Types	Actors	Actions	Results	Function	Location	Size/Capacity	Ownership or Accountability	Materials Flow Volume
Primary Stakeholders	Repair Shops	Repairing, Refurbishing and Servicing of broken electronic items	Reducing the need for new product purchases	Service provider	Local	Small to medium	Private	Low to medium
	Refurbish Shops	Refurbishing And reselling old electronic items	Reducing the need for new product purchases, Extending the life of old electronic items	Service provider	Local	Small to medium	Private	Low to medium
	Reselling / Second-Hand Shops	Reselling old e-waste products	Extending the life of e-waste products	Service provider	Local	Small to medium	Private	Low to medium
	Household	Producer of E-waste	Environmental Pollution and Health Hazards	Consumer	Local	N/A	Private	High
	End Consumers	Producer of E-waste	Environmental Pollution and Health Hazards	Consumer	Local	N/A	Private	High
	Formal Scrap Collectors	Collecting e-waste items from Households and Businesses	Safe and responsible transportation of e-waste items for Recycling	Collection and transportation	Local	Small to large	Private	Low to high
	Informal Scrap Collectors	Collecting e-waste products from households and businesses	Convenient disposal for Consumers, transportation of e-waste items for recycling and management	Collection and transportation	Local	Small to medium	Private	Low to high

	Waste Pickers	Collecting and recycling e-waste products	Informal recycling and management of e-waste products	Collection and processing	Local	Small to medium	Private	Low to medium

Secondary Stakeholders	Online Collectors	Collecting e-waste products through online channels	Convenient e-waste disposal for consumers	Collection and transportation	Online	Small to medium	Private	Low to medium
	Recycling Facilities	Processing and recycling e-waste products	Reducing the amount of e-waste in landfills, Reduction in e-waste generation	Recycling and processing	Local	Small to large	Private	Low to high
	Informal Scrap Aggregators	Collecting e-waste products from informal scrap collectors	Convenient disposal for Consumers, unsafe segregation and management of e-waste items for recycling and disposal	Aggregation and processing	Local	Small to medium	Private	Low to high
	Formal Scrap Aggregators	Collecting e-waste products from formal scrap collectors	Safe and responsible Segregation & disposal of e-waste items & Recycling	Aggregation and processing	Local	Medium to large	Private	Low to high
	Municipal Waste Management	Collect and dispose of waste generated within their jurisdictions	Ensure public health and safety, environmental sustainability	Waste collection and disposal	Across Nepal	Varies by municipality, depending on population and waste generation	Public ownership and accountability to citizens	N/A
	Private Waste Management	Collect and dispose of waste generated by	Generate revenue by providing waste management	Waste collection and disposal	Across Nepal	Varies by business, depending on size	Private ownership or accountability to	N/A

		their clients	services, provide a convenient and efficient waste management solution for clients			and scope of operations	shareholders	
	Retail Shops	Purchase products from wholesalers or manufacturers and sell them to end consumers	Generate revenue by selling products at a markup, provide convenience and accessibility to products for consumers	Sales and customer service	Typically located in commercial areas with high foot traffic	Varies by business, depending on size and scope of operations	Private ownership or accountability to shareholders	Moderate to high volume of products sold to end consumers
	Wholesalers	Purchase and distribute products to retailers or other businesses	Generate revenue by selling products at a markup, maintain supply chain efficiency	Supply chain management, sales and marketing	Typically located in urban areas, with warehouses and distribution centers in industrial areas	Varies by business, depending on size and scope of operations	Private ownership or accountability to shareholders	High volume of products purchased and distributed

External Stakeholders	Manufacturers	Responsible production and disposal of e-waste products	Reduction in e-waste production	Production and disposal	National/Global	N/A	Private	N/A
	Importers	Responsible importation and disposal of e-waste products	Reduction in e-waste production	Import and disposal	National/Global	N/A	Private	N/A

	Government Agencies	Develop and enforce policies and regulations related to waste management and recycling, provide funding for waste management initiatives	Ensure public health and safety, environmental sustainability	Policy development and enforcement, funding and resource allocation	Across Nepal	N/A	Public ownership and accountability to citizens	N/A
	Donor Agencies	Provide funding for waste management projects, support research and development of new technologies and processes	Increase availability of resources for waste management initiatives	Funding and resource allocation, research and development	Varies by organization	N/A	Private ownership or accountability to stakeholders	N/A
	Development Agencies	Support waste management and recycling initiatives as a means of promoting sustainable development	Improve economic and social outcomes, environmental sustainability	Project management, funding and resource allocation	Across Nepal	N/A	Private ownership or accountability to stakeholders	N/A

Annex 3: Aurahi Rural Municipality End of Life E-Waste Flow Chart

Consumers	Collector	Recover	Dispose
• Household • Corporate • Government • Institution • Health post	• Repair Shop • Informal Scrap Collector of Nepal • Informal Scrap Collector of India (dominant)	• Repair shop (minimal) • Informal Scrap Collector of Nepal	• Open space dump (HH, Institution, Scrap collector) • River side dump (Scrap collector, HH) • Burning (HH, Institution) • Scrap collector in Nepal (HH, Institution)
Items per HH consumer	**Volume collected**	**Volume recovered and resold**	
• TV • Fan • Motor • Fridge Mobiles	• One or two items per day	• E-waste • Plastic • Papers/Cartoons • Glass/Fiber • Metals • Iron • Copper • Aluminum	

Annex 4: Janakpur Sub Metropolitan City Waste Flow Chart

Consumer	Collector	Recover	Dispose
• Household Local vendors/ Hotels Corporate Government • Institution/NGO/ING O • Health post • Hospitals	• Repair shop • Scrap collector • Scrap dealer Municipality service ECG foundation	• Repair shop • Authorized service Center	• Open space (HH, Institution) • River side dump (Scrap Collector) • Burning (HH, Institution) • Scrap dealer in Janakpur (Scrap collector) • Scrap dealer in Birgunj (scrap dealer from Janakpur) • Landfill (Municipality, ECG foundation)
Items per consumer	**Volume collected**	**Volume recovered and resold**	
• TV • Fan • Motor • Refrigerator • Cooler/ AC • Induction/Infrared • Rice cooker • Boiler • Chimney • Heater • Mixer blender • Washing machine • Electric Geyser • Laptop/Computers • Mobiles	• Eight to ten items per day	• E-waste • Plastic Papers/Cartoons • Metals • Iron • Copper • Aluminum Glass/Fiber	

Annex 5: Kathmandu Metropolitan City Waste Flow Chart

Consumer	Collector	Recover	Dispose
• Household • Local vendors/ Hotels • Corporate • Government • Institution • Development Agencies (NGO/INGO) • Health post • Hospitals	• Formal Recyclers • Repair shop • Informal Scrap collector • Informal Scrap dealer / Aggregators • Municipality Waste Collection service • Online service Providers • Wholesalers / Importers (as Exchange Offer)	• Repair shop • Authorized service Center • Second hand shop • Refurbish Shop • Formal Recyclers • Informal Scrap Dealers / Aggregators	• Open space (HH, Institution) • River side dump (Informal Scrap Collector, Municipality Waste) • Burning (Informal Scrap Collectors) • Landfill (Municipality) • Recycling Facilities (Formal Recyclers & Informal Scrap Aggregators • Upcycling (HH, Formal Recyclers)
Items per consumer	**Volume collected**	**Volume recovered and resold**	
• TV • Fan • Motor • Refrigerator • Induction/Infrared Cooktop • Rice cooker • Water Boiler / Kettle • Chimney • Heater • Mixer blender • Washing machine • Electric Geyser	• Eight to ten items per day	• E-waste • Plastic • Papers/Cartoons • Metals • Iron • Copper • Aluminum • Glass/Fiber	

• Laptop/Computers • Mobile		

Annex 6: Mahankal Rural Municipality Waste Flow Chart

Consumers	Collector	Recover	Dispose
• Household • Government Office • Institution • Health post	• Repair Shop • Informal Scrap Collector from Chapagaun / Lele	• Repair shop (Components) • Informal Scrap Collectors	• Open space dump (HH, Institution, Scrap collector) • River side dump (HH) • Burning (HH) • Recycling Facilities (Scrap collector in Lalitpur District (Chapagaun/ Lele) (HH, Institution) • Upcycling (HH) • Burying (HH)
Items per consumer	**Volume collected**	**Volume recovered and resold**	

Consumers	Collector	Recover	Dispose
• Household • Government Office • Institution • Health post	• Repair Shop • Informal Scrap Collector from Chapagaun / Lele	• Repair shop (Components) • Informal Scrap Collectors	• Open space dump (HH, Institution, Scrap collector) • River side dump (HH) • Burning (HH) • Recycling Facilities (Scrap collector in Lalitpur District (Chapagaun/ Lele) (HH, Institution) • Upcycling (HH) • Burying (HH)
Items per consumer	**Volume collected**	**Volume recovered and resold**	
• TV • Mobiles • Induction Cooktop • Boiler • Grass Cutting Machine	• One or two items per month	• E-waste • Plastic • Papers/Cartoons • Metals • Iron • Copper • Aluminum • Glass • Components	

Annex 7: Material components of few Household Items after dismantling

Induction Stove				Recyclable Possibility	Component Selling Possibility
Item	**Unit**	**Weight**	**% component**		
Gross Weight	gm	1,600	100.00%		
Ceramic Top plate	gm	540	33.75%	No	No
Plastic Casing	gm	500	31.25%	No	No
PCB	gm	140	8.75%	Yes	Yes
Iron	gm	120	7.50%	Yes	NA
Misc	gm	110	6.88%	No	No
Copper	gm	80	5.00%	Yes	NA
Cooling Fan	gm	70	4.38%	Yes	Yes
Aluminum	gm	40	2.50%	Yes	NA

Microwave Oven				Recyclable Possibility	Component Selling Possibility
Item	**Unit**	**Weight**	**% component**		
Gross Weight	Kg	12	100%		
Plastic	Kg	0.16	1.33%	Yes	NA
Transformer	Kg	3.82	31.83%	Yes	Yes
Capacitor	Kg	0.17	1.42%	No	No
Microwave Generator	Kg	0.85	7.08%	Yes	Yes
Induction Copper Coil	kg	0.73	6.08%	Yes	Yes
Components	Kg	0.12	1.00%	No	Yes
Metal	Kg	4.78	39.83%	Yes	NA
Aluminum	Kg	0.18	1.50%	Yes	NA
Heating Coil	Kg	0.04	0.33%	Yes	Yes
Cables	Kg	0.54	4.50%	Yes	NA

Rice cooker				Recyclable Possibility	Component Selling Possibility
Item	**Unit**	**Weight**	**% component**		
Gross weight	gm	1,600			
Metal	gm	1,260	78.75%	Yes	
Wires	gm	340	21.25%	Yes	

Coffee maker				Recyclable Possibility	Component Selling Possibility
Item	**Unit**	**Weight**	**% component**		
Gross weight	gm	1,410			
Plastic	gm	1,062	75.32%	No	No
Metal	gm	289	20.50%	Yes	
Wires	gm	41	2.91%	Yes	
Screws	gm	9	0.64%	Yes	
Loss	gm	9	0.64%		

Color TV set				Recyclable Possibility	Component Selling Possibility
Item	**Unit**	**Weight**	**% component**		
Gross Weight	Kg	35	100%		
Leaded Glass	Kg	16	45.71%	No	No
BFR / Plastic casing	Kg	7.5	21.43%	No	No
Metal (Iron)	Kg	7	20.00%	Yes	NA
PCB	Kg	2	5.71%	No	Yes
Cables	Kg	1	2.86%	Yes	NA
Speaker (2 Pcs)	Kg	0.7	2.00%	No	No
Metal (Copper)	Kg	0.55	1.57%	Yes	NA
Metal (Aluminum)	Kg	0.2	0.57%	Yes	NA

Washing Machine				Recyclable Possibility	Component Selling Possibility
Item	**Unit**	**Weight**	**% component**		
Gross Weight	Kg	24.8	100%		
Plastic PP	Kg	11	44.35%	Yes	NA
Motor 2 Pcs	Kg	6.5	26.21%	Yes	Yes
Metal Sheet	Kg	5.9	23.79%	Yes	NA
Electric Components	Kg	1.1	4.44%	No	Yes
Screws	Kg	0.14	0.56%	Yes	NA
Misc	Kg	0.1	0.40%	No	No