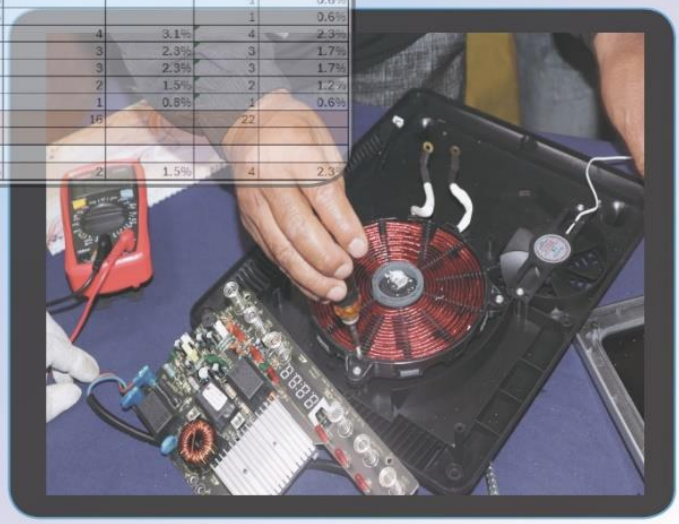
MECS
Modern Energy Cooking Services

Developing local after-sales services to support a sustainable electric cooking ecosystem in Nepal

Technical issues inventory, all ECO follow up studies — indicates critical issue where the device was reported as no longer useable

Technical issue	Electric pressure cookers								TOTAL no of issues	
	Urban		Phillips Hd2139/65		Geepas		Sinbo	SESCOM MY-CI6001W	Total sample	
	n=	32	n=	89	n=	30	n = 30	n = 40	n =	212
EPC doesn't turn on	8	25%					1 3.33%		9	4.2%
Inner pot not heating	1	4%	1	1.3%	2	7%			4	1.9%
Display not readable	7	22%	3	3.3%				2 5%	10	4.7%
Pressure valve malfunction			1	1.3%				1 2.5%	2	0.9%
Sealing ring leaking steam			1	1.3%					1	0.5%
Overheating due to insufficient liquid added			2	2.5%					2	0.9%
Loss of coating on inner pot	1	3%			30	100%			31	14.6%
Lid jams	1	3%							1	0.5%
Broken lid hinge	1	3%							1	0.5%
EPC making strange noises	1	3%							1	0.5%
Electric shock					1	3%			1	0.5%
Hole in inner pot					2	7%			2	0.9%
Broken power cord					1	3%		2 5%	3	1.4%
Leakage from lid gasket					1	3%			1	0.5%
Timer knob broken								1 2.5%	1	0.5%
Inner pot loses shape/lid no longer closes								1 2.5%	1	0.5%
TOTAL issues	21		6		36		1	7	71	
TAL critical issues	10	31.3%	0	0%	5	16.7%	1	3.3% 2 5%	16	

Technical Issues	Induction stove CG		Induction stove PEEDA Study		Total Number of Issues	
	n = 41		n= 131		n= 172	
Stove doesn't Turn on	1	2.4%	2	1.5%	3	1.7%
Making strange noise	1	2.4%	1	0.8%	2	1.2%
Intergated circuit damaged	1	2.4%			1	0.6%
Fuse Damaged	1	2.4%			1	0.6%
Wire short circuit due to cockroaches	1	2.4%			1	0.6%
Display not working	1	2.4%			1	0.6%
Buttons not working			4	3.1%	4	2.3%
Fracture cooktop			3	2.3%	3	1.7%
Block Airvents/internal fan not moving			3	2.3%	3	1.7%
Shutts of unexpectedly			2	1.5%	2	1.2%
Slow Functioning			1	0.8%	1	0.6%
Total Issues	6		16		22	
Average% of HHs affected by issues						
tal Critical Issues	1	2.4%	2	1.5%	4	2.3



March 2024

UKaid from the British people

MECS Modern Energy Cooking Services

Loughborough University

ESMAP Energy Sector Management Assistance Program

Research Team:

Mr. Biraj Gautam, People, Energy and Environment Development Association (PEEDA)

Mr. Gaurab Singh Hamal, People, Energy and Environment Development Association (PEEDA)

Mr. Prem Bikram Karki, People, Energy and Environment Development Association (PEEDA)

Ms. Alina Dangol, People, Energy and Environment Development Association (PEEDA)

Mr. Nabindra Raj Shrestha, People, Energy and Environment Development Association (PEEDA)

Dr. Richard Sieff, Modern Energy Cooking Services (MECS)

'This material has been funded by UKAid from the UK government and is implemented by the Foreign, Commonwealth and Development Office; however, the views expressed do not necessarily reflect the UK government's official policies.

Table of Contents

List of Figures

List of Tables

Abbreviations

AECP	-	Alternative Energy Promotion Centre
BEST	-	Balaju School of Engineering and Technology
BTI	-	Butwal Technical Institute
CTEVT	-	Council for Technical Education and Vocational Training
ECO	-	Electric Cooking Outreach
EPC	-	Electric Pressure Cooker
EPC	-	Environment Protection Centre
GCF	-	Green Climate Fund
HH	-	Household
IGBT	-	Insulated-Gate Bipolar Transistor
KAPEG	-	Kathmandu Alternative Power and Energy Group
KM	-	Kilometre
LPG	-	Liquified Petroleum Gas
MECS	-	Modern Energy Cooking Services
NBPI	-	Nepal Banepa Polytechnique Institute
NDC	-	Nationally Determined Contributions
NPR	-	Nepali Rupees
PA	-	Practical Action
PEEDA	-	People, Energy and Environment Development Association
SESCOM	-	Sustainable Energy Service Company
TEVT	-	Technical Education and Vocational Training
WACN	-	Women Awareness Centre Nepal

Executive Summary

This study was conducted by PEEDA to assess repair issues affecting eCooking appliances and to develop local after-sales services. Understanding eCooking repair issues and solutions is key to supporting a sustainable eCooking ecosystem in Nepal and achieving the Government of Nepal's policy target of 25% of households using electricity as a primary cooking fuel by 2030 as stipulated by the 2nd Nationally Determined Contributions (NDC) plan. Recent research has identified a critical lack of local eCooking repair and maintenance services in Nepal, with four MECS pilot studies all highlighting that this deficiency was a key barrier to adoption, compromising customer confidence and reducing eCooking use while likely exacerbating Nepal's growing eWaste issue.

The study was primarily carried out in Mahankal Rural Municipality (South Lalitpur district), an ideal site as it enabled the assessment of longer-term appliance repair issues and solutions affecting two major eCooking projects that started in 2021. A survey was conducted with beneficiaries of the two projects: 32 (from a total sample of 110) households that had received a 60% subsidy on the cost of an electric pressure cooker (EPC) through a PEEDA pilot study funded by the MECS Electric Cooking Outreach (ECO) challenge fund; and 202 (of approximately a total 2000) households which had received free electric induction stoves through a government intervention. The survey was used to identify repair and maintenance issues faced by the end-users in Mahankal and assess how they can be addressed. To supplement these findings, eCooking repair issues reported by four other ECO pilots were gathered and used to create an inventory of common eCooking appliance issues. Each pilot used a different brand of EPC and one distributed induction stove, enabling comparisons between different stoves. Service centres for major eCooking appliance suppliers in Nepal were also interviewed for their insights on repair issues.

The results show that reliability & durability vary significantly between different EPCs. Two of the five EPCs that had performed well in initial controlled cooking tests (CCTs) assessing energy consumption and cooking costs had far worse durability performance than the other three EPCs assessed and were not recommended for purchase. The reliability and durability of the induction stoves in the ECO pilots were approximately equivalent to the three better-performing EPCs. These findings highlight the importance of assessing durability data alongside other more easily accessible data parameters.

The most common critical issues that left EPCs no longer usable were the EPC not turning on, the inner pot not heating, and a faulty power cord. The most common non-critical issues that affected the usability of the EPC but did not prevent cooking were the loss of coating on the inner pot and the display not turning on. For induction stoves, a damaged Insulated Gate Bipolar Transistor (IGBT) was by far the main repair issue. Supplier service centres reported that damaged IGBTs accounted for 90% of the repairs they received. The main cause of overheating IGBT faults was poor ventilation, poor quality parts, and short-circuiting from cockroach fecal matter. Replacement IGBTs were found to be widely available in Kathmandu, but quality and cost varied considerably, complicating repairs.

In Mahankal, existing local repair solutions were analysed partly by surveying the actions households took in cases where they experienced appliance faults. The most common response was

to take no action, partly reflecting the lack of repair services in the municipality. However, this issue was far more common with the freely distributed induction stoves (77%) than the part paid for EPCs (44%) (despite the poorer durability of the particular EPC used in the study). Recipients of the part paid for EPCs were part of a pilot study and received after-sales support. Recipients of the free induction stove did not.

The high cost of repair services in urban centres compounded the current challenges for rural households to repair appliances. High minimum service charges made even minor repairs expensive. Moreover, in a non-competitive and unregulated market, providers of repair services tended to charge as much as they could, leaving households unable or unwilling to cover repair costs, which were often similar to the price of a new appliance (a particular disincentive for households who had received appliances for free or at a heavily subsidized rate). Overall, free distribution of eCook appliances and no provision of after-sales services was found to correlate with low use of repair, and these kinds of interventions are therefore not recommended.

These findings on eCooking repair and maintenance issues were used to develop a training module and materials for an eCooking appliance repair course. The module and materials were also informed by interviews and a workshop held with vocational training institutes and other leading government and non-government organizations working in the eCooking sector. The training course was carried out in Mahankal with the support of the Multi Technical Training School, Butwal. Four local technicians successfully undertook the course, receiving certificates to carry out induction stove and EPC repairs. The training has led to benefits for households in Mahankal as it has decreased the time and cost of repairs and increased confidence in using eCooking devices.

Overall, several significant conclusions and impacts have emerged from the study.

- The study has highlighted the varying reliability of different eCooking products and their supply chains, which can inform the procurement process for forthcoming major eCooking distribution initiatives in Nepal as well as provide feedback to vendors and manufacturers to help design and develop a spare parts supply chain.
- The findings also emphasize the importance of considering the durability in eCooking procurement alongside other criteria to ensure sustained usage. In addition, bulk procurement processes that prioritize cost over quality risk future carbon finance earnings, highlighting the false economy of this approach. Stocking spare parts should focus on common issues that are fixable through replacement components.
- This study's development of a comprehensive training module and manual for EPC and induction stove repair can have major benefits for the institutionalization of repair and maintenance within organizations working in the field of eCooking both in Nepal and beyond. Supporting the Technical Education and Vocational Training sector to contribute to the development of vocational training curriculums and courses for eCooking repair and maintenance in Nepal is a significant step towards this critical objective.

1. Background

1.1 Introduction

Indoor air pollution is a critical health issue that affects many households in Nepal. Approximately 63.6% (or 3.59 million) of Nepal's 5.64 million households cook indoors, using fuels like firewood, cattle dung, or agro-waste, in inefficient traditional cookstoves (PEEDA, 2021). The negative health consequences — disproportionately impacting women and children — have been well documented. Moreover, the World Health Organization's report has stated that every year, around 24,000 people die due to indoor air pollution in Nepal (WHO, 2019).

Thus, to increase its share in cleaner cooking, the Government of Nepal has heavily prioritised electric cooking (eCooking) and set ambitious access targets. Most prominent are Nepal's Nationally Determined Contributions (NDCs), targeting 25% of households using electricity as a primary cooking fuel by 2030. Accordingly, many rural and urban municipalities have been planning eCooking interventions, with major development agencies also supporting initiatives. Much larger subsidised eCooking interventions are planned for 2023 in Nepal. A case in point is the US$49.5m project part-financed by the Green Climate Fund (GCF) to distribute electric cookstoves to 500,000 households in 22 Terai districts over the next five years (MECS, 2022).

A key emerging finding from these eCooking interventions is that there is a critical need to improve access to local eCooking repair services in Nepal to facilitate sustained use of eCooking appliances and increase consumer confidence in the technology. Notably, four pilot studies in Nepal carried out as part of the MECS Electric Cooking Outreach (ECO) challenge fund all found that a lack of repair services was a key challenge for promoting eCooking outside of major urban centres (MECS, 2022). A lack of training courses and materials for eCooking repair was also identified, along with a lack of information on the key spare parts needed to support such after-sales services.

People, Energy and Environment Development Association (PEEDA), along with partners Kathmandu, Power and Energy Group (KAPEG), and the University of Bristol (UB) carried out one of the ECO pilots in Mahankal Rural Municipality (south Lalitpur district) that ended in December 2021, which saw 110 households provided with a part-subsidised electric pressure cooker (EPC). Shortly after the PEEDA intervention began, the nodal agency of the Governmental of Nepal for renewable energy, the Alternative Energy Promotion Center (AEPC) supported the Mahankal Rural Municipality (Municipal Government) with a heavily subsidised intervention which provided free electric induction cookstoves to all households (around 2000) in the same Mahankal Rural Municipality.

Returning to Mahankal in 2023, approximately 18 months after both eCooking interventions facilitated this study's focus on understanding the repair issues affecting different eCooking appliances over time and their solutions. The study also drew on findings from four other ECO pilots of similar duration and the experiences of appliance suppliers and service centres in Nepal. The findings were used to develop and implement a training module and materials for eCooking appliance repair in Mahankal and then disseminated with the aim of institutionalizing repair within

vocational training institutes and eCooking programs and improving the sustainability of the major eCooking interventions planned by the government and non-government entities in Nepal.

1.2 Aim and Objectives

This project seeks to support government policy to accelerate sustainable transitions to cooking on electricity by developing local after-sales services for eCooking. The project is situated in Mahankal Rural Municipality, which has seen two major eCooking interventions (a heavily subsidised Government induction stove initiative and a more market-based EPC intervention by PEEDA), providing an ideal location to better understand and develop local repair services.

Under this research, the three core objectives to be addressed are:

1. Understanding repair and maintenance issues and their solutions.
2. Identifying and training local stakeholders to provide eCooking after-sales services.
3. Dissemination of research findings to key stakeholders in the vocational training sector

The findings from this study are intended to have a broader, longer-term impact. By assessing the reliability of different eCooking products and their supply chains, the research is timely as it can inform the procurement process for forthcoming major eCooking distribution initiatives in Nepal as well as provide feedback to vendors and manufacturers to help inform the design and develop a spare parts supply chain. Research findings will also be disseminated to vocational training institutes (leveraging PEEDA's existing links) to contribute to the development of vocational training curriculums and courses for eCooking repair and maintenance.

This study is one of two concurrent studies carried out by PEEDA in Mahankal Rural Municipality, which together inform the development of a sustainable eCooking ecosystem in Nepal. The other 'Assessing the impact of electric cooking appliance subsidies on eCooking usage' is also available on the MECS website (www.mecs.org.uk) and compares the use of eCooking appliances in Mahankal Rural Municipality among the households receiving free induction stoves via the government initiative and those which received a partial subsidy on EPCs through PEEDA's ECO pilot study.

1.3 Project site assessment

Location

The study was carried out in Mahankal Rural Municipality, which is in Lalitpur district in Bagmati Province of Nepal, approximately 40 km south of Kathmandu. This rural municipality is divided into 6 wards. The municipality spans 82.44 km2 in area.

Demography

As per the National Census 2021 (CBS, 2021), the total population of Mahankal Rural Municipality is 8,122, of which 50.1% are male and 49.9 % are female. There are a total of 1,939 households in the municipality, with an average household size of 4.19 persons per household.

Households by main source of lighting

As per the National Census 2021, 97.3% of the households in Mahankal Rural Municipality use electricity as their main source of lighting in the household and have access to electricity through the national grid (figure 1). 2.3% of households use solar as a source of lighting. Some households still use Kerosene and other sources for lighting. (CBS, 2021)

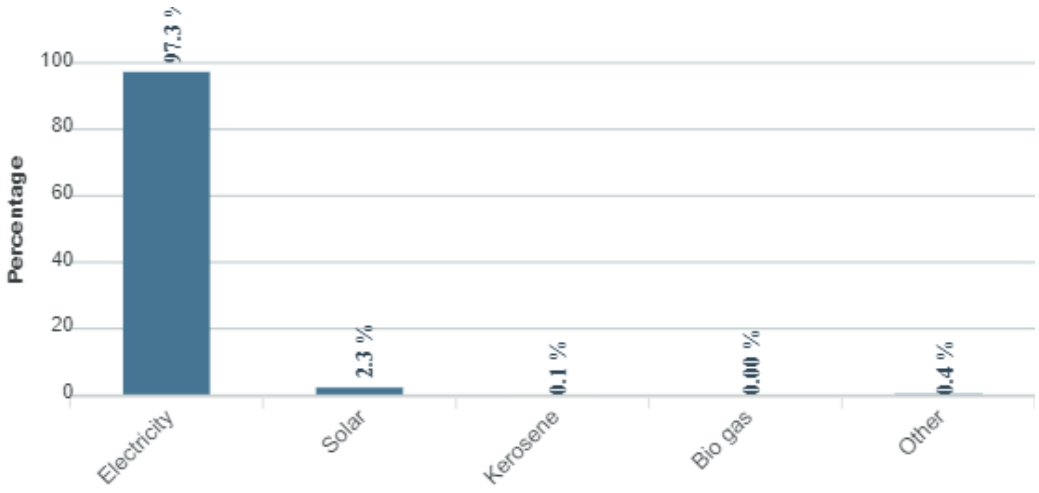


Figure 1: Households in Mahankal Rural Municipality by main source of lighting

Household by fuel usually used for cooking

As can be seen in Figure 2, wood is the major source of fuel usually used for cooking in Mahankal Rural Municipality, accounting for 80.7% of the total households (CBS, 2021). This is followed by LPG at 17.6% and electricity at only 0.1% of the total households. Other fuel sources usually used for cooking include biogas at 1.6% and cow dung and kerosene in a very small number of households, as per the CBS 2021 report. (CBS, 2021)

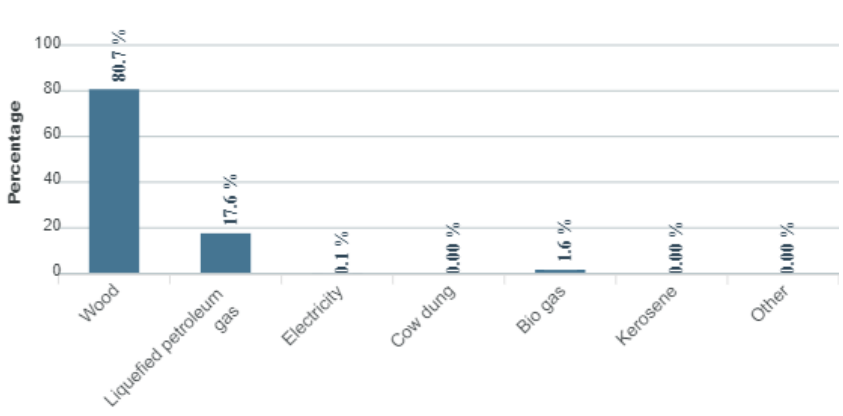


Figure 2: Households in Mahankal Rural Municipality by fuel usually used for cooking

As highlighted in the introduction, Mahankal Rural Municipality has seen two major eCooking interventions since 2021. Via the MECS-funded ECO pilot project, PEEDA supported 110 electric pressure cookers in partnership with UB and KAPEG. The intervention approach was a partial

subsidy, with households required to pay 40% of the appliance costs. Demonstrations, cooking training, technical backstopping, and on-call repair support were also provided as part of the pilot. This study refers to these households (HHs) as ECO HHs.

In addition, approximately 2000 stoves were distributed by the Mahankal Rural Municipality, with support from AEPC covering almost every household in the rural municipality. The stoves were distributed free of cost to every household in the municipality without any demonstration or training on eCooking devices. Induction stoves need specific induction-compatible utensils, which were not provided to households. There was also very little awareness raising in the community. In this study, these households are referred to as non-ECO HHs.

To expand the database and increase confidence in the findings, four other ECO follow-up studies was also incorporated into the analysis. All studies covered a similar duration facilitating comparisons. The other ECO follow-up studies were by Environment Protection Center Nepal (EPC-Nepal), Practical Action Consulting, Women Awareness Centre Nepal (WACN) in Nepal (figure 1), and Sustainable Energy Service Company (SESCOM) in Tanzania.

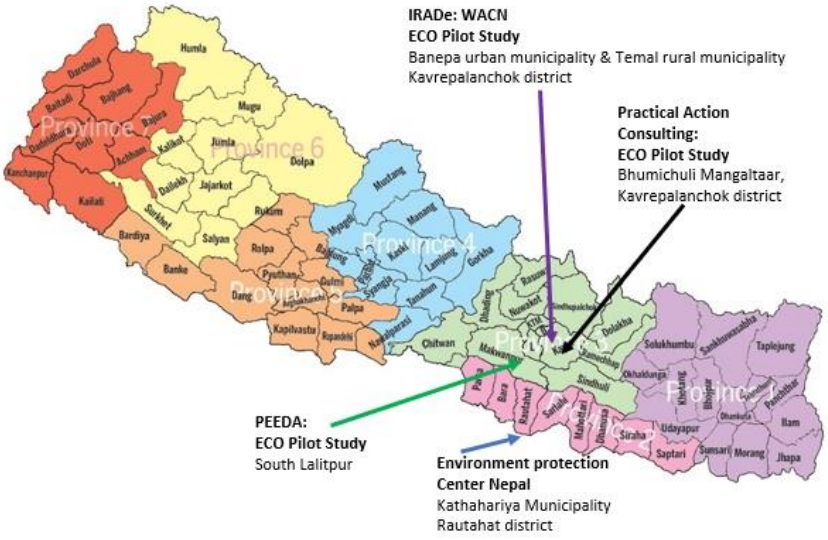


Figure 3: Project partners of MECS in Nepal

2. Research Methodology

The research study was carried out using the methodology shown in Figure 4 and consisted of different methods and approaches to address each of the three research objectives.

1) Methods and approaches used to address research objective 1: Understanding repair and maintenance issues and their solutions

A household survey was conducted with 234 households using a KOBO data collection application. 202 households were non-ECO HHs, which is approximately 10% of the total households where induction stoves were distributed for free. The remaining 32 were ECO HHs, accounting for 23% of the households who part-paid for an EPC through the ECO pilot project. Similar surveys were used for both ECO HHs and non-ECO HHs to help compare and analyse the data. Using the Survey data, an inventory of eCooking appliance repair and maintenance issues in the municipality was created to identify common appliance issues and assess how they can be addressed. Inventories were also gathered from the other ECO Follow-up study projects.

PEEDA also carried out a survey in the Kathmandu valley with repair centres from major eCooking appliance suppliers and distributors such as Chaudhary Group, Him Electronics, and Baltra. As most of the repairs are done in these city-based shops, incorporation of the information from these centres were very important to be included in the training modules and manuals. Data from the survey were also taken into consideration to compare the similarities of the faults. Key Informant Interviews (KIIs) were also conducted with some representatives from these repair centres to get a better understanding on the possibilities of repair for eCooking devices. Similarly, KIIs were also conducted with local technicians in Mahankal partly to understand their practices and challenges better and to consider the possibilities of training them in the future. This information was later used to inform the training of local stakeholders identified as strategically placed and motivated to provide repair and other after-sales services.

2) Methods and approaches used to address research objective 2: Identifying and training local stakeholders to provide eCooking after-sales services.

To help identify suitable organisations/individuals for after-sales training, firstly, key stakeholders operating in the municipality, such as NGOs, cooperatives, and local government, were consulted during a site visit for their views. Also, many repair and maintenance shops in all 6 wards of Mahankal Rural Municipality were visited and observed during the site visit to find suitable technicians with repair shops who could potentially provide repair and maintenance services in the community in the future. These local technicians were interviewed and asked about their experience in electrical and electronics appliance repair, their shops, and their willingness to work in the community for a long period of time. Following this process, four local technicians were identified to be trained in providing eCooking after-sales services, covering most of the areas in Mahankal where the eCooking devices had been distributed. As it is highly unlikely that an individual or organisation can subsist entirely on working for eCooking repair and maintenance, stakeholders who can add this capacity to their existing work were targeted for the training program.

To support the training of the four selected individuals, PEEDA, in close consultation with the MECS team, developed a training module and manual on EPC and induction stove repair. The content of the module and manual was based on the survey and interview data gathered from undertaking research objectives 1 and 2 and included a specific focus on addressing the issues identified by the eCooking repair inventory. The current home appliance training module of the Council for Technical Education and Vocational Training (CTEVT) of Nepal was also considered when developing the training module. This module was also discussed with the course trainers regarding any additional components required. The trainers were then asked to use the module as the basis for the EPC and induction stove repair and maintenance training course they delivered to the four technicians in Mahankal. the 2-day course was carried out in Gotikhel, which is a centrally located town in the heart of Mahankal Rural Municipality. This location was chosen because of its accessibility for technicians in the municipality.

3) Methods and approaches used to address research objective 3: Dissemination of research findings to key stakeholders in the vocational training sector

Two workshops were scheduled to disseminate research findings from the project. Details of the workshops are provided below.

Workshop 1 was held in March 2024 and engaged key stakeholders in the vocational training sector (e.g., CTEVT, local training institutes such as BTI and BSET), to raise awareness of the opportunity to integrate research findings into their own syllabus and training activities and to receive feedback on the repair training materials developed through this study. Private sector suppliers, vendors, and appliance manufacturers were also invited so that insights from the repair and maintenance activities might help inform product design and the development of a spare parts supply chain. Policymakers from the Alternative Energy Promotion Centre (AEPC) and other major organizations working in the field of eCooking projects were also invited to raise awareness of the relevance of the findings for their own eCooking interventions. The workshop will hopefully initiate the institutionalization of repair and maintenance training, standardization of the eCooking appliance, and policy for the Nepali government for the effective distribution of the eCooking appliances.

Workshop 2 will be organised for the first half of 2024 and will engage implementors of major distribution initiatives (e.g., AEPC, local government, donor community) to highlight the reliability of different eCooking products and their supply chains to help inform future procurement processes and also inform on the effective use of subsidies to support sustainable eCooking adoption.

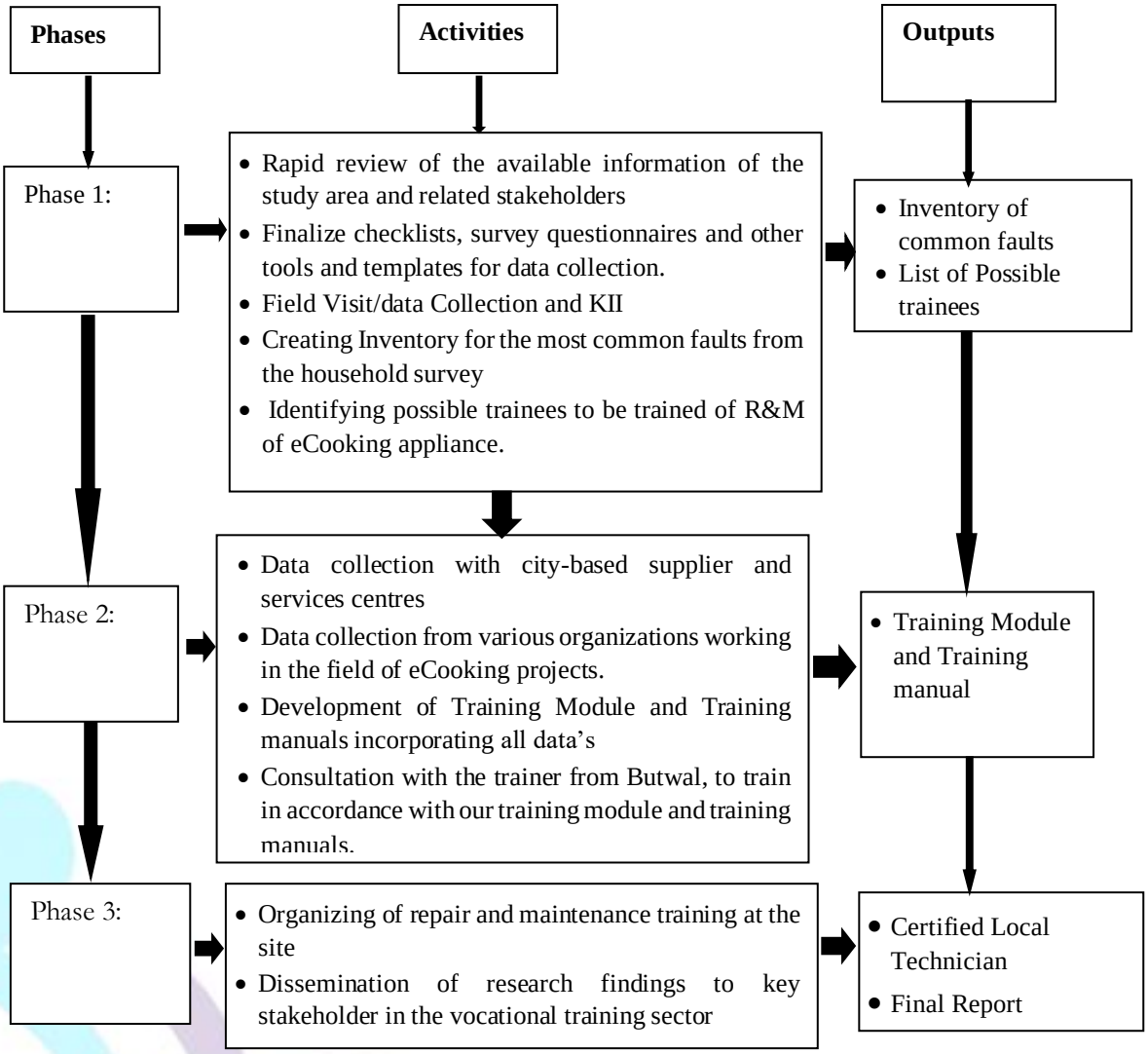


Figure 4: Research methodology for the project.

3. Results and Findings

This section highlights the main results and findings from the activities carried out to address each of the three core research objectives.

3.1 Results for research objective 1: Understanding eCooking repair and maintenance issues and their solutions.

This section details the main repair issues found to be affecting eCooking appliances distributed through the following interventions and organisations:

- The induction stoves are provided for free through the Mahankal Municipal Government-AEPC intervention (non-ECO HHs).
- The part subsidised EPCs provided via the PEEDA ECO pilot in Mahankal (ECO HHs)
- The EPCs and induction stoves were distributed through four other MECS ECO pilots.
- The eCooking appliances received by the service centres of major suppliers in Nepal.

These findings were used to inform the development of the eCooking training module and materials for research objective 2.

3.1.1 Repair and maintenance issues: Induction stoves in Mahankal

The municipal government distributed induction stoves for free in September 2021, although households were required to buy induction-compatible utensils if they did not already own them. Many households didn't start using the stoves immediately after the distribution. So, at the time of the survey conducted (April 2023), the period of actual usage varied from 2 years to a few months. Participants were provided with a 2000 W induction stove. The induction stove was not manufactured under any specific brand name. The stoves in the community were named after an organization distributing the stove as "Nepal Urja Vikas Company". It had all the general functionality available in most of the induction stoves available on the market, such as different cooking modes, temperature variation, wattage variation, etc.

Figure 5: Induction stove provided for free in Mahankal Rural Municipality

Among the 202 households (non-ECO HHs) surveyed that had been provided with free induction stoves, 95.5% had stoves still in working condition. However, only 63.8 % were using the induction stoves, with the main reason for non-use being that households lacked induction-compatible utensils. Other reasons found for non-use were unreliable electricity, technical problems, and lack of necessary skills[1].

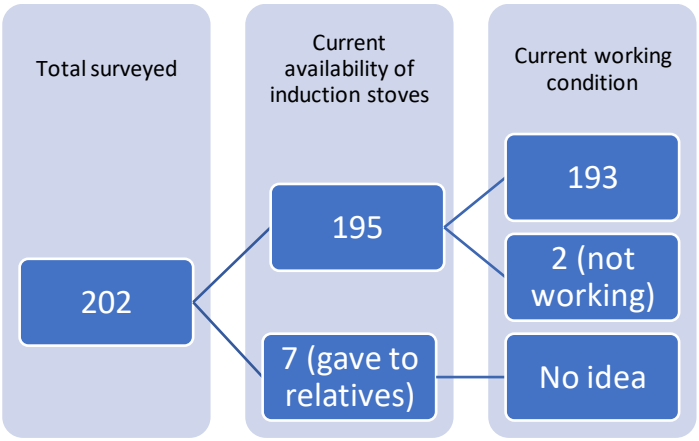


Figure 6: Key finding on usage of Induction stove in Mahankal RM, South Lalitpur

The household survey also identified repair and maintenance issues with the induction stoves, which are listed in Table 1. The colours of the rows reflect the severity of the problem. Red indicates that the device is not in working condition. Amber indicates that the issue didn't prevent the usage of the device but posed some difficulties. Light green indicates that the device is working despite the issue. Issues are ordered by number of households (HHs) affected. The percentage of households affected is calculated from the number of households who reported they were using the devices (131 households) rather than the total number of households surveyed (202 households). This is to avoid skewing the reliability data with devices not being used – in a number of households surveyed the distributed induction stoves remained unopened in their boxes.

Overall, 16 technical issues with the induction stoves were reported in total, of which 6 (4.5% of the sample) were critical red issues preventing the device from being used. Faulty buttons were the most common fault found, affecting four participants (3%) and also a red issue. Broken cooktops, blocked air vents, shutting off unexpectedly, and stoves not powering up were the next most common issues affecting 2-3 households each. Problems of noisy operation, faulty fan, and slow functioning were found in one household each. All these issues are caused by internal faulty circuits or components in the induction stove. Further details of the technical issues affecting these induction stoves can be found in ANNEX I.

[1] See PEEDA (2024) companion study 'Assessing the impact of electric cooking appliance subsidies on eCooking usage' for further details on this non-use.

Technical Issues	No. of HHs affected
Buttons not working properly	4/131 (3%)
Broken cooktop	3/131 (2%)
Blocked air vents	2/131 (1.5%)
Shutting off unexpectedly	2 /31(1.5%)
Noisy operation or unusual sounds	1/131 (0.76%)
Induction not powering up	2/131 (1.5%)
Internal fan not moving	1/131 (0.76%)
Slow functioning	1/131 (0.5%)

Table 1: Key finding on usage of Induction stove in Mahankal RM, South Lalitpur

3.1.2 Repair and maintenance issues: EPCs in Mahankal

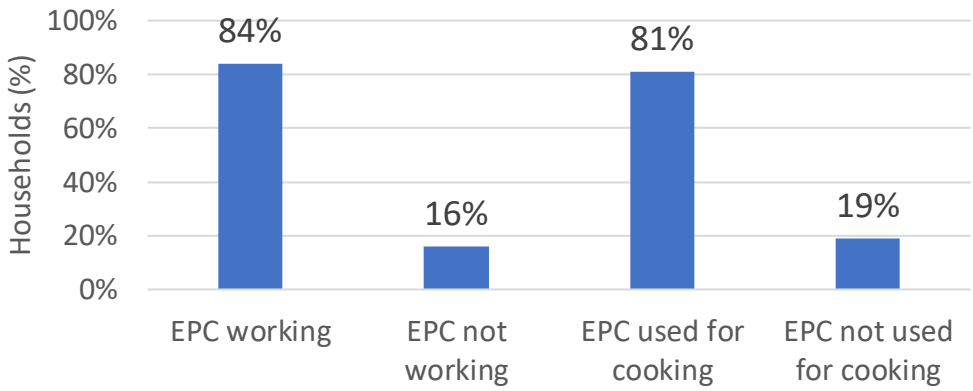
As part of the PEEDA ECO pilot study, EPCs were distributed to 110 households (ECO HHs) in Mahankal Rural Municipality in two lots. In the first lot, 30 EPCs were distributed in April 2021. Further, 80 EPCs were distributed in September 2021. So, the length of ownership varied at the time of the survey (April 2023) varied from 19 months to 2 years.

The EPC distributed was from the Urban brand and had a 6-litre capacity and a 1000-watt rated power capacity. It has multiple cooking options with single pressure switch cooking, is very easy to operate, and has strong safety features. During the initial phase of the ECO project, several EPCs available in the Nepali market were tested in the PEEDA lab. The Urban EPC was identified as the best model available in the market for the project as per the PEEDA study.

Figure 7: The Urban Electric Pressure Cooker (EPC)

Of the 32 ECO HHs surveyed, 84% had EPCs that were still working, while 16% had technical issues (figure 6). Of those 84%, 81 % of the participants were using it daily to cook food at least once a day. The remaining 19% of the surveyed participants were not using it, mostly because of technical issues, which meant they were no longer working. Other reasons for non-use were unreliable electricity and lack of necessary skills.

Figure 8 : Key finding on usage of EPC in Mahankal RM, South Lalitpur



Specific repair and maintenance issues with the EPC were identified from the household survey and are listed in Table 2 using the same severity colour coding in Table 1 and ordered by the number of households (HHs) affected. The percentage of households affected is calculated from the total number of households surveyed (32), as data from the ECO shows that all households had used the device since the pilot began.

Overall, few technical issues were reported with the induction stoves. Faulty buttons were the most common fault found, affecting four participants (3%), with the issue preventing cooking (a red issue). Broken cooktops, blocked air vents, shutting off unexpectedly, and stoves not powering up were the next most common issues affecting 2-3 households each. Problems of noisy operation, faulty fan, and slow functioning were found in one household each. Most of these issues are caused by internal faulty circuits or components in the induction stove.

Overall, faults were more common with the Urban EPC than with the induction stove distributed in Mahankal and tended to be more serious. 21 issues in total were reported, of which 10 (31% of the sample) were critical red issues preventing the EPC from being used. The EPC not turning on was the most common critical issue reported by 8 households (25%) and a red issue preventing cooking. Faulty display (a yellow issue) was the other main issue identified, with 22% of the respondents reporting this issue. The other issues reported by 1-2 households each were: inner pot not heating, inner pot discoloration, lid jamming, broken hinges (which are mostly due to improper handling of the eCooking devices), and the EPC making a strange noise. Further details of these EPC technical issues can be found in ANNEX I.

Technical Issues	No. of HHs affected
EPC not turning on	8/32 (25%)
Display not working properly	7/32 (22%)
Inner pot not heating	2/32 (6%)
Discolouration of the inner pot	1/32 (3%)
Lid jamming	1/32 (3%)
Broken hinge of the lid/cover	1/32 (3%)
EPC making a strange noise	1/32 (3%)

Table 2: Technical issue inventory in EPC

3.1.3 Repair and maintenance issues: MECS ECO pilot studies

As stated in the methodology, the other four MECS partners who carried out ECO pilot follow-up studies in Nepal and Tanzania shared inventories of repair and maintenance issues found with the stoves they promoted in their communities. Each ECO pilot study began in 2021, with the follow-up study conducted in 2023 with all participating households owning their stoves for at least 18 months. An overview of each study is provided in the table below.

Organization	Location	Appliance type	Brand & model	Average length of ownership
IRADe-WACN	Banepa Municipality & Temal Rural-Municipality, Nepal	EPC	Phillips, Hd2139/65	24 Months
PAC	Mangaltar, Roshi Rural Municipality	EPC and Induction Stove	CG Induction stove, Sinbo EPC	24 Months
PEEDA	Mahankal Rural Municipality	EPC	Urban	18 months
Winrock-EPC Nepal	Katahariya Municipality, wards 2 &3, Rautahat	EPC	Gepas	18 months
SESCOM	Morogoro Municipality, Tanzania	EPC	SESCOM, MY-CJ6001W	24 Months

Table 3: Overview of MECS ECO pilot studies

Additional finding from these organizations are as follows:

- **IRADe-Women Awareness Centre Nepal (WACN).** There were a few issues with the Philips model, and none prevented households from cooking with the device. All six devices that had issues were able to be repaired, and all 80 sampled participants' EPCs are in working condition. Further details can be found in ANNEX V.
- **Practical Action Consulting (PAC).** There was only one issue reported with the Sinbo EPC (3% of the sample), which was a critical issue where the device did not turn on. Six issues were reported with the CG induction stoves, of which three were damaged beyond repair (two integrated circuit faults and one display not working fault). The other three induction stoves were successfully repaired. Noise in the fan, fuse damage and short circuits due to cockroach infestation were other issues noted with the induction stove. See ANNEX VI.
- **Environment Protection Centre Nepal.** There were 36 issues reported with the 30 Geepas EPCs. Six EPCs (20%) had critical issues resulting in the device not being in working condition (two cases each of holes in the inner pot and broken power cords and one case of the inner pot not heating and leakage from the lid gasket). A significant issue was inner pot discoloration, which all 30 participants reported, leaving the stove useable but often causing food to overcook or crumble at the bottom. See ANNEX VIII.
- **Sustainable Energy Service Company (SESCOM)**. From the 40 sampled participants, there were 8 issues reported with the SESCOM EPC distributed. However, all were repaired, and all of the participants' EPCs are in working condition. A damaged pressure valve, display malfunction, EPC not turning on, damaged lid, and damaged timer were some of the faults observed during the study. See ANNEX VII.

Table 4 provides an EPC technical issues inventory for all the ECO follow-up studies and shows that overall reliability and durability varied significantly between the different EPCs promoted. The Phillips, Sinbo, and SESCOM models had significantly fewer faults than the Electron and Geepas devices. The Electron and Geepas devices performed well during initial controlled cooking tests (CCTs), which assessed the energy used for cooking, the running cost, and the time taken and physical testing (more than 50 parameters including safety, finishing, elegance, cooking options etc) carried out by PEEDA. However, their durability performance was far worse than the other three models assessed and is therefore not recommended for purchase. The Urban branded devices had the most critical issues (31.3% of surveyed houses received this device), while the Phillips model had the fewest. The Urban brand operated best in lab conditions but lacked durability in the rural community. These findings highlight the importance of assessing durability data alongside other more easily accessible data parameters.

Across the five studies, the most common critical issues causing the appliance to no longer be useable were the EPC not turning on (9 devices), the inner pot not heating (3 devices), and faulty power cords (3 devices). The most common non-critical issues (but still affecting usability) were the EPC display not turning on (10 devices, of which 8 were for the Urban model) and the loss of inner pot non-stick coating (31 devices, of which 30 were for the Geepas model). This latter issue does not affect stainless steel pots, highlighting the greater durability of this material over non-stick coating.

EPC technical issues inventory: all ECO follow up studies — indicates critical issue where the device was reported as no longer useable

Technical issue	Electric pressure cookers										TOTAL no of issues	
	Urban		Phillips Hd2139/65		Geepas		Sinbo		SESCOM MY-CJ6001W		Total sample	
	n=	32	n=	80	n=	30	n =	30	n =	40	n =	212
EPC doesn't turn on	8	25%					1	3.30%			9	4.2%
Inner pot not heating	2	6%	1	1.3%	1	3%					4	1.9%
Display not readable	7	22%	1	1.3%					2	5%	10	4.7%
Pressure valve malfunction			1	1.3%					1	2.5%	2	0.9%
Sealing ring leaking steam			1	1.3%							1	0.5%
Overheating due to insufficient liquid added			2	2.5%							2	0.9%
Loss of coating on inner pot	1	3%			30	100%					31	14.6%
Lid jams	1	3%									1	0.5%
Broken lid hinge	1	3%									1	0.5%
EPC making strange noises	1	3%									1	0.5%
Electric shock					1	3%					1	0.5%
Hole in inner pot					2	7%					2	0.9%
Broken power cord					1	3%			2	5%	3	1.4%
Leakage from lid gasket					1	3%					1	0.5%
Timer knob broken									1	2.5%	1	0.5%
Inner pot loses shape/lid no longer closes									1	2.5%	1	0.5%
TOTAL issues	21		6		36		1		7		71	
TOTAL critical issues	10	31.3%	0	0%	5	16.7%	1	3.3%	2	5%	16	7.5%

Table 4: EPC Technical issues inventory for all ECO follow up studies

Table 5 provides an induction stove technical issues inventory, combining the findings from the PEEDA analysis of the Mahankal Rural Municipality initiative and the Practical Action Consulting (PAC) study. PAC was the only ECO awardee to provide induction stoves, distributing CG-branded devices as part of their project. Overall, the reliability and durability of the two induction stoves used in the two studies were similar and approximately equivalent to the three better performing EPCs.

Induction stove technical issues inventory: all ECO follow up studies			indicates critical issues where devices were no longer usable			
	Induction stove	CG	Induction stove	PEEDA Study	Total number of issues	
Technical Issues	n =	41	n=	131	n=	172
Stove doesn't turn on	1	2.4%	2	1.5%	3	1.7%
Making strange noise	1	2.4%	1	0.8%	2	1.2%
Intergated circuit damaged	1	2.4%			1	0.6%
Fuse damaged	1	2.4%			1	0.6%
Wire short circuit due to cockroaches	1	2.4%			1	0.6%
Display not working	1	2.4%			1	0.6%
Buttons not working			4	3.1%	4	2.3%
Fracture cooktop			3	2.3%	3	1.7%
Block airvents/internal fan not moving			3	2.3%	3	1.7%
Shutts of unexpectedly			2	1.5%	2	1.2%
Slow functioning			1	0.8%	1	0.6%
Total Issues	6		16		22	
Average% of HHs affected by issues						
Total Critical Issues	1	2.4%	2	1.5%	4	2.3%

Table 5: Induction stoves technical issues inventory (Mahankal Rural Municipality Initiative and PAC ECO study)

3.1.4 Repair and Maintenance issues: service centres of major suppliers

To triangulate the findings from the household surveys and ECO follow-up studies, we also interviewed many major eCooking suppliers and distributors in Kathmandu, visiting their stores, corporate offices, and service centres. It was common in all the service centres and repair shops to repair induction stoves, electric pressure cookers, and other home appliances. Questions were asked regarding the most repaired electronics appliances, repair/maintenance issues and causes, spare parts, and the cost of repairing.

Table 6 shows the technical and maintenance issues reported by the service centres. For EPCs, the most common faults were the EPC not turning on, the inner pot not heating, faulty display, lid jam, and broken hinges. To repair faults like faulty displays and motherboards, spare parts need to be ordered from India or China, as only some components can be found in the local market.

For induction stoves, the Insulated-Gate Bipolar Transistor (IGBT) being damaged was the most common issue, reported to account for around 90% of faults. Other common faults included a damaged capacitor, broken cooktop, damaged coil, and short circuit of the motherboard. It was also observed that most spare parts are available in the Nepali market, but in some cases, the spare parts need to be ordered from India or China directly from the vendor.

Questions	CG Service Center	Urban EPC distributor
Repaired Electronic appliances	Vs, Radios, EPC, Induction stoves, Refrigerators, etc.	EPCs
repair/maintenance Issues normally found in Electric pressure cookers	- EPC not turning on. - Inner pot not heating. - Display showing unreadable characters. - Others are mechanical issues like lid jamming, broken hinge etc.	- EPC not turning on. - Inner pot not heating. - Display showing unreadable characters. - Others mechanical issues like lid jamming, broken hinge etc.
Problems/issues cause	Low voltage	Voltage fluctuation
Spare parts	- Small components from the local market. - Boards or displays are ordered from vendors in China or India.	Mostly from China.
Cost of repairing	NRP 500 to 1,500.	around NRP 1,000.

Questions	Electron EPC/Induction distributor	Shankar Electronics (Local Shop & repair center
Repaired electronic appliances	Induction, EPC, Rice Cooker, Electric Kettle, Electric motors etc.	Induction, EPC, Rice Cooker, Electric Kettle, Electric Chimney parts, radio, TV, etc.
Some Issues found in induction stoves	- **Damaged IGBT (most frequent ~90%)** - Fans not moving - Damaged Capacitor - Burnt heating coil - Broken Glass/cooktop - Display not working (Display not showing anything or characters not readable) - Short-circuiting of the motherboard (rare) Damaged Bridge rectifier (rare)	- Damaged IGBT (most frequent ~90%) - Damaged Capacitor - Burnt heating coil - Broken Glass/cooktop - Display not working (Display not showing anything or characters not readable) Short-circuiting of the motherboard (rare)
Spare parts	Directly from the vendors of Induction stoves and EPC (China or India). In some cases, from local markets in Kathmandu.	Usually, from the local market in Kathmandu. sometimes, from India
Spare parts availability, quality, and reliability.	parts found in the local market. Prices vary depending upon the quality and reliability of spare parts	Yes, all parts found in the local market. Price varies depending upon the quality and reliability.
If authorized spare parts not available	damaged parts to be replaced with an equivalent replacement part	Equivalent replacement parts can be used.
repair/maintenance cost	varies from NPR 500 to 1,000.	costs NPR 1,200 to 3,000.
multiple times for the same issue	replaced the IGBT of an induction stove more than 4 times.	1 to 2%, not many.

Table 6: Technical and maintenance issue in service centers

Different suppliers reported different ways of working in this sector. Some are focusing more towards the urban sector, providing repair and maintenance services only in Kathmandu and some major cities in Nepal, while others are operating in the bigger towns of rural parts of Nepal. There is a big challenge for them to provide after-sale services in rural areas as there is less market penetration of eCooking appliances, therefore making it less cost-effective to open a service centre.

There was also hesitancy from some suppliers to authorise local technicians to carry out repairs as there can be cases of frauds, and managing these cases poses a significant challenge for them. But others were willing to take a risk, go beyond these issues, authorize local technicians to carry out repairs, and be sales agents for their products.

Some suppliers also provide spare parts to local technicians who are authorized to carry out repairs. However, for most suppliers, repair work on their products can only be carried out in their own service centres which are only found in large cities. By establishing a network that links local technicians authorized by one supplier to perform repairs with service centers operated by different suppliers in nearby cities, we can effectively bridge the gap in after-sales support in rural Nepal. This network would enable rural communities to access a wider range of repair services and technical expertise, improving the overall maintenance and longevity of products and equipment used in various projects. Additionally, it could facilitate knowledge exchange and capacity building among technicians, ultimately enhancing the quality and efficiency of after-sales services in these areas.

One of the major issues noted during the survey and the interviews was the high cost of repair services. According to discussions with the local repair shop and the repair centers in Kathmandu, repair costs for induction stoves fall in the range of NPR 1,000 to 1,500. The cost can go as high as NPR 2,500 depending on the type of fault and the components that need to be replaced. Even if the actual cost of spare parts is very low, the high service charge makes the overall repair cost very expensive. The minimum service charge for any kind of repair is NPR 500. It can increase based on the difficulty of the repair task and how long it takes. Moreover, repairers will likely charge as much as they wish in a non-competitive and unregulated market. It is very unlikely that people who received appliances for free or at a heavily subsidized rate will be willing to spend such a high cost for repairs.

Further details of the findings from the interviews with major eCooking suppliers in Nepal can be found in ANNEX III.

3.1.5 Measures taken by households in Mahankal Rural Municipality to address eCookstove issues

Both non-ECO households who received free induction stoves from Mahankal Rural Municipality and ECO households who partially paid for EPCs through the PEEDA pilot normally did nothing if their eCooking appliance malfunctioned. However, the household survey findings indicate that this issue was more common with the induction stove, despite the poorer durability of the Urban EPC. Recipients of the partially paid-for EPCs were part of the ECO pilot study and received after-sales support through PEEDA, while recipients of the free induction stove did not.

Figure 9 shows that only 5 (23%) of the 22 households who reported technical problems with their induction stoves took their device to repair centres while the remaining 17 (77%) did nothing.

On the other hand, 10 (56%) of the 18 households who reported issues with their EPCs made efforts to repair their devices, while only 8 (44%) did not (figure 10). Those who did not take any action did so either because they did not know where to take the device for repair, their devices were not completely damaged and still functional, or there were no accessible repair centers available.

Figure 9: Actions of households reporting technical issues with free induction stoves.

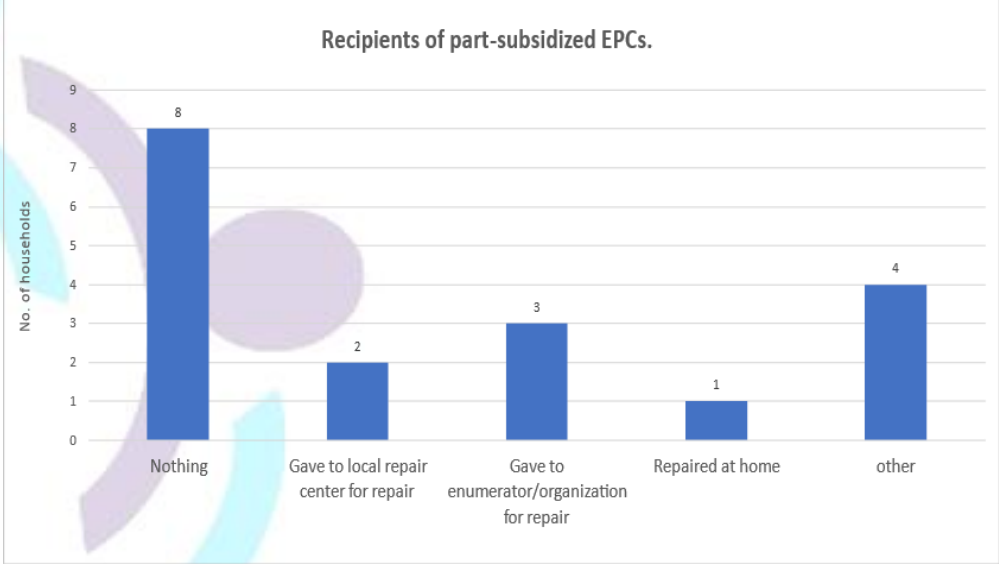


Figure 10: Actions of households reporting technical issues with part-paid for EPCs.

PEEDA observed that households that received the induction stove did not have much idea about the availability of local after-sales services for the appliances they received. In the nearby community of Gotikhel, there was one technician with some familiarity with repairing the appliance, although devices sent to this local technician most often continued to have problems

after the repair due to a lack of genuine spare parts. Local technicians lack connections with suppliers and authorized spare part providers in urban centres. Many households in Mahankal reported they could not even send devices to technicians in Kathmandu because the cost of repair was very high, almost – similar to the price of the new induction stove. As a result, most households that experienced faults with their induction stoves kept the device at home without using it. It was observed that this was also creating a lot of e-waste in the community. The overall conclusion was that free distribution of eCooking appliances, and no provision of after-sales services correlates with low use of repair.

3.2 Results for research objective 2: Identifying and training local stakeholders to provide eCooking after-sales services

3.2.1 Preparation of training module

Currently, there are very few eCooking repair training facilities in Nepal, especially for induction stoves and EPCs. There has been an increased need for repair as the distribution of eCooking devices has reached a larger scale. Local technicians have been learning to repair devices from online searches (e.g., YouTube and Google), resulting in more trial-and-error kinds of repairs, and the lack of guiding information creates risks for the success of repairs. There have been only a few cases where technicians have received proper repair and maintenance training.

Training institutes lacked proper training modules or manuals, relying mostly on the trainer's experience. Research into CTEVT programs found there were repair training modules for other home appliances, but none covered induction stoves and EPCs. These appliances are becoming increasingly common in Nepal and are central to Nepal's efforts to transition away from polluting fuels. To address this gap, PEEDA prepared a training module specifically focused on induction stoves and EPCs.

The module was developed by incorporating the findings from the activities undertaken while carrying out objective 1 of the study, principally the repair inventory, household surveys, and the interviews with technicians and service centres. The CTEVT training module on other home appliances was also considered during the preparation of the module. As IGBT faults were found to be so common, a comprehensive section covering analysis, testing, and replacement of the IGBT was inserted in the training module. Following the training, feedback from the trainers saw some key additional content (identified as missing from the training course) incorporated into the module, such as checking all error codes.

Two versions of the training module were developed to cater to different types of trainee profiles.

- Version 1 – a shorter 2-day programme for more experienced technicians
- Version 2 – a longer 5-day programme for less experienced technicians

The 2-day training program of (10 hours total) was designed for technicians who have some background in electronics repair and may have limited time to take part in the training due to their need to avoid loss of earnings from their regular repair jobs. The training module was therefore

designed to accommodate these needs and avoid situations where suitable candidates are unable to attend through not being able to take time off. The 5-day program was more comprehensive and designed for less experienced technicians or untrained potential technicians.

3.2.2 Understanding trainee profiles and their requirements

This module can be used with trainees from a range of backgrounds and experiences but requires different approaches to the way the module is used. The section below outlines three common trainee profile types, what is required of each profile before taking the module, and advice on how to approach using the module with each profile type.

1) **Untrained potential technician:**

Profile

a. These individuals lack formal education or training in electrical and electronics.
b. They may possess a basic interest or curiosity in the field but lack specific skills.
c. Without formal training, they might have a limited understanding of safety protocols, circuitry, and electronic components.

Requirements before taking the module:

- Before taking the module, individuals in this profile are required to pass CTEVT Level Basic Electrical and Electronics Training (or an equivalent course provided by a CTEVT-authorized institute). These courses provide foundational knowledge in electrical and electronics and should cover basic circuit theory, electronic components, and introductory troubleshooting.

Approach for using the training module:

- The 5-day version of the training program is recommended for these technicians.

2) **Technician with basic training (CTEVT Level 1) but limited experience in electronics repair:**

Profile

a. These individuals have passed the CTEVT Level 1 Basic Electrical and Electronics Training (or equivalent course provided by a CTEVT-authorized institution).
b. Despite having theoretical knowledge, this technician may not have significant hands-on experience.

Requirements before taking the module:

- None

Approach for using the training module:

- The 5-day version of the training program is recommended for these technicians.
- These technicians often lack hands-on experience and might need additional guidance when applying their knowledge to practical scenarios.

3) **Technician with basic training (CTEVT level 1) and experience in electronics repair:**

Profile:

a. These individuals have passed the CTEVT Level 1 Basic Electrical and Electronics Training (or equivalent course provided by a CTEVT-authorized institute)
b. They have a solid theoretical understanding of electrical and electronic principles.
c. They have experience in practical application of their electronic repair and maintenance skills and are likely familiar with diagnosing faults, soldering, and replacing components in electronic devices.
d. This technician is more self-reliant and capable of handling basic repairs independently.

Requirements before taking the module:

- Trainees work for organizations already embedded within the local repair supply chain.

Approach for using the training module:

- The 2-day version of the training program is recommended for these technicians.
- Training will focus on advanced troubleshooting techniques for induction stoves and electric pressure cookers.

3.2.3 Training module

The module content was first put into the format used and requested by CTEVT, which details the course content covered but not the timetable. This content was then transferred into two timetables: one for the 2-day program and one for the 5-day program, which is shown below.

1) Training module (CTEVT format)

The training module has been developed using the CTEVT training module's present format. Time in this module can be used as per the 2- or 5-day programme listed below:

Repair and Maintenance of Induction Cookstove — Total time:
Training Module — Theory time:
Task Analysis — Practical time:

S.N.	Steps	Terminal performance objective	Related technical knowledge
1.	Take Instruction	Given: Workshop, damaged induction cooker, circuit diagram for various induction cooker	• Working principle of various induction cooker provide • Specification of various
2.	Collect required tools, equipment and wear safety gears		
3.	Testing of electrical cord of Induction cookstove		
4.	Testing of Input terminal of Induction cooker		
5.	Visual Inspection of components damages		

6.	▪ Troubleshooting start-up problems: inspection of **IGBT,** fuse, bridge diodes, capacitors, and resistors – replacement of faulty parts ▪ Troubleshooting of buttons issues and their replacement ▪ Inspection of the cooling system and fans – replacing fans, fixing blocked vents ▪ Inspection of heat sensors and temperature control – replacement of faulty sensors ▪ Troubleshooting of other control panel issues and their replacement ▪ Addressing broken cooktops ▪ Fixing display not working issues ▪ Checking for and addressing loose connections, damaged wiring, short-circuiting ▪ Checking all error codes	Task: Repair of Induction cooker	components provided. • Process of dismantling and re-assembly
8.	Reassemble the device		
9.	Provide the supply and check if the device is working properly	Standard: Proper functioning of Provided Induction cooker	
10.	Clean the workshop working area		
11	Put the tools and components on its original position		

Repair and Maintenance of Electric Pressure Cooker Total time:

Training Module Theory time:

Task Analysis Practical time:

S.N.	Steps	Terminal performance objective	Related technical knowledge
1.	Take Instruction	Given: Workshop, damaged EPCs, circuit diagram for various EPCs	• Working principle of various EPCs provide • Specification of various components provided. • Process of dismantling and re-assembly
2.	Collect required tools and equipment's		
3.	Testing of electrical cord of EPC		
4.	Testing of Input terminal of Induction cooker		
5.	Visual Inspection of components damages		
6.	▪ Addressing EPC not turning on problem: Testing of fuse, diodes, Zener diodes, capacitors and resistors ▪ Addressing inner pot not heating check for loose connections and damaged wiring, inspect heating element and temperature sensor – replace faulty components.	Task: Repair of EPC	

	▪ Fixing display not working problem: Check connections and display settings – replace faulty display. ▪ Mechanical issues like lid jamming, broken hinges, pressure valve etc. ▪ Checking all error codes		
7.	Reassemble the device		
8.	Provide the supply and check if the device is working properly	Standard: Proper functioning of Provided EPC	
9.	Clean the workshop working area		
10.	Put the tools and components on its original position		

Tools, equipment, and materials:
Soldering Iron and wire, different sizes of screwdriver, Extension Cord, Multimeter etc.
Safety/Precautions:

1. Provide an electrical supply to the Induction Stoves/EPC only after visually checking the cord and using a multimeter.
2. Make sure the terminals and screwdrivers are tightened properly.

Equipment provided by training facility: damaged induction cooker and electric pressure cooker, circuit diagram for devices, all required tools, and safety equipment.

2) Training module version 1 (2-day program)

Training Module Version 1 is a 2-day training program (12 hours total) for Profile 3 trainees, which includes some theory but mainly focuses more on practical advanced troubleshooting techniques for induction stoves and electric pressure cookers. The course is two days as it is assumed that trainees already work in the repair supply chain and may have limited scope to take time off from their regular jobs.

Total time: 12 hrs (Theory time: 2 hrs Practical time: 10 hrs)

Day 1. Advanced troubleshooting for induction stoves and EPCs		**Time (hr)**
Morning Session 1	Morning session (Induction stove): Review of components and operation: ▪ Comprehensive overview of key components such as the induction coil, control panel, fan, temperature sensors, and their roles in the functioning of the stove. Troubleshooting Techniques: ▪ An in-depth discussion on diagnosing complex issues, including power fluctuations, coil malfunctions, and control panel errors. ▪ Analysis of common error codes and their corresponding troubleshooting steps.	1.5
Session 2	Hands-on practice:	1.5

	▪ Participants engage in practical exercises utilizing diagnostic tools to identify and diagnose problems accurately.	
Break/Lunch		
Afternoon Session 3	Afternoon session (Electric Pressure Cooker): Review of components and functionality: ▪ Brief review of components, including the pressure cooker pot, heating element, control panel, pressure release valve, and safety mechanisms. Troubleshooting techniques: ▪ Detailed exploration of issues like pressure regulation failures, temperature sensor malfunctions, and control panel errors. ▪ Strategies for diagnosing and resolving complex problems efficiently.	1
Session 4	Hand on practice: ▪ Participants work through repair scenarios to apply the troubleshooting techniques they learned, focusing on identifying root causes and implementing effective solutions.	2

Day 2. Repair, disassembly, and reassembly for Induction Stoves and EPCs		**Time (hr)**
Morning Session 1	Morning session (Induction stove): Repair techniques: ▪ Step-by-step guidance on replacing faulty components such as induction coils, control boards, and temperature sensors. ▪ Demonstration of specialized repair tools and equipment required for intricate repairs.	1.5
Session 2	Disassembly and reassembly best practices: ▪ Instruction on proper disassembly techniques to avoid damage and ensure safe removal of components. ▪ Tips for reassembly to ensure correct alignment and functionality. Sourcing Replacement Parts: ▪ Guidance on sourcing genuine replacement parts and navigating the process of ordering from manufacturers or authorized distributors.	1.5
Break/Lunch		
Afternoon Session 3	Afternoon session (Electric Pressure Cooker): Hands-on practice: ▪ Practical workshop where participants perform repairs on electric pressure cookers, focusing on tasks such as replacing heating elements, fixing pressure release valves, and addressing sealing ring issues. ▪ Individualized guidance and support from instructors as participants work through repair tasks.	1.5
Session 4	Disassembly and reassembly best practices: ▪ Instruction on proper disassembly techniques to avoid damage and ensure safe removal of components. ▪ Tips for reassembly to ensure correct alignment and functionality. Preventive maintenance procedures: ▪ Demonstration of preventive maintenance tasks to prolong the lifespan of electric pressure cookers, including cleaning, lubrication, and inspection of critical components.	1.5

3) Training module version 2 (5-day program)

Training module version 2 is a 5-day training program (30 hours total) for profile 1 & 2 trainees. As this module is designed for individuals with less experience in electronics repair, the content of the module is more detailed to enable the participants to gain more knowledge and skills and more hands-on experience with repairing eCooking appliances. The module also includes more theory than Module 1. Details of the Training module are as below:

Total time: 30 hrs (Theory time: 6 hrs Practical time: 24 hrs)

Day 1. Introduction to Induction stoves & Electric Pressure Cookers (EPCs)		**Time (hr)**
Morning Session 1	Overview of Induction stoves and Electric Pressure Cookers: ▪ Discuss the basic principles behind each appliance, including how induction stoves use electromagnetic induction to generate heat and how electric pressure cookers use pressure and heat to cook food. ▪ Overview of the most common tools for the repair and maintenance work	1.5
Session 2	Safety precautions and hazards: ▪ Emphasize safety measures such as, avoiding water contact, and handling high temperatures.	1.5
Break/Lunch		
Afternoon Session 3	Comparison of components: ▪ Identify and explain the key components of both appliances, such as heating elements, control panels, pressure release valves, and safety mechanisms, together with resistors, capacitors, relays, IGBT, transistors, switches, diodes etc.	3

Day 2. Troubleshooting basics and disassembly and assembly of Induction stoves		**Time (hr)**
Morning Session 1	Troubleshooting basics ▪ Common issues and causes: Discuss common problems like no power, uneven heating, or error codes, and their potential causes such as faulty components or electrical issues. Diagnostic tools and techniques: ▪ Introduce multimeters, and other diagnostic tools.	1.5
Session 2	Hands-on practice: ▪ Provide scenarios where participants can apply troubleshooting techniques to diagnose and solve simulated issues.	1.5
Break/Lunch		
Afternoon Session 3	Step-by-Step disassembly guide: ▪ Provide a detailed walkthrough of how to disassemble an induction stove safely, Identification of key components: ▪ Help participants understand the function of each component and how they interact within the stove. Reassembly and testing:	2

	▪ Guide participants through the reassembly process, ensuring they reconnect components correctly. Test the stove to ensure it functions properly.	
Session 4	Proper handling and storage: ▪ Stress the importance of handling components with care to avoid damage and the need for proper storage to prevent contamination or loss. Cleaning techniques: ▪ Demonstrate proper cleaning methods for different parts of the stove, including the cooktop, fan, and ventilation system, using appropriate tools.	1

Day 3. Troubleshooting basics and disassembly and assembly of an EPC		**Time (hr)**
Morning Session 1	Troubleshooting basics ▪ Common issues and causes: Discuss common problems like no power, uneven heating, or error codes, and their potential causes such as faulty components or electrical issues. Diagnostic tools and techniques: Introduce multimeters, and other diagnostic tools.	1.5
Session 2	Hands-on practice: Provide scenarios where participants can apply troubleshooting techniques to diagnose and solve simulated issues.	1.5
Break/Lunch		
Afternoon Session 3	Step-by-Step disassembly guide: ▪ Provide a detailed walkthrough of how to disassemble an EPC safely, Identification of key components: ▪ Help participants understand the function of each component and how they interact within the EPC. Reassembly and testing: Guide participants through the reassembly process, ensuring they reconnect components correctly. Test the EPC to ensure it functions properly.	2
Session 4	Proper handling and storage: ▪ Stress the importance of handling components with care to avoid damage and the need for proper storage to prevent contamination or loss. Cleaning techniques: Demonstrate proper cleaning methods for different parts of the stove, including the ventilation system, using appropriate tools.	1

Day 4. Advanced troubleshooting for Induction stoves		**Time (hr)**
Morning Session 1	Advanced troubleshooting and repair for Induction stoves ▪ Complex issues and solutions: Explore problems like circuit board failures, component malfunctions, or system errors, and discuss troubleshooting strategies to address them.	1.5
Session 2	Repair techniques: ▪ Teach to repair or replace damaged components, including soldering techniques, component testing, and sourcing replacement parts.	1.5
Break/Lunch		

Afternoon Session 3	Case studies and practical application: ▪ Present real-world scenarios or case studies for participants to analyze and solve, applying the knowledge and skills they've learned throughout the training. ▪ Asking the trainee to bring the faulty Induction Stove to repair under the supervision of the trainer	3

Day 5. Advanced troubleshooting for EPCs		**Time (hr)**
Morning Session 1	Advanced troubleshooting and repair for Electric Pressure Cooker (EPC) ▪ Complex issues and solutions: Explore problems like circuit board failures, component malfunctions, or system errors, and discuss troubleshooting strategies to address them.	1.5
Session 2	Repair techniques: ▪ Teach to repair or replace damaged components, including soldering techniques, component testing, and sourcing replacement parts.	1.5
Break/Lunch		
Afternoon Session 3	Case studies and practical application: ▪ Present real-world scenarios or case studies for participants to analyze and solve, applying the knowledge and skills they've learned throughout the training. ▪ Asking the trainee to bring the faulty Electric Pressure Cooker to repair under the supervision of the trainer	3

3.2.2 Organization of the training program

A 2-day training program on EPC and induction stove repair was organized for the four local technicians identified in Gotikhel, centrally located in Mahankal Rural Municipality. As per the ToR, the location was chosen so suitable candidates were able to attend the training program without taking time off. The trainees were selected from different parts of Mahankal to help provide repair services to all parts of the municipality. Three trainees had previous experience in electronic repair and maintenance and were already embedded within the local supply chain. They had repair shops and had been carrying out repairs for many years of other electronic devices such as TVs, radios, water pumps, and mobiles (table 7). One participant had even been repairing electronic devices for the last 30 years but lacked experience in repairing more modern eCooking devices. As the training program focused on adding capacity to their existing work, specifically for induction stoves and EPC repair, they were motivated to participate.

Table 7: Trainee Details

S.N.	Participants	Address	Remarks
1.	Trainee 1	Mahankal - 3, Lalitpur	Have been doing electrical/electronic repair (TV, Radio, Water pumps etc.) for nearly 30 years now. Can repair several faults in induction stoves as well. Lacked confidence in repairing EPC.
2.	Trainee 2	Mahankal - 3, Lalitpur	Have been doing the house wiring and other electrical/ electronic works, has a smartphone repair shop but lacked confidence in electronic repair
3.	Trainee 3	Mahankal - 6, Lalitpur	Has a smartphone repair shop but was not trained on other complicated electronics devices.
4.	Trainee 4	Mahankal - 4, Lalitpur	Have been doing house wiring work in the local communities. No previous experience of electronic repair

The training course was conducted with technical support from the Multi Technical Training School, Butwal, and consisted of theoretical as well as practical sessions. In the theoretical sessions, a general briefing of the eCooking device was taught to the trainee, together with briefing of each individual components of the induction stove and EPC. In practical sessions, trainees were shown all the components found in the eCooking appliance, steps to test/check its functioning, and rated values, which are also indicated in the training manual. Practical sessions also covered the detailed steps to take when analyzing the faulty device and error codes and techniques to do the repair work. All the electrical/mechanical components were checked in all the induction stoves and EPCs available in the training program. After dismantling the devices, not only were the faults corrected, but the trainee was taught to check all the components in the devices and repair other faults as well, if any.

Trainees were given hands-on experience in repairing faulty devices. Trainees were asked to bring 1 or 2 faulty devices found around their community, and under the supervision of the Trainer, the trainee was asked to repair the faulty devices. Various cases of faulty devices were repaired, and a full list of these devices is shown in Annex IV. Trainees were provided with a set of tools for future repair works. To help with ongoing supervision and support for the new trainees, a WhatsApp group was created so that the trainer could supervise any questions and problems faced by the new trainee in close coordination with PEEDA technical personnel. Trainees were provided with a certificate from the training centre, which gave them documentation to carry out repair and maintenance work on induction stoves and EPCs.

Figure 11: 2 days eCooking appliances R&M training program in Gotikhel, Lalitpur

For future reference, an entire workshop video has been created. PEEDA will work on technical videos that will show steps to check all the components as indicated in the training manual. It will also consist of detailed steps for analysing faulty devices, component error codes, and the techniques to do the repair work.

3.2.3 Evaluation of the training module and the training programme.

This project's identification (aided by the local community government and leader) and training of local technicians has helped address the lack of eCooking repair services in Mahankal as these technicians are now available to carry out repair work in the community. The training module was designed per the technicians' needs, helping the course cover all the important topics and tasks that were required. Also, the training program was designed for 2 days. Considering the availability of time, the technician gained most of the knowledge and skill they required for the real-time repair. As the technician was asked to bring the faulty device from their nearby community, they gained good experience diagnosing the actual faults, assessed all the possible faults, and repaired the device in the best possible way.

After completing the training program, it was observed that for three of the four technicians, specifically those with more experience in electronics repair, the 2-day program was sufficient to enhance their capacity. However, one technician could still have gained more experience if the training program had been longer (3-5 days). He did gain good knowledge and skill, but still, he didn't feel much confident doing the repair work. It seemed he wanted to learn more and repair

more devices under the supervision of a professional trainer by gathering faulty devices from the community – a process that could lead to more confidence to repair the devices in the future.

There is also a possibility of organizing a 1-day repair and maintenance campaign in Gotikhel where all the trainers and the local trainees will be available to repair the faulty devices in the community. We believe that if the parts are repaired in front of the end-users, they will also have more confidence in using the device, seeing the possibility of repair of the faulty devices.

PEEDA also undertook a thorough follow-up initiative, engaging with two of the four trainees by visiting their repair shops and conducting interviews by phone with the remaining two trainees who were unavailable during the on-site visit. This approach allowed PEEDA to gain insights into the training progress and the individual experiences of each trainee. During these follow-ups, close attention was paid to monitoring the trainees' development and engagement with the training program.

Trainee feedback on the course was positive. They reported that it had been difficult for them to carry out repair work before the course, particularly because they did not have the capability to check any problems with the circuit board in detail. As a result, they used to replace the whole master board. However, since the training program, they noted it was easy for them to recognize the individual components, issues, and errors codes and components and, where necessary, replace any components accordingly. Some challenges remained, such as when repairing devices where spare for damaged components were not available. For instance, with sensor IC damage, trainees highlighted they had to replace the whole circuit board as spare sensor IC components were not readily available even in the Kathmandu market.

Overall, these observations and evaluations indicate that the trainees have positively impacted the community. Each of the two interview technicians had repaired around 20 induction stoves since the completion of training. They seem to be very confident about the repair work and about providing a good repair service in their community. People also seem to be very happy with the availability of good repair services near the community and with the cheaper cost of the services.

3.3 Dissemination of the results findings

Dissemination of the research findings was done with the organization of a workshop with invitees from relevant stakeholders such as the Alternative Energy Promotion Centre (AEPC), Council for Technical Education and Vocational Training, and its school from Kathmandu, Balaju School of Engineering and Technology (BEST), Butwal Technical Institute (BTI), Nepal Banepa Polytechnique Institute (NBPI), RETs, Private sector dealer and suppliers of eCooking appliances, Private Training institutes, INGOs/NGOs working in eCooking projects etc. with special focus on the TEVT sector of Nepal.

Figure 12: Participants of the dissemination workshop

Much of the workshop focussed on receiving feedback and inputs on the training module and manual thorough group discussion. The module and manual were shared with all the participants in the workshop. Experts from three different institutes were selected to be reviewers and leaders for the group discussions. All the experts had excellent (over ten years) experience in the field of TEVT, especially in electronics repair and maintenance training module design, review, and implementation.

S.N.	Institution
1.	Balaju School of Engineering and Technology (BSET)
2.	Butwal technical Institute (BTI)
3.	Ministry of Physical Infrastructure and Transport

Table 8: List of expert's institution as lead reviewer

Group session was done with leadership from the selected three reviewers. After the discussion, all the insights and feedback have been listed. Feedback was given in the module and manual regarding its theoretical and practical time, steps in finding the faults, standard rating in the components, the inclusion of more block diagrams in the manual, etc. Figure 13 shows the group discussions.

Figure 13: Review and feedback session with group discussion

The feedback from the workshop proved fruitful for the study and various suggestions were incorporated into the module and manual. The most important feedback received from the workshop was as follows:

- The training must be at least 390 hours in order to be part of a CTEVT program. However, this was considered too long for eCooking appliances, and CTEVT experts recommended making it part of their home appliance training program (aligning with the initial idea of this study).
- Comprehensive guidance on the techniques for using repair tools was requested to be included in the repair manual.
- in the repair manual, include alternative replacement parts options for the standard rated components in eCooking appliances (e.g. Transistor BC548 can be replaced by Transistors BC547, BC549, 2N2222, 2N3904, and BC550, although the pin configuration of some

transistors may be different from BC548 and therefore there is a need to check the pin configuration first before replacing in a circuit).

- Develop an online animated video of workflow diagrams, showing how the induction stove and EPC work.
- Local-level coordination should be in place to plan for repair and maintenance training at an institutional level

Further details of the group work feedback are attached in Annex IX.

Overall, CTEVT experts seemed very much interested in including the induction stove and EPC repair module in their home appliance training program. They also recommended using the module as a capacity-building program for trained technicians. Other private institutions were also interested in implementing this module and manual, and the workshop had a notable impact in mainstreaming the study's findings and outputs; the support and expertise of such esteemed participants will aid meaningful advancements in promoting sustainable eCooking practices. The following were the main achievements:

- CTEVT stated they were willing to integrate the induction stove and EPC repair module and manual into their module on home appliance repair and maintenance.
- AEPC stated they are willing to make the module and manual a key component of the after-sales service in their next GCF-funded eCooking projects.
- GIZ has conveyed their willingness to provide assistance in the formalization and implementation of repair and maintenance services, emphasizing the notable demand for such services within the local community. They aim to support the establishment of sustainable structures to address the ongoing need for repair and maintenance of eCooking appliances.

4. Conclusion and Recommendations

Conclusion

In conclusion, this study has highlighted the urgent need for local eCooking repair services for induction stoves and EPCs in the Mahankal Rural Municipality. Also, there is a lack of major sensitization for the operation of eCooking appliances in the community as there has been no demonstration program to show the community people how to use the cooking appliances properly. Similar will be the case for all the eCooking projects that are being implemented in Nepal.

Almost 16% of the EPC distributed and 11% of the induction stoves have some kind of faults in the community that need to be repaired. IGBT, which accounts for 90% of the faults found in the induction stove, is a major component being damaged. Suppliers need to provide genuine IGBT and spare parts of all other components to make the repair more reliable. Technician in the rural community does not have any authorized or certified training courses for the repair of Induction Stoves and electric pressure cooker. They are repairing some device only through some information they get on the internet which is mostly by hit and trial method. With the proper identification of reliable local technicians to provide continuous service to the project site, the end-users will benefit greatly from this and get their devices repaired in the local community. They will save a lot of time and money to repair the faulty devices with less hassle, which will increase the beneficiaries' confidence to use the eCooking appliance more and help create a smokeless kitchen in the community. Beneficiaries are ensured to use these devices for longer periods of time, which will also create less e-waste in the area. The important thing to remember is that the “future of electric cooking is its uses, not the distribution.”

The reliability of different eCooking products and their supply chains has been highlighted, which will inform the procurement process for forthcoming major eCooking distribution initiatives in Nepal as well as provide feedback to vendors and manufacturers to help design and develop a spare parts supply chain.

This training module has been developed to provide a training report with details of many contexts on eCooking sustainability. This module will support the TEVT sector of Nepal in introducing and including these modules and manuals in their home appliances Repair & Maintenance Training course. This will support the Projects of mass distribution of eCooking appliances taken by the Nepali Government, Alternative Energy Promotion Centre (AEPC) and various other organizations to make it more sustainable.

Recommendations

- **Procurement.** The findings highlight the importance of including durability alongside other more easily tested assessment criteria to inform procurement and enable sustained eCooking use.

- **Bulk procurement and unlocking carbon finance**. For eCooking carbon finance projects to generate credits over a typical 5-year project period, there is a clear need for an eCook

appliance to last 5 years. A bulk procurement process that prioritizes least cost over product quality and reliability puts potential future carbon finance earnings at risk.

- This issue reinforces the growing evidence that least-cost bulk procurement is a false economy for eCooking interventions.
- **Spare parts**. Common issues that are fixable through the replacement of components should be prioritized when stocking spare parts.
    - EPCs: replacement fuses to aid the repair of faulty displays and power cords. Source devices with higher quality (ideally stainless steel) inner pots.
    - Induction stoves: replacement IGBTs
- **Local repair.** The data should be used to inform the development of urgently needed local eCooking repair services. Training and materials should cover (as a minimum) the most common repairable issues.

5. References

- Central Bureau of Statistics (CBS). (2021). *"National Report: National Population And Housing Census 2021".*
- MECS. (2022, February). *Nepal eCooking market Assessment.* MECS. Retrieved from https://mecs.org.uk/wp-content/uploads/2022/02/MECS-EnDev-Nepal-eCooking-Market-Assessment.pdf
- PEEDA. (2021, December). Retrieved from https://mecs.org.uk/wp-content/uploads/2022/02/Understanding-the-Suitability-of-Electric-Pressure-Cookers-in-Nepali-Households.pdf
- Sieff, R. (2022). *ECO Final Report: Analysis of the Key Findings from the Electric Cooking Outreach (ECO) Challenge Fund Projects*. MECS report.
- WHO. (2019, July). Retrieved from https://www.who.int/nepal/news/feature-stories/detail/Combating-the-Silent-Killer-in-Nepali-Homes

ANNEX I

Details of Technical issues in Induction stove in study by PEEDA in South Lalitpur

Technical Issues	No. of HHs affected	Description of problems
Buttons not working properly	4/131 (3%)	The device setting remains unchanged even after pressing the buttons. Sometimes, forceful pressing may lead to a setting change, while in other cases, no change occurs. Furthermore, the button indicators occasionally light up intermittently or fail to do so. Despite these issues, the households have managed to use the stove by resorting to alternative settings.
Broken cooktop	3/131 (2%)	The induction stoves had ceramic cooktops. The fracture on the cooktop didn't prevent the operation of the stove. However, some households discarded using such stoves because of safety concerns.
Blocked air vents	2/131 (1.5%)	The fan of the induction stove occasionally stops moving. Upon inspection, it was found that the air vent was filled with a lot of dust. This problem, however, didn't affect other functionalities of the induction stove and the households were able to use it regularly.
Shutting off unexpectedly	2 /31(1.5%)	Occasionally, the induction stove shuts off unexpectedly. This is not a regular problem and the HH is able to use the induction despite this issue.
Noisy operation or unusual sounds	1 (0.76%)	Sometimes the stove produces strange noises like that of arcing wires. Despite this issue, the device is working properly.
Induction not powering up	2 (1.5%)	The stove doesn't turn on even after connecting it to the electrical outlet. Households are not able to use the stove at all.
Internal fan not moving	1 (0.76%)	The stove is working fine, but the internal fan is not moving.
Slow functioning	1 (0.5%)	One participant said that her induction stove runs slower than before despite maintaining the same setting. The stove was repaired one time before because it had stopped working after lightning.

ANNEX I contd.

Details of Technical issues in Electric Pressure Cooker in study by PEEDA in South Lalitpur

Technical Issues	No. of HHs affected	Description of Problems
EPC not turning on	8/32 (25%)	EPCs don't turn on even after connecting their power cord to the outlet.
Display not working properly	7/32 (22%)	The digital display doesn't show anything at all or show unintelligible characters. Other functionalities of the Cookers are not affected. Households were using the device despite not being able to set the timer and other difficulties.
Inner pot not heating	2/32 (6%)	EPCs turn on but the inner pot doesn't heat up.
Discolouration of the inner pot	1/32 (3%)	The inner pot lost its coating over time. It often causes food to be overcooked.
Lid jamming	1/32 (3%)	Once the cover or lid of the EPC is locked, it is difficult to unlock it. Sometimes, the cover doesn't unlock at all no matter the amount of force applied.
Broken hinge of the lid/cover	1/32 (3%)	The hinge of the cover was broken. Despite this issue, the device was being used regularly.
EPC making a strange noise	1/32 (3%)	Sometimes EPC produces strange noises like arcing wires. Despite this issue, the device is working properly.

ANNEX II

Survey with the top eCooking technology providers in Nepal

Questions	Him Electronics	Baltra	CG
What is the warranty period provided for eCooking appliances in your product?	1 year	1 year	1 year
Can you please inform us about the structure of your service centers?	We have a centralized structure. We don't have a dedicated service centre in Dolakhs as the market is small and we don't usually receive a large volume of complaints from that area. However, if there is a necessity, we can send our authorized repairers there once a month.	We have a decentralized structure. There is a dedicated service center in Charikot, Dolakha. If the repair services are required at Mainapokhari and the volume of complaints is high, we can send our repairers there as well.	Service centers mostly on the bigger cities on Nepal. If repair service is required, need to come to the nearest service centers.
Can a local technician without certification repair your products that are still under the warranty period?	No. Unauthorized individuals are not allowed to repair devices that are under warranty period.	No. Unauthorized individuals are not allowed to repair devices that are under warranty period.	No. Unauthorized individuals are not allowed to repair devices that are under warranty period.
Is there a provision for providing repairer/technician with certification?	We do have a provision for providing local technicians with training and the certification required to repair our products. First, we train them on our standards and repair procedures. If the trainees meet our guidelines and are well versed in technology, we will certify them to repair our products.	No, we do not have any provisions for training individuals outside of our organization. Also, we do not provide any certification to external participants.	We can provide training for individuals outside of our organization in some conditions. But we do not provide any certification to external participants. This will only support the community during and after the completion of the warranty period as repair can be done locally but with a price.
What are the trainees' guidelines and desired qualifications?	They are required to have the following qualifications: ▪ Should have been trained in basic electronics before ▪ Should have a registered repair shop with a PAN ▪ Should be well versed with smartphones and should be fluent in using mobile applications	N/A	They are required to have the following qualifications: • Should have been trained in basic electronics before

	▪ Should have a bank account		
Once trainees are certified do you provide them with the necessary spare parts?	Yes, we can provide the local repair centers with major replacement parts. These include the power board, control board, IGBT, MOSFETs, etc. However, for small components like resistors and capacitors, they will have to source them somewhere else as we don't usually have them in stock.	N/A	N/A

ANNEX III

Survey with the top eCooking technology providers service centres and other repair centres in Nepal

	Electron EPC/Induction distributor	Shankar Electronics (Local Shop & repair center)
Proprietor Location	Amit [9851026014] Bhotebahal	Raj Kumar [9841360191] Bagdole
Which electronic appliances do you repair?	Induction, EPC, Rice Cooker, Electric Kettle, Electric motors etc.	Induction, EPC, Rice Cooker, Electric Kettle, Electric Chimney parts, radio, TV, etc.
What are some repair/maintenance Issues normally found in induction stoves?	▪ Damaged IGBT (most frequent ~90%) ▪ Fans not moving ▪ Damaged Capacitor ▪ Burnt heating coil ▪ Broken Glass/cooktop ▪ Display not working (Display not showing anything or characters not readable) ▪ Short-circuiting of the motherboard (rare) ▪ Damaged Bridge rectifier(rare)	▪ Damaged IGBT (most frequent ~90%) ▪ Damaged Capacitor ▪ Burnt heating coil ▪ Broken Glass/cooktop ▪ Display not working (Display not showing anything or characters not readable) ▪ Short-circuiting of the motherboard (rare)
Why do these problems/issues occur?	▪ Trying to heat very heavy loads usually burns the induction coil. ▪ Poor ventilation and heat transfer cause IGBTs to get heated over time and ultimately melt or burn them. ▪ Fecal matters of Cockroaches cause various parts of the PCB to be short-circuited. In some cases, the whole motherboard requires a replacement	
Where do you get the spare parts from?	Directly from the vendors of Induction stoves and EPC (China or India). In some cases, we get spare parts from local markets in Kathmandu as well.	Usually, I get these parts from the local market in Kathmandu. If not available here, sometimes, I order those parts from India as well.
Are all Spare parts including the motherboard and universal board available in our local market/Kathmandu? Comment on their quality and reliability.	Yes, all required parts can be found in the local market. Prices vary widely depending upon the quality and reliability of spare parts. e.g., a low-quality IGBT can be purchased for less than NPR 100 while a good-quality IGBT costs NPR 250 to 300. Similarly, Aluminum induction coils can be purchased for 300 rupees while copper coil costs more than 800 rupees.	Yes, all parts including the motherboard and universal board can be found in the local market. Price varies depending upon the quality and reliability.
What if the exact model of the part that was initially installed in the induction stove isn't available in the local market or from the vendor where you get these parts?	In such cases, damaged parts can be replaced with an equivalent replacement part. Care should be taken on the quality and compatibility of the parts with the induction stoves. For example, if the original IGBT had a current carrying capacity of 20 Amps, the alternative to this IGBT should have a current rating of 20 Amps or more.	Equivalent replacement parts can be used. In case the motherboard needs to be replaced and an exact match is not available, a universal board can also be used. But it's better to find the original board as it is more reliable and durable.
How much do you charge for repair/maintenance?	Depends on the type of fault and quality of spare parts. Typically, it varies from NPR 500 to 1,000. It also depends on the customer's willingness to pay. If they are looking for cheaper options, we use poor quality/cheap spare parts. And, if durability is their priority, we use expensive but reliable spare parts.	Replacement of the motherboard costs NPR 1,200 to 1,500. Replacement of all electronic parts costs NPR 2,500 to 3,000. This is the rate for repairing individual stoves. Cost can be reduced if repair/maintenance is to be done in large quantities.
Has there been any case when you had to repair the same induction stove multiple times for the same issue? If so, what is the reason?	Many times. I have replaced the IGBT of an induction stove more than 4 times. It can happen for a couple of reasons. The use of poor-quality parts is one. It can also happen if other parts on the board are faulty and unchecked. The user's way of handling the device also plays a significant role.	1 to 2%, not many.
Suggestions	Most of these issues can be prevented or minimized with proper handling of the device. Users themselves must be aware of the safety of appliances. Simple activities like regularly checking whether the fan is moving or not can be helpful. Most importantly, both EPC and induction should be protected from Cockroaches.	

Contd.

	CG Service Center	Urban EPC distributor
Proprietor **Location**	Dhobighat, Lalitpur	Sanchit Mahaboudha, Kathmandu
Which electronic appliances do you repair?	All kinds of products we sell – TVs, Radios, EPC, Induction stoves, Refrigerators, etc.	EPCs
What are some repair/maintenance Issues normally found in Electric pressure cookers?	▪ EPC not turning on. ▪ Inner pot not heating. ▪ Display showing unreadable characters. ▪ Others are mechanical issues like lid jamming, broken hinge etc.	▪ EPC not turning on. ▪ Inner pot not heating. ▪ Display showing unreadable characters. ▪ Others are mechanical issues like lid jamming, broken hinge etc.
Why do these problems/issues occur?	Low voltage is the main reason. These issues are not as common in city areas as they are in rural areas.	Voltage fluctuation is the main reason. Especially in rural areas, voltage can drop below 170 volts. Operating EPCs below 200 volts is generally not suggested as internal components can get damaged at low voltages.
Where do you get the spare parts from?	Small components are purchased from the local market. Boards or displays are ordered from vendors in China or India. But generally, we don't prefer this option as it takes more time.	Mostly from China. If small components in PCB boards need replacement, they can be purchased in the local market. But, if the display or whole PCB needs to be replaced, we have to buy them directly from China.
How much do you charge for repairing an EPC?	NPR 500 is our minimum charge. The exact cost of repair depends on the type of fault and the component to be replaced. Typically, it falls in the range of 1,000 to 1,500 rupees.	It depends on the type of issue and the number of components to be replaced. Typically, repair cost falls around 1,000 rupees.
Suggestions	Creating an environment where electric cooking devices can be repaired locally would be a great idea. We can provide reliable spare parts to the local technicians and train them as well.	If EPCs are repaired at the local level, repair costs can be drastically reduced. For example, if the repair cost is 1,000 rupees, the actual cost of components is not more than 300 rupees in most cases. Additionally, repairing EPCs locally isn't that difficult. For a person skilled at repairing other electronic gadgets like TVs, and radios, there's nothing new. The components are similar, and they will only have to identify the problem and detect faulty parts.
Questions	**Him Electronics**	**Baltra**
What is the warranty period provided for eCooking appliances in your product?	1 year	1 year
Can you please inform us about the structure of your service centers?	We have a centralized structure. We don't have a dedicated service centre in Dolakhs as the market is small and we don't usually receive a large volume of complaints from that area. However, if there is a necessity, we can send our authorised repairers there once a month.	We have a decentralized structure. There is a dedicated service center in Charikot, Dolakha. If the repair services are required at Mainapokhari and the volume of complaints is high, we can send our repairers there as well.
Can a local technician without certification repair your products that are still under the warranty period?	No. Unauthorised individuals are not allowed to repair devices that are under warranty period.	No. Unauthorized individuals are not allowed to repair devices that are under warranty period.
Is there a provision for providing repairer/technician with certification?	We do have a provision for providing local technicians with training and the certification required to repair our products. First, we train them on our standards and repair procedures. If the trainees meet our guidelines and are well versed in technology, we will certify them to repair our products.	No, we do not have any provisions for training individuals outside of our organization. Also, we do not provide any certification to external participants.
What are the trainees' guidelines and desired qualifications?	They are required to have the following qualifications: ▪ Should have been trained in basic electronics before ▪ Should have a registered repair shop with a PAN ▪ Should be well versed with smartphones and should be fluent in using mobile applications ▪ Should have a bank account	N/A
Once trainees are certified do you provide them with the necessary spare parts?	Yes, we can provide the local repair centers with major replacement parts. These include the power board, control board, IGBT, MOSFETs, etc. However, for small components like resistors and capacitors, they will have to source them somewhere else as we don't usually have them in stock.	N/A

Annex IV

Case study of Repaired faulty device during R&M training in South Lalitpur

S.N.	Description	Faults	Solutions	Status
1.	Induction Stove - Case study 1	- showing an E0 error - Damaged IGBT - Damaged Transistor	-faulty components (IGBT and Transistor) replaced and - All other parts checked.	Devices working normally
2.	Induction Stove - Case study 2	- showing an E0 error - Damaged IGBT - Damaged IC	-faulty component (IC) not available at the market. -power board replaced by the universal power board. -All other parts checked.	Devices working normally
3.	Induction Stove - Case study 3	-Faulty preset (potentiometer)	-faulty preset (potentiometer) replaced	Devices working normally
4.	Induction Stove - Case study 4	- all the buttons damaged on control board	-all the Faulty buttons replaced - All other parts checked.	Devices working normally
5.	EPC – Case Study 1	- display damaged	-device dismantled and display was de-soldered and resoldered. -Display not change due to unavailability. -Trainee connected to city-based supplier for repair of display in near future. -All other parts checked.	-Devices working normally except the display
6.	EPC – Case Study 2	- display damaged	-same as in case 1 -All other parts checked	-Devices working normally except the display
7.	EPC – Case Study 3	- not operating	-EPC dismantled and the PCBs were dry-soldered. -Many loose connections tightened	-Devices working normally

ANNEX V

Details of the R&M report by WACN

Organization: IRADe-WACN
Project Location: Banepa Municipality and Temal Rural-Municipality, Nepal
eCooking appliance type: Electric Pressure Cooker
Brand: Phillips
Model: Hd2139/65
The approximate average length of household ownership: 24 months

Technical Issue	No. of HHs affected/sample	Description of problem	Stove still useable?
Inner pot not heating (Error code - E4)	1/80 (1.3%)	The EPC showed an E4 error after being connected to power. We contacted the service centre, and they suggested bringing the cooker in, as it was a technical fault.	Yes, the issue was fixed at the service centre without any charge under the product warranty
Display issue	1/80 (1.3%)	The display won't turn on.	Yes, the issue was fixed at the service centre without any charge under the product warranty
Pressure valve malfunction	1/80 (1.3%)	The pressure valve was continuously leaking steam while cooking and as a result, the food is not being cooked properly.	Yes, the issue was fixed at the service centre without any charge under the product warranty
Sealing ring issue	1/80 (1.3%)	Due to an issue with the sealing ring EPC was leaking steam.	Yes, the sealing ring was replaced.
Overheating (E3 error)	2/80 (2.5%)	EPC overheated because of not adding enough liquid.	Yes, the user was advised to maintain adequate liquid and the issue gets resolved. It was not required to bring EPC to the service centre.

Note: 80 sampled households participated in the study "Testing electric cooker adoption in the socio-economic and cultural context of Nepal" executed by IRADe and WACN team

Other concerns/safety issues

There was not any major concern or safety issue faced by any household. Some elderly people find it difficult initially to operate an EPC. They were assisted by a young household member or young neighbour.

ANNEX VI

Details of the R&M report by Practical Action Consulting

Organization: Practical Action Consulting (PAC) Pvt. Ltd

Project Location: Mangaltar, Roshi Rural Municipality

eCooking appliance type: Electric Pressure Cooker (EPC) and Induction Stove

Brand: Induction stove (CG), Sinbo (EPC)

Approximate average length of household ownership: 24 months

Technical Issue	No. of HHs affected/sample	Description of problem	Stove still useable?
EPC not turning on	1/41(2.43%)	The local technician could not diagnose the problem and repair the EPC	No
Display not working properly	1/41(2.43%)	The display was completely broken. New display was replaced but the induction stove never worked after replacing the broken display.	No
IC damaged (twice)	1/41 (2.43%)	IC in the induction stove was damaged and was replaced. The replaced one was also damaged but again repaired successfully.	No
Unknow reason	1/41 (2.43%)	There was strange noise while using induction stove. Later it stopped working. No particular reason for damage was diagnosed.	No
Fuse Damaged	1/41 (2.43%)	Fuse in the induction stove was damaged and was replaced.	Yes
Induction stove making strange noise	1/41 (2.43%)	While using induction stove, there is a loud disturbing noise (probably coming from fan). The noise disappears once the user taps 2-3 time on the surface of the stove.	Yes
Short-circuit in wire	1/41 (2.43%)	There was cockroach infestation when induction stove was dismantled. The cockroaches seemed to have caused short-circuit in the wires. This was repaired.	Yes

Note: These were confirmed form the collected data during ECO Follow up study and phone conversation with the local technician who was trained to repair the eCooking appliances.

Other concerns/safety issues

All together 3 induction stove and one EPC was damaged beyond repair. Three induction stoves were successfully repaired. It seemed like noise in the fan of induction, IC and fuse damage and cockroach infestation was major issue in induction stove.

There was one instance reported by one of the users of induction stove during FGD. The user had wet hands and when she tried to switch on the induction stove, she got minor electric shock which did not caused any significant harm to the user

ANNEX VII

Details of the R&M report by SESCOM

Organization: SESCOM
Project Location: Morogoro Municipality, Tanzania
eCooking appliance type: Electric pressure cooker
Brand: SESCOM
Model: MY-CJ6001W.
Approximate average length of household ownership: 24 months

Technical Issue	No. of HHs affected/sample	Description of problem	Stove still useable?
Pressure release Valve damaged	1/40 (2.5%)	The steam escapes from the pot when cooking, this delays to build enough pressure for cooking. This family indicated the inner rubber of the valve was damaged by cockroach when it was left out after cleaning. They continue to use EPC with precautions.	Yes, the valve was replaced
Green indicator stopped displaying	2/40 (5%)	The EPC is on but the green indicator didn't display when the timer for cooking switched ON. Technician identified it was a fuse problem which was probably due to voltage fluctuation.	Yes, the fuse was replaced and continue to use
EPC not turning on	2/40 (5%)	Cooker didn't turn ON after it is connected to power. Assessed and found it was the power cord fuse which burnt out.	Yes, power cord fuse was replaced.
Top Lid don't cover and tight the EPC as required	1/40 (2.5%)	This was due to the facts that the inner pot lose shape because of mishandling of the pot especially during washing, and became difficult to close EPC, sometime had to cook while lid is not closed.	Yes, but with difficulties until when they change inner pot
Top Lid outer part and handle get burnt	1/40 (2.5%)	The top lid outer part and the handle get burnt; it was put on the LPG stove burner accidentally (fuel mix).	Yes, need to get spare to change the lid
Timer knob broken	1//40(2.5%)	The timer knob was broken by a relative in the family who used EPC without proper guide. They had to use alternative means to turn ON the cooker until when it was replaced.	Yes, regularly used regardless of the challenge.

Note that 40 was sampled households participated in the Follow-up study (10 for cooking diaries and 30 indicative cooking diaries hhs)

Other concerns/safety issues

The safety was a concern to the household where the pressure valve control was damaged because of the steam which was escaping from the pot while cooking. That one considered to jeopardise the safety of the users because they could accidentally touch the steam and get injured. Despite of that the household didn't stop using the EPCs rather took high precautions when using it until when the valve was replaced.

ANNEX VIII

Details of the R&M report by EPC Nepal

Organization: Environment Protection Centre

Project Location: Katahariya Municipality, wards 2 &3, Rautahat

eCooking appliance type: Electric Pressure Cooker (EPC)

Brand: Gepas

Model:

Approximate average length of household ownership: 18 months

Technical Issue	No. of HHs affected/sample	Description of problem	Stove still useable?
Inner pot not heating	1/30 (3%)	EPC turns on but the inner pot doesn't heat up.	No
Hole in inner pot	2/30 (7%)	Small hole in the inner pot, maybe due to forceful cleaning.	No
Broken power cord	2/30 (7%)	Power cord is not working, and needs replacement	No
Leakage from lid gasket	1/30 (3%)	The inner pot lost its coating over time. It often causes foods to overcook.	No
Electric shock on the outer surface	1/30 (3%)	electric shock on the outer surface when touched with hand.	Maybe, but they are afraid to use
Discoloration of the inner pot	30/30 (100%)	The inner pot lost its coating over time. It often causes foods to overcook.	Yes, but the food is crusted at the bottom

Other concerns/safety issues

ANNEX IX

Dissemination workshop 1 feedback from the group work

Group / Questions	Q1. What are the areas that need to be updated in the repair module and repair manual?	Q2. How will you enable your institution or repair center to organize more training?	Q3. How can your institution incorporate these repair and maintenance manuals into your courses, trainings, and future programs?	Q4. We have planned to digitalize these materials (upload on website, distribute pdf files etc.). Do you have any suggestions on the formatting and structuring of digital materials so that they will be more interactive and user-friendly?
Group 1	• Inclusion of the animated form of process flow and workflow diagram. • How to properly store disassembled parts; How to safely operate repair tools • Detailed tasks for individual faults and analysis and testing procedures • Alternative standard rating components to be included • How to accelerate fault findings and analysis • Summary of error codes should be at the start • Block diagrams should not be missed out	Basic knowledge to users and institutional level on how to safely operate electric pressure cookers, induction stoves, infrared stoves, etc. Knowledge of basic household wiring	Incorporate repair and maintenance section in pre-diploma and diploma-level courses	• Animated videos of workflow diagrams on the website • Repair and maintenance video on the website • Video showcasing fault findings • List of vendors where spare parts can be available, to be listed on the website
Group 2	• Target group identification with at least 1 year of work experience • Clarity on certification standards • Correction of pictorial representation; Correction of technologies • Include circuit training • Listing more common problems, and solutions with procedures • 5-day training should also focus on basic electrical and electronics components	• Resource availability • Skill Upgrade training along with on the job training	• 390 hours household appliances training • Coordinate with CTEVT to revise curriculum	Animated videos inclusion on the website
Group 3	• Theory of components should be included • Practical training duration should be increased • Evaluation scheme to be included in the course design	• On the job training to be provided to upgrade operational skills • National Vocational Institute only certifies 390 hours course	Additional technologies can be included like sine wave inverters	• Systematic repair module is missing (troubleshooting) • Diagrammatic representation/ flowchart in an interactive way should be included • Job Name, Job Objective, Materials, Tools description, specification, standard ratings, quantities specification, methods of how to repair, check, evaluation, safety protocols should be included.