NUVONI RESEARCH

Accelerating the Electrification of Cooking in Kenya's Urban Informal Settlements

Project Report

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eCooking Capacity Building & Market Development Programme (eCAP)

The eCooking Capacity Building & Market Development programme (eCAP) was implemented in 2023 as a partnership between Kenya Power and two UK-Aid-funded programmes, MECS and UK PACT. eCAP was managed collaboratively by Kenya Power and MECS via the STEER (Sustainable Transitions in Energy, Environment and Resilience) Centre at Loughborough University, UK and Gamos East Africa, Kenya.
Kenya Power owns and operates most of the electricity transmission and distribution system in the country and sells electricity to over 9 million customers. Kenya Power's Pika na Power (Cook with Electricity) campaign aims to stimulate demand for electricity and increase the social and environmental impacts of electricity access.

Modern Energy Cooking Services (MECS) and United Kingdom Partnering for Accelerated Climate Transitions (UK PACT) are UKAid-funded programmes with the shared vision of supporting Kenya to transition from unsustainably harvested biomass to renewably-generated electricity.

- eCAP aims to accelerate the uptake of eCooking in Kenya by building the capacity of key market actors and driving forward the development of a sustainable eCooking sector by:
- Developing institutional capacity within Kenya Power
- Designing and implementing a pipeline of scalable activities in parallel with the Kenya National eCooking Strategy (KNeCS)
- Identifying pathways for scaling up the Pika na Power campaign
- Bringing together Kenya's clean cooking and electricity access sectors to empower a network of eCooking Champions
- Generating evidence on the role of eCooking as a tool for stimulating demand and increasing the social impact of electricity access to inform decision-making by Kenya Power's Board of Directors

For more information on eCAP, visit www.MECS.org.uk.

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A2EI	Access to Energy Institute
CBO	Community Based Organisation
EPC	Electric Pressure Cooker
FCDO	Foreign Commonwealth & Development Office
FGD	Focus Group Discussion
ICS	Improved Cook stoves
Kg	Kilograms
KNeCS	Kenya National Electric Cooking Strategy
KPLC	Kenya Power & Lighting Company
LPG	Liquefied Petroleum Gas
MECS	Modern Energy Cooking Services
MJ	Megajoules
MTF	Multi-Tier Framework
SCODE	Sustainable Community Development Services
SDG	Sustainable Development Goals

Executive Summary

The objective of this study is to assess the potential for the adoption of electric cooking (eCooking) in urban informal settlements. This evidence would be used to provide evidence to support the development of interventions to promote access to and usage of electric cooking appliances. By examining current cooking practices, energy usage, and the factors influencing energy choices in these settlements, the study aimed to identify barriers and leverage opportunities to promote electric cooking. The study also evaluated consumer financing and market interventions to address upfront costs and stimulate the use of electric cooking technologies in households and food businesses.

Households and food vendors in informal settlements and the respective market for cooking solutions thus formed the key units of analysis informing the two-part structure of the report. The first part of the report focuses on households and food businesses as consumers of cooking solutions. The second part concentrates on market scoping of the cooking solutions market in informal settlements. In examining the potential for eCooking, household electricity access in the urban informal settlement was key. The multi-tier framework (MTF) approach guided the analysis of access to electricity, albeit with contextual modifications to account for the unique aspects of the informal settlement setting. For instance, the formality and informality of electricity was considered instead of the standard grid, mini-grid, and off-grid classification.

Based on this approach, household electricity access is significantly dominated by informal electricity connections (86 percent) relative to formal connections (14 percent). The study reveals a strong correlation between the form of electricity access and housing conditions, education, and wealth in informal settlements. Wealthier households are more likely to have formal electricity connections. However, the market for household electricity in the informal settlement is intricate, with structured market systems that cater to affordability needs and pose risks, such as appliance damage and bodily injuries resulting from substandard household wiring installations. In order to address the prevalence of informal electricity access, the study recommends addressing the affordability of electricity in informal settlements, noting that households' average monthly expenditure is between Kshs. 314.00 and Kshs. 786.00. Some suggested solutions include subsidies, flexible payment options, and targeted support for low-income households. In addition, collaboration between Kenya Power and Lighting Company and informal electricity vendors is proposed to minimise the prevalence of informal connections. This approach is likely to address illegal connections as income is the key incentive for the vendors. Awareness creation is also suggested as a way to minimize the do-it-yourself (DIY) wiring installations and eliminate accidents, injuries and fires resulting from faulty wiring installations.

Another critical component of the potential for eCooking in urban informal settlements examined in the study is household cooking practices. Cooking practices covered typical cooking solutions, meals, and dishes prepared. This component was examined using a household survey and cooking diaries methodologies. While household stacking is evident,

most households stack are made of two cooking solutions (about 86 percent of households). The preferred primary cooking solution is the LPG stove (59.4 percent of household), Kerosene stove (22.9 percent of households), and Biofuel stove (Koko Networks) and improved charcoal stove (both 6.4 percent). The preferred secondary cooking solutions are Kerosene stove (18.7 percent of households) and electric coil stove (14.2 percent of households). Similar patterns are observed in the cooking diaries. Cooking diaries reveal the willingness to switch to eCooking, especially to electric pressure cookers (EPC), with the main driving factors being speed and self-regulating properties of the EPC. However, food vending business face the challenge of the small capacity of the typical EPC, and the need for multiple concurrent cooking points. Addressing the EPC's design to cater for food vending business is thus recommended as a solution.

Regarding the dishes prepared, tea dominated households' breakfast (89.2 percent of households) while rice and ugali dominated lunch and supper. Further, boiling and stewing dominated households cooking techniques, which implies that household cooking practices in the urban informal settlement are amenable to eCooking. In particular, the potential for including efficient electric cooking using appliances such as electric pressure cooker was evident in the second phase of the cooking diaries where 69.8 percent of the cooking events were performed using electricity. With the exception of chapati and pancakes, most of the dishes cooked by residents of Mathare are compatible with the EPC as shown by cooking diaries.

In terms of energy use, daily electricity consumption for cooking alone was found to be more energy-efficient compared to stacking cooking fuels. During phase 2 of the cooking diaries, using electricity as a stand-alone fuel with an energy-efficient appliance (EPC) required only 1.18MJ/day/capita for heating functions, whereas using electricity in an LPG stack required a total of 2.81MJ/day/capita. This means LPG contributed twice the energy required when used in an energy stack with electricity, thus reducing overall energy efficiency and increasing household energy consumption. However, despite the reduced energy efficiency in the electricity-LPG stack, it still required almost 5 times less energy than using kerosene alone for cooking and half the energy required when using only LPG for heating events.

The second part of the study focused on market scoping. The study shows the cooking solutions market is dominated by fuel vendors (69 percent of businesses), followed by cookstove vendors (26 percent of businesses), and vendors selling both fuels and cookstoves (5.29 percent). The study identifies affordability as the main driver for demand in the cooking solutions market (36.94 percent of businesses), followed by availability and accessibility (17.12 percent of businesses). However, businesses identify capital constraints and security as major constraints. Further, legal and regulatory factors are not viewed by most businesses as constraints as most businesses are unregistered. Businesses identify energy efficiency, safety, ease of use, and effectiveness as factors that determine competitive advantage.

Cooking solution distribution channels in informal settlements are varied and encompass manufacturers or suppliers, wholesalers, distributors, retailers within the settlement, and

street vendors. Factors like coverage, cost, delivery speed, and reliability influence the selection of suppliers. Notably, kiosks serve as the primary points of purchase, catering to approximately 11.9 percent of households. This underscores the importance of understanding the unique conditions of informal settlements for businesses intending to enter the cooking solutions market in the settlements.

An interesting development is the emergence of '*Orodha*' markets, specializing in second-hand electric appliances to address affordability concerns in the informal settlements market. However, in the absence of local markets, households venture outside the settlement to purchase cooking appliances from supermarkets and specialized stores such as Burn and LG distributors. The lack of supermarkets within the settlement might be attributed to space constraints.

To overcome these challenges, the study recommends innovative distribution methods such as utilizing motorbikes to enhance accessibility and eliminate the need for supermarkets within the settlement. Additionally, mobile phone-enabled distribution, partnering with women and youth groups, and adopting innovative financing solutions, such as combining appliance financing with maintenance or extended warranties, are recommended mechanisms to develop markets in informal settlements. These approaches can help businesses tap into the potential of this market and cater to the unique needs of households in informal settlements.

1.0 Introduction

1.1. Background

Rapid urbanization estimated at 6.9% a year in Nairobi has resulted in the massive expansion of unplanned and informal settlements in and around the city. Informal settlements, sometimes referred to as 'slums', refer to 'heavily populated urban areas characterised by substandard housing and squalor' whose population is comprised of very poor people with limited assets [1]. A significant share of sub-Saharan African population lives in informal settlements, and that share stands at over fifty percent (50%) of urban households in Kenya[2]. Informal settlements lack access to basic services – potable water, appropriate housing, healthcare – and modern energy[3], and are often excluded or underrepresented in national development planning efforts. Sustainable Development Goal 11, however, envisions cities and human settlements that are inclusive, safe, resilient, and sustainable[4]. Furthermore, energy access is an enabler for sustainable development, and its importance acknowledged in the United Nations' 2030 Agenda. Sustainable Development Goal (SDG) 7 aims to "ensure access to affordable, reliable, sustainable, and modern energy for all"[5].

Energy needs for cooking often constitute the largest share of the overall national energy use in developing countries[6]. Kenya has been on the path of promoting modern cooking fuels and technologies such as LPG, Biogas, electric cooking etc. This has, however, not been achieved as desired since many people in Kenya continue to rely on biomass fuels mainly charcoal and firewood [7] which contribute significant amounts of greenhouse gas emissions and lead to respiratory illness and related mortalities due to exposure to household air pollution. Shortage of low-cost sources of energy has resulted in families' abandoning traditional foods that require long cooking time, such as *githeri* (maize and beans) to prepare faster cooking foods such as ugali (maize meal paste) or have resulted to using unhealthy materials as sources of energy such as plastics which have potential negative health impacts.[8] Stacking of fuels is also practiced in urban informal settlements[9] like in many other regions in sub–Saharan Africa.

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[1] UN-Habitat. 2003. The Challenge of Slums, Global Report on Human Settlements.
[2] Our World In Data, Share of urban population living in slums, 1990 to 2014, Global Change Data Lab. 2021. Retrieved from https://ourworldindata.org/grapher/share-of-urban-population-living-in-slums?tab=chart&country=KEN
[3] United Nations Economic and Social Council, Progress towards the Sustainable Development Goals (E/2020/57), 2020. Retrieved from https://unstats.un.org/sdgs/files/report/2020/secretary-general-sdg-report-2020--EN.pdf
[4] United Nations, Transforming our world: the 2030 Agenda for Sustainable Development, 2015
[5] United Nations, Transforming our world: the 2030 Agenda for Sustainable Development, 2015. Retrieved from https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
[6] Bhattacharya. S.C. (2002). Biomass energy in Asia: A review of status, technologies, and policies in Asia. Energy for Sustainable Development 6(3), 5-10
[7] MoE (2019). Abridged Report. Kenya Cooking Sector Study: Assessment of the Supply and Demand of Cooking Solutions at the Household level
[8] Njenga et al 2009. Community-based energy Briquette production from urban organic waste at Kahawa Soweto Informal Settlement, Nairobi. Urban Harvest Working Paper Series Paper
[9] Okore MKL, Koske J, & Letema S (2022). Household-based determinants of cooking and heating fuel mixes in informal settlements of Kisumu City, Kenya. Energy for Sustainable Development Volume 71: 64-72

There is a need among households in slum settlements for safe and affordable alternative sources of cooking fuel and, thus, the provision of clean, modern and affordable energy services to meet the cooking needs for households in the urban informal settlements presents an urgent need. Additionally, energy choices that promote energy stacking need to consider clean energy stacks. There is potential for substantial economic, health and safety benefits for low-income households and businesses adopting modern clean cooking systems such as electric cooking while at the same time stimulating legal electricity demand.

Challenges for the uptake of electric cooking in informal settlements include high upfront cost, limited awareness of energy -efficient electric cooking appliances, lack of access to electric cooking appliances, informal electricity connections, shared meters, and poor-quality wiring in the households. Some studies indicate that limited supply and high cost of energy-efficient stoves at local levels, shortages of electric meters, unavailability and high cost of spare parts, lack of access to credit facilities, and spending priorities for other basic needs affect the use of energy-efficient technologies[10], [11]. The cost of using ICS and cooking appliances is capital intensive and unaffordable. The importance of providing incentives and arranging flexible payment' systems and credit facilities is underlined[12].

Electricity access has also been cited as a challenge. In Kenya and many sub-Saharan African countries, efforts to electrify slums are confronted with barriers, among them, high connection fees and household inability to pay. Where electricity is available, families illegally share metres, or turn to unlicensed electricians and even local cartels that provide the service illegally[13]. Such illegal connections are not only unsafe, sometimes causing fires, but they also damage grid infrastructure and cause technical and non-technical losses for utilities. In Kenya, electricity access in the urban informal settlements has been accelerated by programmes such as Last Mile Connectivity Programme but faces low consumption or and misuse of meters[14]. Studies conducted in the urban areas hardly consider energy services beyond household use, e.g., energy for productive use are lacking. It is, thus, important to delve into the energy use for productive use in the urban informal settlements with a view of creating awareness and developing capacities to transition to cleaner fuels with the focus being electricity. Therefore, the need to identify mechanisms that can be implemented with the aim of promoting access to and use of electric cooking appliances by households and food businesses/enterprises in urban informal settlements, and ultimately, stimulate consumption of electricity is timely.

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[10] Zeng et al. 2018. On the Disruptive Innovation Strategy of Renewable Energy Technology Diffusion: An Agent-Based Model. Energies. 11, 3217

[11] Bayer et al. (2020). The need for impact evaluation in electricity access research. Energy Policy, 137

[12] Padam G et al (2018) Ethiopia-Beyound connections: energy access diagnostic report based on the multi-tire framework. World Bank Group, Washington DC

[13] Butera, Caputo, Adhikari, & Mele. 2019.

[14] Impact Evaluation of the AfDB-supported Kenya Last Mile Connectivity Project, Phase I: https://idev.afdb.org/sites/default/files/documents/files/IE%20of%20the%20AfDB-supported%20Kenya%20Last%20Mile%20Connectivity%20Project%20Phase%20I%20-%20Report.pdf
How Kenya Power 'lost' over 1m meters in Last Mile project: https://nation.africa/kenya/business/riddle-of-one-million-meters-that-kenya-power-lost-3571006

1.2. Purpose of study

The goal of the project was to conduct market scoping on electric cooking opportunities in informal urban settlements, to inform a market development intervention aimed at promoting access to and usage of electric cooking appliances by households and (food) businesses in informal settlements. To deliver this objective, there was need to generate evidence-based information on electric cooking by households and food businesses in urban informal settlements. The information generated from this study will feed into the development of the Kenya National Electric Cooking Strategy (KNeCS). The mapping out of market systems that can be developed to enhance utilisation of electric cooking appliances even in the informal settlements will contribute immensely to the achievement of universal clean cooking by 2028, of which electric cooking is one of the key pathways to achieving clean cooking. The aim is to assess the potential of the adoption of electric cooking by residents of urban informal settlements, both households and productive users such as enterprises involved in cooking food through development of interventions that will tap into and reach the informal settlements considered an unexplored electric cooking market.

First and foremost, it was, thus, necessary to understand existing potential for eCooking in urban informal settlements and the status of cooking in these settlements, for households and enterprises. Previous research shows that households in informal settlements in Kenya have developed cooking systems that work for them given their context[15] . An understanding of the current cooking practices and energy use, which includes fuel and technology adoption, will go a long way in establishing points of leverage for promotion and adoption of electric cooking. Further, understanding both external factors such as pricing and supply or availability, and internal household dynamics such as income, education level and decision-making channels among others will help identify some of the factors that influence or are thought to influence energy choices of households and businesses in the informal settlements. Through this study, we will be able to further understand the barriers to adoption of electric cooking by residents of these settlements.

Consumer financing and development of market interventions to counter the high upfront costs, which have often been cited as setbacks in acquiring electric cooking technologies, have a role in stimulating use of electricity for cooking for households and food businesses in urban informal settlements. As such, the study evaluated the opportunities and barriers that exists in expanding the niche markets for electric cooking. The ultimate aim was to expand the target market and users of electric cooking appliances into the urban informal settlements, which has often been left out, through pro-poor innovative business ideas that will facilitate the penetration of electric cooking appliances into these zones. Identification of methods that would be deployed in extending into the urban inform settlements and, therefore, attracting

[15] Lambe & Senyangwa. 2015. Identifying behavioural drivers of cookstove use: a household study in Kibera, Nairobi. Stockholm Environment Institute, Working Paper 2015-06

new users of electric cooking appliances, while also stimulating demand for electricity was therefore timely.

2.0 Approach and methodology

The study employed a mixed methods approach, incorporating qualitative and quantitative methodologies for data collection and analysis. To gather quantitative data, structured questionnaires were utilized and distributed to households as well as fuel and cookstove vendors. On the other hand, qualitative data was obtained through key informant interviews and focused group discussions guided by a predetermined set of questions. Overall, the study conducted a total of five focused group discussions: two in the informal settlements of Kibra and Mukuru, and one in the informal settlement of Mathare. However, the mapping and survey of fuel and cookstove vendors and survey and the survey of households were conducted only in the informal settlement of Mathare.

2.1 Household Survey Approach and Methodology

To achieve the goal of the eCap survey, a representative sample of 350 households within the informal settlement of Mathare were interviewed. Eligibility for the interview included all adult-headed households, considered as individuals who were 18 years old or older at the time of the survey, regardless of gender. For the purposes of the survey, a household was defined as a group of related or unrelated individuals residing together in the same dwelling unit, with one adult recognized as the head.

The sampling approach aimed to generate precise estimates at both the settlement level and, whenever possible, at the village level. Specifically, the survey utilized a sample drawn from an area frame created from the household enumeration exercise conducted by Slum Dwellers International (SDI) in Mathare Informal Settlement in 2022. This enumeration data from SDI provides the most up-to-date information on the number of households and the population of the settlement.

Sampling Methodology

The Informal settlement of Mathare is located within the Nairobi City County and spans across two sub-counties, Mathare and Ruaraka. The settlement is divided into four administrative wards: Hospital, Mabatini, Utalii, and Mlango-Kubwa. These wards are further subdivided into villages. Hospital ward has three villages (Mathare 4B, Kosovo, and Gitathuru), Mabatini ward has six villages (Mabatini, Kwa Kariuki, Mathare 3C, Mathare 3A, Mathare No. 10, and Mashimoni), Utalii ward has one village (Mathare 4A village), and Mlango-Kubwa ward has three villages (Kiamutisya, Village 2, and Mathare 3B). Although there are a total of 13 villages in the settlement, the SDI enumeration combines Mabatini and Kwa Kariuki villages thus reducing the number of villages to 12. Further, SDI refrained from conducting an enumeration in Gitathuru as residents expressed reluctance due to concerns about potential evictions associated with such exercises. As a result, the estimates provided for Gitathuru were derived

from community leaders' approximations, which indicate that Gitathuru and village 4B are similar in the numbers of households and land area. Table 1 summarises the distribution of households and population within the informal settlement of Mathare.

Table 1: Household and Population Distribution in Mathare

	Village	Households	Population	Totals
Hospital Ward	Mathare 4B	1949	7,796	
	Kosovo	3906	15,624	
	Gitathuru†	1949	7796	
	Sub-Total	**7504**		**31216**
Mabatini Ward	Mabatini/Kwa Kariuki††	6249	24,996	
	Mathare 3C	3597	14,388	
	Mathare 3A	4421	17,684	
	Mathare No. 10	4375	17,500	
	Mashimoni	7770	31,080	
	Sub-Total	**26412**		**105,648**
Utalii Ward	Mathare 4A village	3741	14,964	
	Sub-Total	**3741**		**14,964**
Mlango-Kubwa Ward	Kiamutisya	2369	9,476	
	Village 2	13035	52,180	
	Mathare 3B	9945	39,780	
	Sub-Total	**25359**		**101,436**
Mathare Settlement	**Grand Total**	**63016**		**253,264**

Note:
†-the SDI data did not have population values for Gitathuru village. The figures were estimated based on community leaders' knowledge of the settlement and estimation that Gitathuru and Mathare 4B are similar in size. ††-the SDI data combined Mabatini and Kwa Kariuki villages.

The well-defined administrative structure of Mathare, comprising wards and villages with distinct boundaries, served as the rationale for adopting Multi-Stage Area Stratified Cluster Sampling. Due to data limitations on the prevalence of eCooking in the informal settlement of Mathare, the sample size computation was based on overall electricity access rates, regardless of whether it is formal or informal connections. The sample size for the study was determined based on the standard 95 percent confidence level, which is considered conservative in terms of precision. The sample size was determined as follows:

$$n_h = \frac{(Z^2)(r)(1-r)(f)(k)}{(E^2)} \quad \text{.......} \quad (1)$$

Where:

n_h is the sample size-number of households in the sample.

Z is the level of confidence.

r is an aggregate electricity access (both formal and informal).

f is the design effect to account for stratification and clustering.

k is the non-response rate.

e is the margin of error.

The selection of households in the Multi-Stage Area Stratified Cluster Sampling involved dividing the settlement into villages, and within each village, segments were created. From

each segment, clusters consisting of 5 households were selected. The distribution of the sample was based on probability proportionate to size as shown in table 2.

Table 2: Distribution of Sampled Households

	Name	Total Population	HH Allocations	Adjusted Allocation
1	Mathare 4B	7796	10	20
2	Kosovo	15624	17	20
3	Gitathuru	7796	10	20
4	Mabatini/Kwa Kariuki	24996	28	50
5	Mathare 3C	14388	16	20
6	Mathare 3A	17684	20	20
7	Mathare No. 10	17500	19	20
8	Mashimoni	31080	35	35
9	Mathare 4A village	14964	17	20
10	Kiamutisya	9476	11	20
11	Village 2	52180	59	60
12	Mathare 3B	39780	45	45
	Total	**253264**	**287**	**350**

Sampling Weights

To ensure representative results at the settlement level, we applied sampling weights in the analysis. Since the survey utilized a two-stage area stratified cluster sampling method, the sampling weights are we calculated the sampling weights by considering the sampling probabilities for each stage as follows:

$$SW_{vi} = \frac{1}{P_{1vi} \times P_{2si}}$$

Where:

P_{1vi} is first-stage sampling probability of the ith enumeration area in village v.

P_{2si} is the second-stage sampling probability of selecting household i within the ith segment of village v.

2.2 Market Scoping Approach and Methodology

The primary objective of the market scoping component in the study was to evaluate the market potential for eCooking in the informal settlement of Mathare. To accomplish this, the study mapped the locations of all cookstoves and fuel vendors within the settlement to understand their distribution. Subsequently, a survey questionnaire was administered to gather information directly from business owners in the market. The goal was to gain insights into the existing cooking solutions market landscape and assess the viability of eCooking in the settlement. Nonetheless, the response rate was adversely affected by the political environment, as cookstove and fuel vendors mistakenly believed that the survey was conducted for tax purposes in light of the Finance Bill 2023/2024. In cases where a business declined to participate in the interview, only mapping was carried out.

2.3 Testing of Electric Cooking Appliances

The objective of testing electric cooking appliances was to gain insights into cooking practices in urban informal settlements by assessing the use of electric pressure cookers as a case study. The testing component of the study involved two main approaches: maintaining cooking diaries and conducting electric cooking demonstrations.

To achieve the study's objectives, a community-based participatory approach was employed. Right from the outset, there was close collaboration with two community leaders associated with the Ghetto Foundation and Muungano wa Wanavijiji, which are Community-Based Organizations (CBO) located in the informal settlement of Mathare. Through the partnership, 15 participants for the cooking diary component were selected, comprising 10 households and 5 businesses, distributed across the settlement.

We sought to understand cooking practices in urban informal settlements by testing the use of electric pressure cookers within the settlement. The testing section of the project adopted two approaches: cooking diaries and electric cooking demonstrations.

2.3.1 The Cooking Diaries Approach

The cooking diaries entailed daily documentation of menus and cooking practices of households and food businesses. The objective was to capture a comprehensive overview of typical cooking practices, including the types of food prepared, meal preparation times throughout the day, duration of food preparation, energy consumption, and the appliances and utensils utilized in the cooking process.

The selection of cooking diary participants was done in collaboration with the community leaders and was based on the following criteria:

- Participants must reside in the Mathare informal settlement to ensure insights are location-specific.
- Preference is given to family households over individuals living alone to capture regular cooking habits.
- Both households and food businesses must have electricity access, especially vital for the use of Electric Pressure Cookers (EPCs). For this reason, residents of Kosovo village, which lacks electricity, were excluded.
- It's important to include people from various cultural backgrounds to gain insights into different cooking practices.
- Having sockets in the cooking area is essential for the effective use of EPCs and monitoring via smart metering technology.
- Households should engage in daily cooking to provide comprehensive data on cooking behaviours and decisions.
- Participants need to be willing and committed to engage in the study and provide accurate data.

- The ability to read and write is necessary so that participants can keep detailed records of their cooking activities.

Following the selection of participants based on the criteria outlined, a comprehensive one-day training session was conducted. This training focused on familiarizing participants with the process of completing the cooking diary forms and included instructions on properly weighing the fuels they used for cooking. Each participant was provided with diary forms (see Annexes) and weighing scales to facilitate data collection.

Additionally, two enumerators, who were residents of Mathare, were hired and in data collection and data entry using the computer-aided data collection software Survey CTO. The enumerators were responsible for conducting daily follow-up visits to the participants, collecting the completed cooking diary forms, verifying the data entered, and assisting with any challenges encountered while filling the cooking diaries. Given the fifteen participants, one enumerator was assigned seven participants while another eight.

There were two levels of oversight in place for cooking diaries. The community leaders served as the first level of supervision, ensuring that the project was conducted smoothly within the community. They provided guidance, support, and local knowledge. The second level of oversight was provided by the Nuvoni staff, who supervised the diaries, monitored data quality and ensured guidelines were followed.

The tasks carried out by the enumerators during data collection included:

- Collection of the filled-in diary forms from the households
- Verification of the entries made on the forms
- Entering the data on Survey CTO for transmission to Nuvoni.

Implementation of the cooking diaries

The cooking diaries were implemented in two phases as follows:

a. Phase 1-Baseline Phase

Phase 1 served as the baseline phase for the cooking diaries project. Prior to the commencement of this phase, the enumerators conducted an entry survey. The primary objective of the baseline phase was to document and understand the existing cooking practices of both households and food businesses before introducing Electric Pressure Cookers (EPCs) to the participants. This phase aimed to gather information on current cooking practices, types of fuels used, fuel consumption, and the time spent cooking various dishes. The baseline phase spanned a duration of two weeks (14 days), during which participants from households and food businesses maintained a daily cooking log.

b. Cooking demonstration

An electric cooking demonstration was organised following the baseline phase and preceding the intervention phase (Phase 2). The primary objective of this demonstration was to introduce the participants to electric pressure cookers (EPCs) through a practical one-day session. The

event took place on 7th June 2023 at St. Teresa's Catholic Parish, Eastleigh, in collaboration with Agnes Kalyonge from Jikoni Magic. Jikoni Magic is well-versed in conducting cooking demonstrations using various electric cooking appliances and possesses extensive knowledge of local cuisines, ensuring their compatibility with the participants' preferences.

The cooking demonstration aimed to achieve several objectives. Firstly, it aimed to increase awareness about electric pressure cookers among the cooking diary participants. Additionally, the session aimed to educate the participants about electric cooking, emphasizing safety precautions and general maintenance of the EPCs. This included guidance on cleaning the EPCs and maintaining overall cleanliness in the cooking process.

Photo 1: Training session on care and maintenance of electric pressure cooker

The purpose of the demonstration was to empower participants to comfortably engage with the electric pressure cookers (EPCs) and confidently prepare a wide range of dishes. Beyond that, the demonstration served as an opportunity for creating awareness about the use of EPCs and provided a platform for participants to interact, ask questions, and seek clarification from a seasoned user. The goal was to ensure that participants felt equipped with the knowledge and skills necessary to effectively utilize the EPCs in their cooking practices.

Photo 2: Electric cooking interactive session

A menu for the cooking demonstration was developed in collaboration with the community leaders and Jikoni Magic. These dishes were prepared in the presence of the participants to showcase the capabilities of the electric pressure cookers (EPCs). The intention was for the participants to subsequently adopt the use of EPCs for their household and food business

cooking needs. The cooking demonstration included preparing various dishes, such as ugali, *pilau*, *omena*, chicken, *Sukuma wiki*, sweet potatoes, beef stew, and *githeri*.
The cooking demonstration was designed to be participatory, encouraging active engagement and interaction between the participants and the demonstration team. Participants were able to freely ask questions, share their experiences, and exchange insights with the team.
Following the successful execution of the electric cooking demonstration, each participant was provided with an electric pressure cooker. This cooker would be utilized by the participants from Nuvoni, which they were to use for their cooking activities during the intervention phase (Phase 2) of the project.

Photo 3: Participants receiving their Electric pressure cooker for use in their houses and food businesses.

c. Phase 2-Intervention phase

Similar to the previous phase, phase two of the study lasted two weeks. During this period, the participants were encouraged to integrate the electric pressure cookers (EPCs) into their regular cooking practices without imposing any precondition on their usage. The aim was to observe how quickly they would adopt the appliance and how frequently they would utilize it for their cooking needs.
Upon the conclusion of this phase, exit interviews were conducted. These interviews served multiple purposes, including evaluating the participants' willingness to pay for the EPCs and determining the amount they would be willing to invest in acquiring them. Additionally, the overall user experience of the EPCs based on the feedback received from the participants was assessed. These interviews provided valuable insights into participants' perceptions and experiences, helping gauge the acceptability and usability of the EPCs in the context of household cooking practices.

3.0 Stakeholder interactions

Active engagement with various stakeholders throughout the project was instrumental in its implementation and success. There was close collaboration with community members associated with Ghetto Foundation and Muungano wa Wanavijji, two community-based organizations (CBOs) deeply rooted in Mathare. Additionally, the community researchers, Jikoni Magic, PowerPay, Gamos East Africa, A2EI, and SCODE, provided valuable contributions and support.

The involvement of these stakeholders allowed us to tap into local expertise, leverage community networks, and gain insights from diverse perspectives. The collective efforts and collaboration of these individuals and organizations greatly enhanced the project's effectiveness and ensured its alignment with the needs and realities of the Mathare community.

To ensure the successful implementation of the project, frequent consultative sessions were conducted with our community collaborators. These sessions, both planned and *ad hoc*, served as valuable forums for brainstorming ideas, discussing project approaches, and planning activities such as data collection in Mathare, as well as the implementation of the cooking diaries and demonstration.

An initial consultative meeting with community leaders was held on 20th April 2023. The primary objective of this meeting was to provide them with an orientation to the project. The project goals were elaborated on, activities outlined, and expected outcomes discussed. This orientation informed their active engagement and clarified their roles throughout the study. The role of the community leaders included:

- Gatekeeping.
- Mobilisation of participants for meetings such as focus group discussions, eCooking demonstrations.
- Logistical support such as booking venues for activities such as the eCooking.

The engagement with the Mathare community leaders proved mutually beneficial for both teams. As an organization, Nuvoni contributed to the local community's economic empowerment and enhanced its data collection capacity. Through the collaborations, a valuable exchange of knowledge and expertise was fostered.

The engagement during the questionnaire development and other study facets gave the research team a unique opportunity to gain a deeper understanding of the local dynamics within the informal settlements, particularly in Mathare. This enabled contextualizing the research and ensuring its relevance and applicability to the specific needs and challenges faced by the community in the informal settlement of Mathare.

4.0 Analysis and results

This section provides a comprehensive synthesis of the quantitative and qualitative analysis of the collected data. The analysis is structured around three main areas of focus, which are discussed in subsequent sections.

4.1 Household Characteristics and Demographics

Social Economic Characteristics of the Mathare Informal Settlement

In the Mathare Settlement, housing conditions are primarily semi-permanent (69%), followed by permanent (22.2%) and temporary (8.8%).

Most housing units have iron sheet roofs (86.8%), iron sheet walls (68%), and cement floors (67.6%).

From the analysis:

- Female-headed households constitute 48.9 percent of the total, while male-headed households make up 51.1 percent.
- Male-headed households tend to have larger average household sizes (3.7 persons) compared to female-headed households (3.5 persons).
- Most household heads and their spouses had attained education at the primary and secondary levels, as depicted in Figure 1.

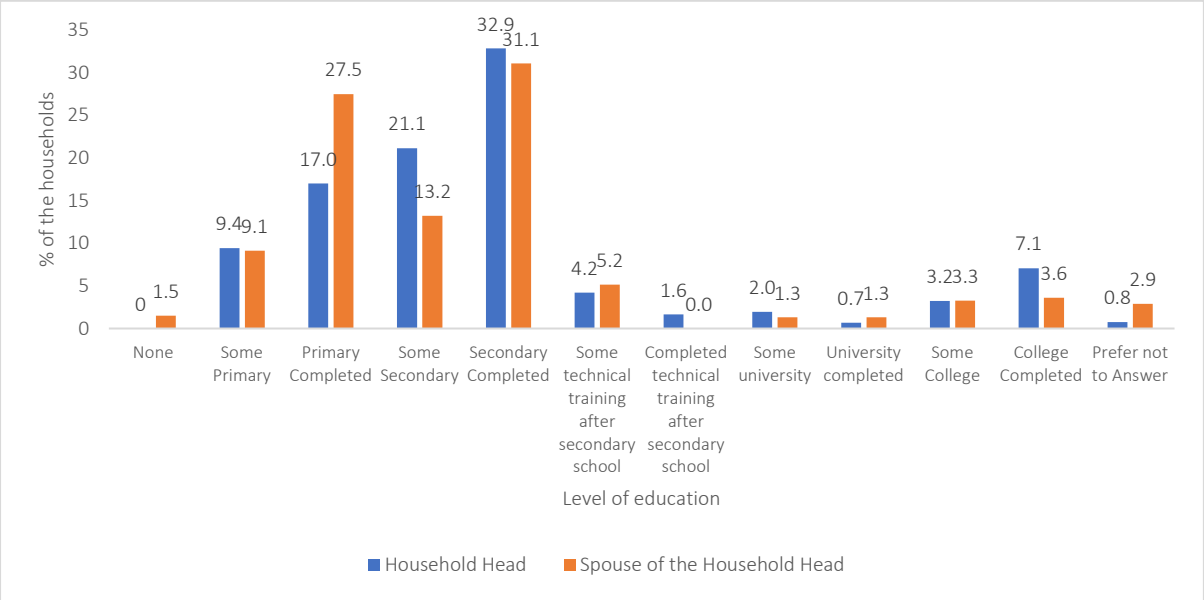


Figure 1: Distribution of Education of Household Heads and Spouses

Most household heads and their spouses have education at the primary and secondary levels, which is attributed to challenges like limited access to quality education facilities, insufficient infrastructure, and inadequate resources pose significant barriers to educational opportunities (Corburn, Ngau, Karanja, &

Self-employment accounts for 33.9% of household income. Casual work constitutes 37.5% of household income.

Makau, 2012). Closely associated with educational attainment is the household wealth distribution. The survey findings reveal minimal differences in wealth quantiles among households are observed, aligning with the concentration of education at the primary and secondary levels in line with human capital theory. Similar findings are obtained by the Abala, Nyambuga, Wairutu, and Kori (2022). Figure 2 shows the simialrity in wealth distribution by gender.

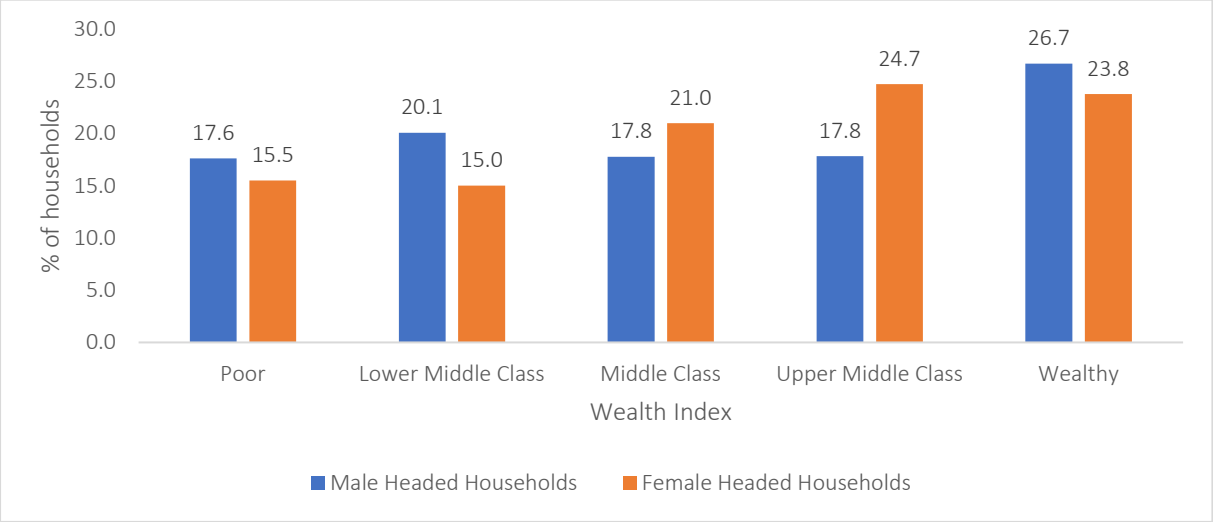


Figure 2: Distribution of Wealth Quintiles by Gender of Household Head

4.2 Household Access to Electricity in the Informal Settlement of Mathare

Electricity access in informal settlements remains a paramount concern. A reliable and stable electricity supply is key to the transition to electric cooking. As depicted in figure 3, household Electricity in Mathare informal settlement is dominated by:

- 86.5 percent main grid connection[16],
- 0.5 percent Solar Home Systems.
- 13.0 percent unconnected.

[16] Households connected to the main grid comprise both those with legal connections through Kenya Power and those with illegal connections.

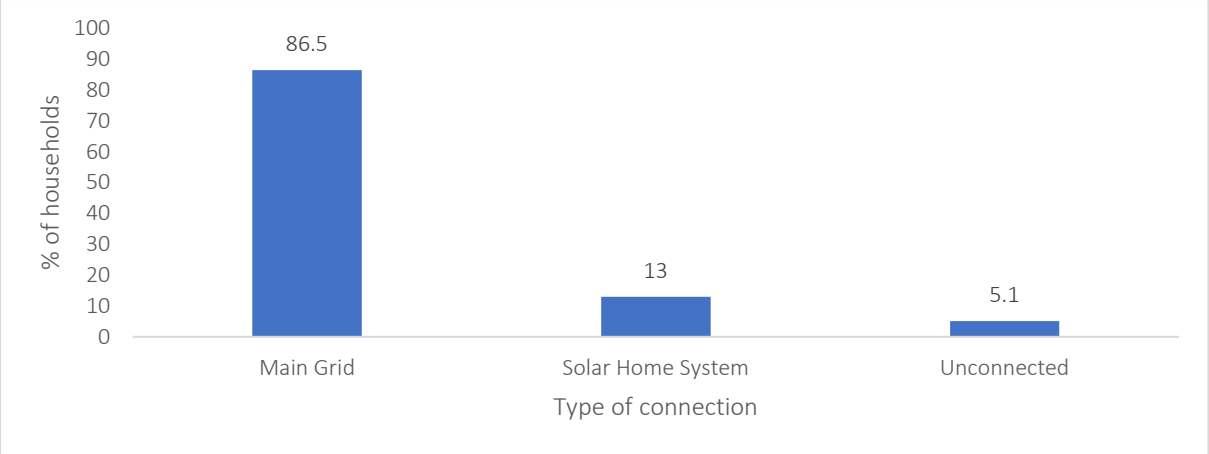


Figure 3: Type of power connection

However, the unconnected households were previously connected to the grid. In the informal settlement of Mathare, the entire Kosovo village lack electricity. It is interesting to note that such cases are also replicated in other informal settlements in Nairobi. For instance, Kisumu Ndogo village in the informal settlement of Kibra also lack electricity connection. Hence, although these villages are currently unconnected, it is important to note that they are unconnected in the traditional sense of the word[17]. To accommodate the unique characteristics of the informal settlement context, the study adopts the Multi-Tier Framework

> Informal resellers, often residents themselves, provide these informal electricity connections. They illegally tap electricity from Kenya Power distribution lines and transformers and distribute the power to households and small businesses. They may have limited expertise regarding electricity connections but possess an understanding of the energy requirements, habits, and affordability of the residents. They provide flexible payment options at rates lower than those offered by Kenya Power making their connection appealing.

guidelines developed by the World Bank and World Health Organization (2021) for analysing household electricity access in Mathare's informal settlement. However, contextual modifications have been made to align with the specific circumstances of the area. For example, household electricity connections are categorized into formal and informal connections[18] as oppsed to the standard grid and off-grid classification.

Following this classification, it is evident that household grid electricity is dominated by informal connections as shown Figure 4.

[17] When Kenya Power staff observe residents in an area using electricity illegally, they dismantle the illegal connections. If the issue persists, they may remove the transformer until the problem is completely resolved. This process can take anywhere from a few weeks to several years.

[18] Electricity connection is considered formal if the household use grid electricity and makes electricity payment to the utility company (Kenya Power and Lighting Company (KPLC)) and informal if the household uses grid electricity service without paying either directly or indirectly to KPLC. The connection is mostly done by Informal Resellers who collect payments from households.

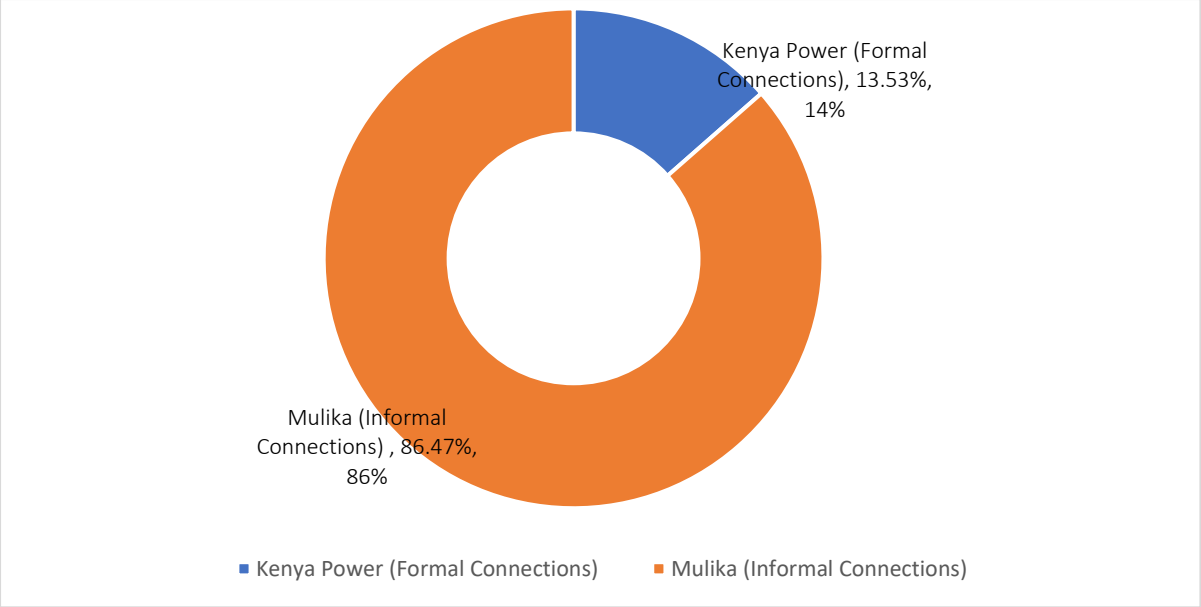


Figure 4: Type of electricity connection

Economic factors play a significant role in driving the prevalence of informal electricity connections in Mathare. The analysis conducted highlights a correlation between the type of grid connection and household wealth quintiles. Notably:

- Households in the highest wealth quintile show a greater proportion of formal grid connections.
- Male-headed households have more formal grid connections, aligning with their higher wealth quintile representation., as illustrated in Figure 5.
- Households with formal connections pay higher monthly bills (Kshs. 786) than those with informal connections (Kshs. 314). This implies that the relatively lower cost associated with informal electricity connections may significantly drive the demand for informal electricity connections in the settlements (Figure 5).

The informal electricity connections market exhibits a considerable level of structure, with customer service options available to households. Notably:

- 43.9% of households prefer contacting informal electricity vendors during power outages.
- Only 1.4% of households choose to contact Kenya Power and Lighting Company.
- This data demonstrates a strong reliance on local electricity vendors for addressing service disruptions.
- It also suggests the presence of a robust and effective customer service network within the Mathare informal settlement.

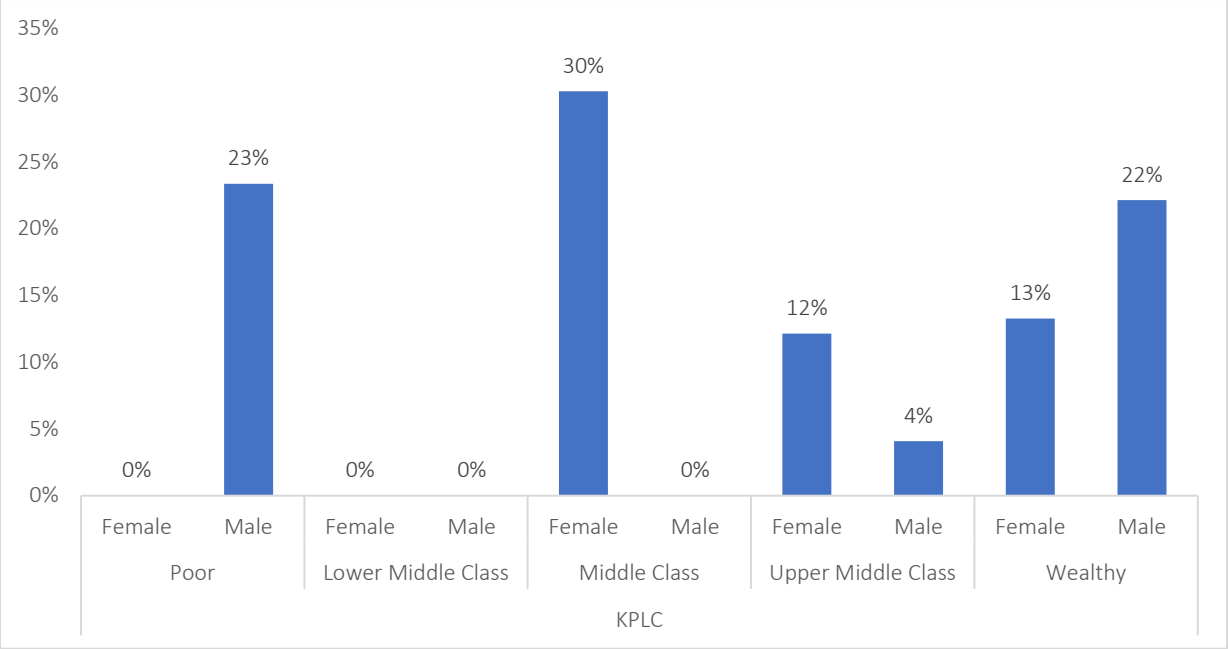


Figure 5: Type of electricity connection and household characteristics

However, the informal electricity connections pose risks to households as will be analysed in the subsequent section under the muti-tier framework.

Household Electricity and Potential for eCooking in Mathare: Multi-Tier Framework Approach

To gain a comprehensive understanding of household electricity access, the analysis employed the Multi-Tier Framework (MTF) developed by Bhatia and Angelou (2015), and subsequently operationalized by the guidelines provided by the World Bank and World Health Organization (2021). Application of the MTF framework enabled deeper insight into household access to electricity in Mathare.

The MTF profiles household electricity connections based on seven attributes: Capacity, Availability, Reliability, Quality, Affordability, Formality, and Health and Safety. Capacity assesses the ability of household electricity to support different appliances, while Availability measures the duration of electricity availability. Reliability captures the frequency and duration of unscheduled outages, and Quality evaluates the voltage stability. Affordability examines households' ability to pay for electricity, while Formality determines the legal status of households' connections. Health and Safety considers potential risks to users, such as electrocution or fire hazards.

Based on the MTF framework, household access to electricity connections is categorized into six tiers, ranging from tier 0 representing no access to tier 5 representing full service. The findings of the Multi-Tier Framework (MTF) analysis regarding household access to electricity in the informal settlement of Mathare are summarized in Table 4?.

Table 3: MTF classification of household electricity connection in Mathare

	Capacity Tiers	Availability Tiers		Reliability Tiers	Quality Tiers	Affordability Tiers	Formality Tiers	Health and Safety Tiers
		24-hours	4-Hours					
Tier 0			1%					17%
Tier 1	26%	3%	2%					
Tier 2	4%	14%	21%			53%		
Tier 3		29%	15%		47%		89%	
Tier 4	3%	30%		10%				
Tier 5	67%	24%	61%	90%	53%	47%	11%	83%

In the Mathare informal settlement, a significant majority of households (67 percent) have access to an electricity connection that can power all their electric cooking appliances.

This analysis reveals a discrepancy compared to the standard MTF guideline, which categorizes all grid electricity as Tier 5 in terms of capacity. However, it is crucial to acknowledge that the electricity services available to households in the informal settlement are dependent on electricity vendors. During focus group discussions (FGDs), participants mentioned that certain informal electricity vendors implement control measures to manage the use of electric appliances to maintain a relatively consistent supply to their clients. In cases where individuals are permitted to use electric coils without such control measures, they often face frequent and prolonged blackouts that can last for days or even weeks.

"You know the people using electricity are many and the electricity is less so you cannot use it for cooking. You know you can only cook with electricity when there is enough power". FGD Participant.

"…the people who have electricity do not allow you to use it for cooking. You know they removed the transformers that were here so when someone brings electricity from far and you cook with it, it will cost them too. Wires burn so they limit people from cooking, and it also prevents fire accident" …FGD participant.

Households in the informal settlement of Mathare face challenges regarding the availability of electricity, particularly when assessing availability over a 24-hour period. As indicated in Table 3:

- Only 36.6 percent of households have access to electricity for at least 23 hours.
- In contrast, the majority of households (57.6 percent) have access to electricity for at least 4 hours during the crucial evening period from 6pm to 10pm, which is when most cooking activities occur.

Consequently, informal settlements such as Mathare and Kibra face challenges due to the prevalence of informal connections, which are unreliable and pose risks to the residents. During focus group discussions, participants highlighted that certain villages, such as Kosovo in

Mathare and Kisumu Ndogo in Kibra, lack access to electricity entirely, an aspect that motivates informal connections.

The control of illegal electricity connections, as depicted in Photo 4, rests with informal electricity vendors operating in these areas. Informal settlements are plagued with informal electricity connections, which are unreliable and pose a risk to the residents of these settlements, as illustrated by photo 4. Informal electricity vendors control electricity connections in informal settlements.

Photo 4: Left and middle: Cables used to tap electricity from nearby transformer, which is then used to supply electricity in the settlements. Right:Thin aluminium wires crisscrossing the settlements. Photo credits: Abigael Okoko

There are glaring quality and health and safety concerns regarding household electricity in Mathare, with a significant number of households experiencing issues.

- Notably, 36.5 percent of households reported electric appliance damage within the past year, while 5.7 percent reported electricity-related injuries during the same period.

To assess the quality and safety of household wiring, plug testers were utilized to conduct tests on the wiring systems. The result from the surveys is supported with the outcome of household wiring tests as shown in figure 5.

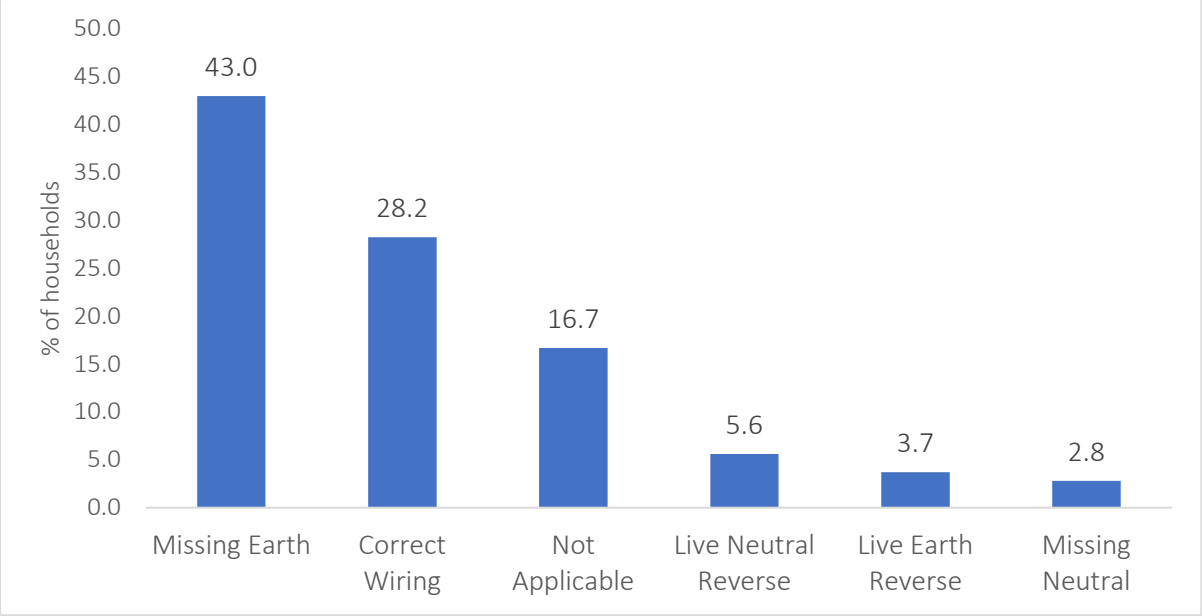


Figure 6: Quality of household wiring in Mathare

Only 28.2 percent of the households in Mathare Informal Settlement have the correct wiring installation (see figure 6).

Photo 6 showcases an example of a typical household wiring installation, highlighting the common issues and challenges observed in the household wiring installations.

- The prevalence of improper wiring, shown in Figure 6 and Photo 5, may be indicative of the high occurrence of reported injuries among households in the study.
- Significantly, households report wiring installations by uncertified electricians (44 percent), certified electricians (10 percent), or self-installation (6.9 percent).

These findings underscore the importance of proper electrical installation carried out by qualified professionals to ensure safety and reduce the risk of injuries in households.

Photo 5: Left: Wiring in one of the households. Right: Vandalised KPLC token system in a household in the informal settlements

4.3 Cooking Practices in the Informal Settlement of Mathare

The cooking practices of households in the informal settlement of Mathare were extensively investigated using both the household survey and the cooking diaries, as outlined in the study's methodology. The findings obtained from these two approaches align consistently and will be discussed in detail in the following sections. This comprehensive examination sheds light on the prevalent cooking practices within Mathare and provides valuable insights into cooking behaviours, fuel usage, and other relevant aspects related to cooking in Mathare.

4.3.1 Meals and Dishes

The meals prepared by households in the Mathare informal settlement were categorized into various categories, including breakfast, lunch, supper, snacks, and food for babies. Each category comprised different dishes based on the specific purposes for which households prepared them.

- Household survey data shows that in the Mathare informal settlement, supper and breakfast are the most frequently prepared meals (Figure 7).
- Findings from household cooking diaries, as summarized in Table 5, also reveal that breakfast and supper are the most commonly prepared meals by households.

> In phase 1, 68.4% of cooking events were done by females.
> In phase 2, this increased to 71.2% of cooking events being carried out by females.

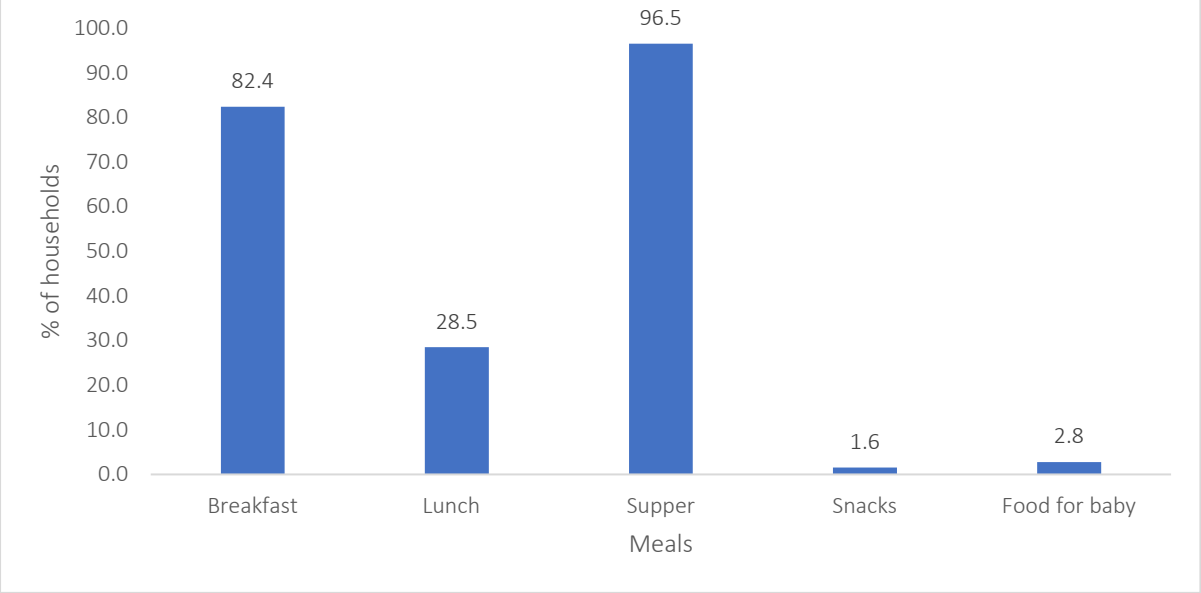


Figure 7: Proportion of Household Preparing Different Dishes

Of the records kept during both phases, breakfast accounted for the largest proportion of the events recorded.

- The breakfast events saw a 3.2 percent increase.

- Lunch events represented the smallest proportion, with a 0.6% reduction during phase 2.
- Lunch events are lower due to people being away from home during conventional lunch periods.
- School-going children have lunch at school, contributing to reduced cooking activities at home.
- Supper accounted for 37.7 percent of cooking/heating events in phase 1 and 39.9 percent in phase 2.

Breakfast and supper emerged as the most frequently prepared meals from both the household survey and cooking diaries as shown in figure 7 and table 5 respectively.

Table 4: Cooking or heating events

	Phase 1				Phase 2		
	Frequency	Valid %	Cumulative %		Frequency	Valid %	Cumulative %
Breakfast	95	38.5	38.5	Breakfast	120	41.7	41.7
Lunch	40	16.2	54.7	Lunch	45	15.6	57.3
Supper	93	37.7	92.3	Supper	115	39.9	97.2
Snack	2	0.8	93.1	Snack	3	1.0	98.3
Food for baby	8	3.2	96.4	Food for baby	2	0.7	99.0
Water heating	9	3.6	100	Water heating	3	1.0	100

As indicated in Table 5:

- The average number of people served by meals prepared by households increased in phase 2 compared to phase 1.
- The minimum and maximum number served remained the same between phases.
- This suggests that the household population remained relatively stable during the data collection period.
- The number of people served per meal directly impacts the amount of food cooked and, consequently, influences the household's energy consumption patterns.

This is an indication that during the data collection period, the household population remained almost the same. The number of people served by a particular meal has a direct relationship with the amount of food cooked and, therefore, would influence the energy consumption patterns of the household.

Table 5: Number of People Served by Meals

Phase 1	Minimum	Maximum	Mean	Median	Std. Dev
Number of people served	1	8	3.16	3.0	1.312
Adults	0	6	1.81	2.0	0.812
Children	0	3	1.34	1.0	1.018
Phase 2					
Number of people served	1	8	3.58	3.0	1.341

Adults	0	6	2.05	2.0	1.094
Children	0	3	1.53	2.0	0.879

Table 7 identifies the specific food types that the households prepared during this phase.

- In phase 1, participating households prepared a total of 33 unique dishes compared to 26 dishes prepared in phase 2.
- Ten (10) dishes that were cooked during phase 1 were not recorded in phase 2. One probable reason is that the households did not cook them during phase 2 on the other hand, 4 of the dishes not recorded in phase 1 were recorded to have been cooked in phase 2.

This analysis indicates that food choices made by the houses are not variant in nature, and households continued to cook their preferred dishes. Variations in dish choices may be introduced by occasions or situations, such as entertaining guests, which may or may not influence households' typical daily dish choices. Understanding of household dish preference is key in assessing the compatibility of dishes to proposed appliances as a determinant of the adoption of electric cooking solutions.

Table 6: Food types cooked by the households.

	Phase 1		Phase 2	
Dish	N	%	N	%
beans	13	3.30	16	3.93
Beef	15	3.81	23	5.65
Butternut	0	0.00	1	0.25
Cabbage	9	2.28	16	3.93
Chapati	1	0.25	2	0.49
Chicken	2	0.51	0	0.00
chicken parts	5	1.27	1	0.25
Dengu (green grams)	4	1.02	7	1.72
eggs	12	3.05	11	2.70
Fish	10	2.54	7	1.72
Githeri	15	3.81	13	3.19
green maize	1	0.25	0	0.00
Kienyeji vegetables	10	2.54	5	1.23
liver	4	1.02	9	2.21
Lungs (mahori)	1	0.25	1	0.25
Mandazi	2	0.51	0	0.00
Matoke	11	2.79	6	1.47
Matumbo	0	0.00	1	0.25
Milk	2	0.51	1	0.25
Mokimo	2	0.51	0	0.00
Nduma	1	0.25	0	0.00
Njahe	3	0.76	0	0.00

Omena	11	2.79	4	0.98
Pancakes	1	0.25	0	0.00
Pasta (spaghetti, indomie)	4	1.02	1	0.25
Peas	2	0.51	0	0.00
Pilau	6	1.52	10	2.46
Pork	1	0.25	1	0.25
Porridge	9	2.28	17	4.18
Potatoes	0	0.00	2	0.49
Pumkin	1	0.25	0	0.00
Rice	36	9.14	39	9.58
Sossi soya	0	0.00	1	0.25
Sukuma wiki/spinach	26	6.60	19	4.67
Sweet potatoes	4	1.02	0	0.00
Tea	105	26.65	124	30.47
Ugali	65	16.50	69	16.95

- Hot drinks like tea were the most preferred choice for breakfast among the households.
- Breakfast accompaniments, such as mandazi and chapati, were seldom prepared at home due to their availability from local vendors.
- Ugali topped the list of frequently prepared starchy foods, followed by rice.
- A variety of proteins, including beef and fish, were commonly cooked among the households.

Number of Dishes Cooked per Meal

Table 8 indicates the number of dishes that made up a meal.

Single-dish meals were highest during breakfast while meals with multiple dishes were highest during supper for both phases as indicated in Table 8.

Table 7: Complexity of meals

Phase 1	Number of dishes			
	1 dish	2 dishes	3 dishes	4 dishes
Breakfast	64	28	2	1
Lunch	18	13	8	1
Supper	17	55	18	3
Food for baby	6	1	1	0
Snacks	2	0	0	0
Phase 2				
Breakfast	96	23	1	0
Lunch	19	22	4	0
Supper	43	63	6	3
Food for baby	2	0	0	0
Snacks	1	2	0	0

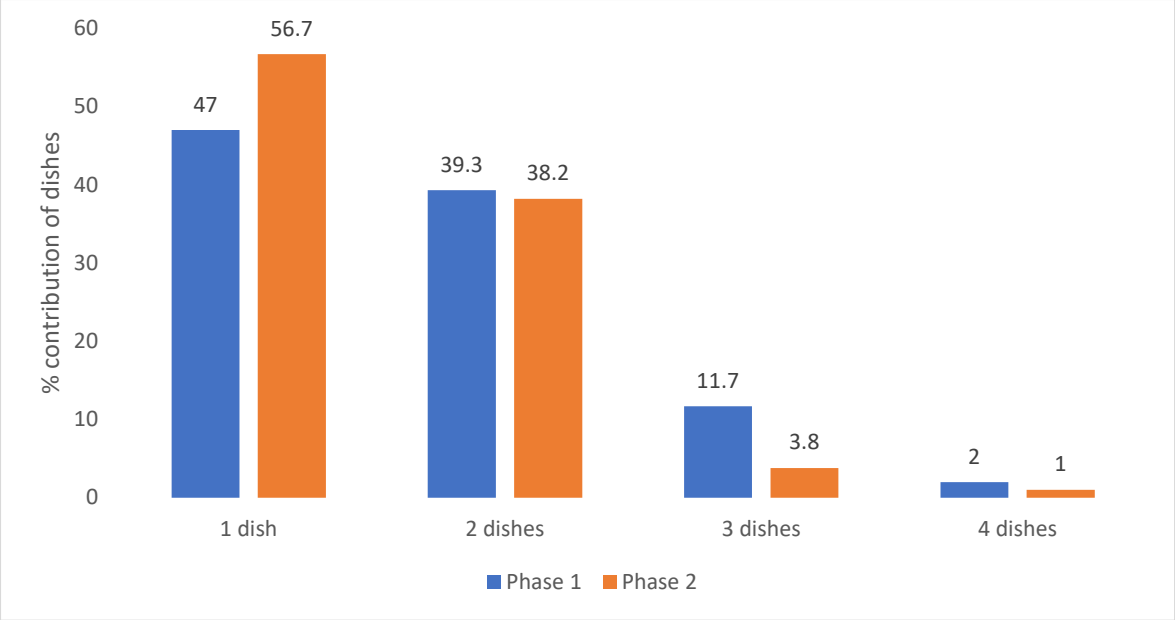


Figure 8: Percent contribution of dishes to meals

In general:

- Participants generally prepared more single-dish meals during both phases of the study. However, the margin between the number of dishes prepared was greater in phase 2 compared to phase 1. Specifically, the margin between single and double-dish meals was more than 2 times higher in phase 2.
- This change can be attributed to the use of the EPC (Electric Pressure Cooker), which typically has a single pot and thus requires washing after a single use.
- The introduction of the EPC may have influenced households to adopt more single-dish meals compared to preparing compounded meals with multiple dishes.
- The choice of cooking appliances can impact meal preparation patterns in households.

Status of meals

We categorized the dishes prepared for respective meals as either fresh, reheated or partially cooked. Figure 9 and Figure 10 present an indication of the status of dishes prepared during phase 1 and 2 respectively. We extracted the status of individual dishes that contributed to the meals and summed them up. The aggregation includes up to three dishes per meal since the number of cases that recorded four dishes in a meal were minimal.

From the analysis,

- 100% of the food prepared for babies was fresh during both phases.
- For other meals, a mixture of statuses was observed.
- Among the mixed-status meals:
    - Reheating dishes had a higher contribution to the status of meals prepared compared to partially cooked dishes during lunch and snacks.
    - Supper saw an equal contribution of reheated and partially cooked foods in phase 1.

- In phase 2, there was a higher contribution of partially cooked food for supper, as shown in Figure 2 and Figure 3.

- The food status during meal preparation varied between phases, with phase 2 showing a shift towards a higher contribution of partially cooked food for supper.

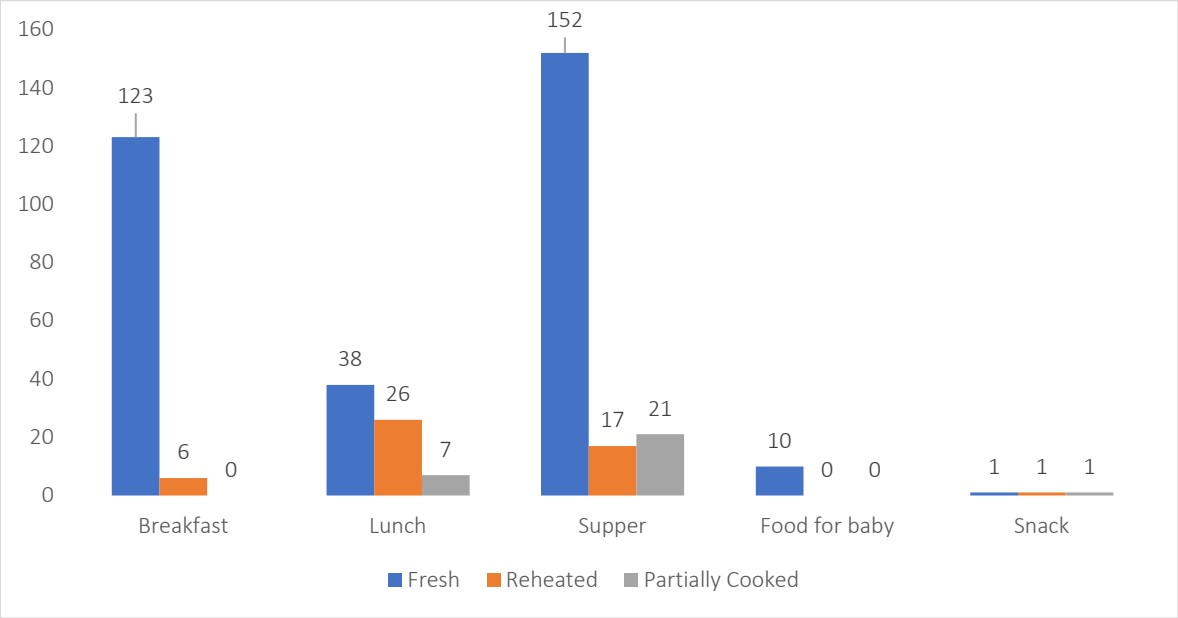


Figure 9: Status of meals prepared-Phase 1

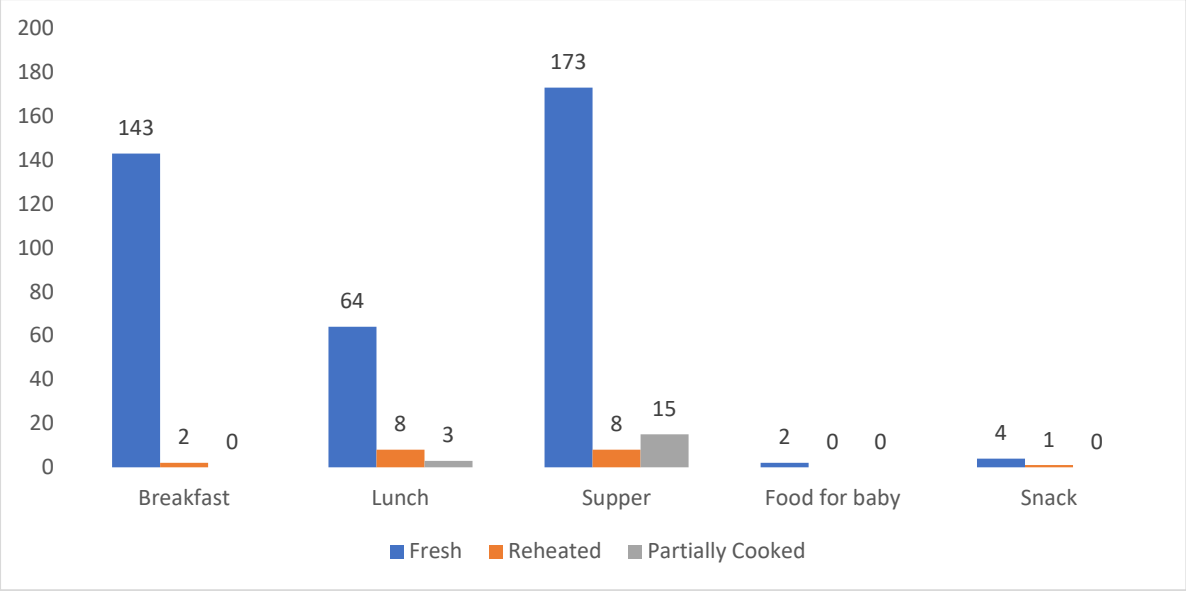


Figure 10: Status of meals prepared Phase 2

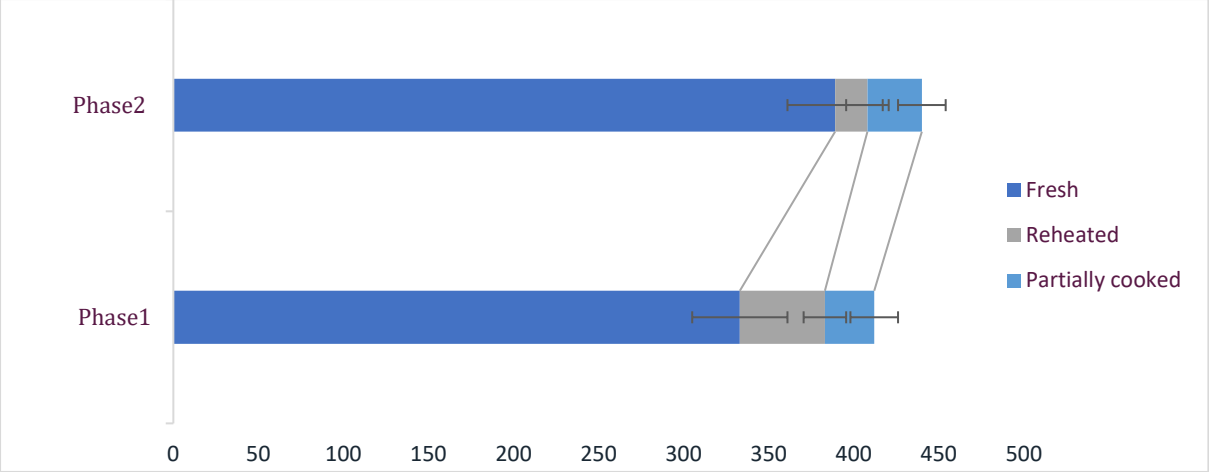


Figure 11: A comparison between the cumulative status of dishes prepared in phase 1 and 2.

Cumulatively, the share of reheated foods reduced considerably in phase 2 compared to phase 1 as indicated Figure 10 but remained almost the same for partially cooked dishes.

- Reheated foods included items like beans, green grams (dengu), beef, vegetables (cabbages and sukuma wiki), githeri, and tea.
- Partially cooked meals mainly consisted of beans and githeri, which are commonly available within the settlement.

Reheated foods included beans, green grams (dengu), beef, vegetables such as cabbages and sukuma wiki, githeri and tea. Partially cooked meals included beans and githeri, commonly vended within the settlement. An analysis of the status of meals is important for understanding a household's energy needs. In this respect, household energy consumption is expected to be higher for freshly prepared foods compared to warming of foods and preparing partially cooked foods.

Most of the dishes prepared were fresh in nature.

4.3.2 Cooking Techniques

Records obtained from the cooking diaries indicate a wide range of cooking techniques used for different dishes. Some dishes have a wide range of techniques that can be used to prepare them while others are restricted to a single technique. For instance, chapati and pancakes retained shallow frying as their technique. Dishes such as *matumbo* (tripes) and chicken exhibited a dynamic application of techniques for their cooking. These techniques are applied either separately or in combination with other techniques often according to taste preference.

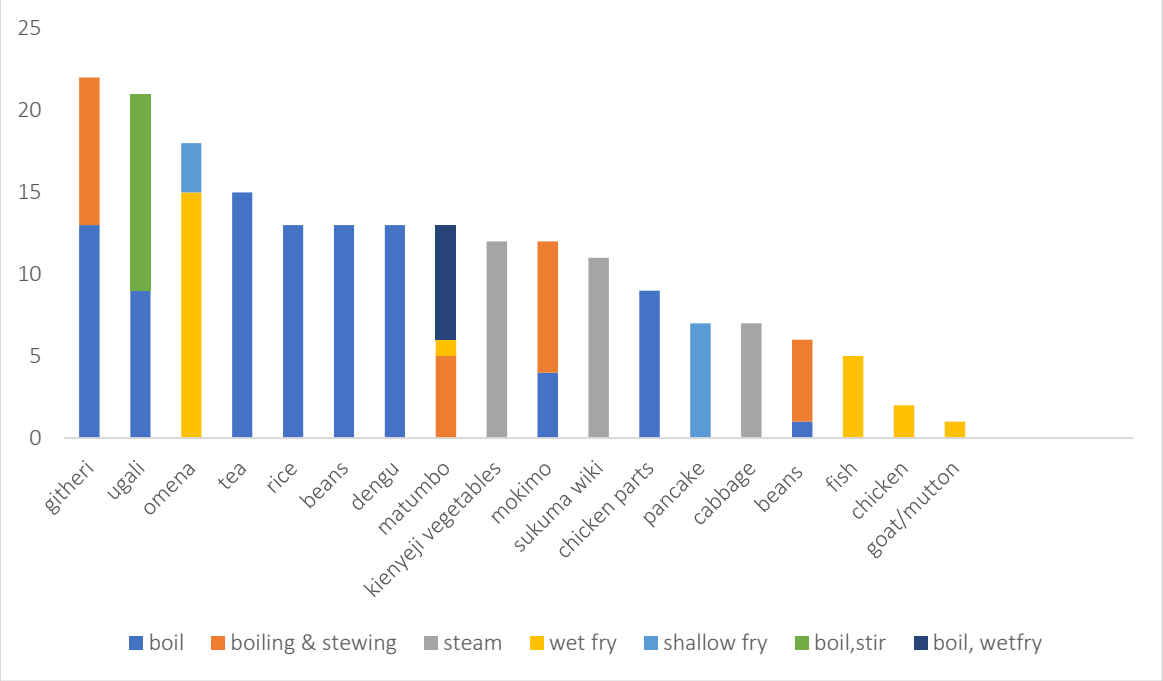


Figure 12: Cooking techniques: business: phase 1

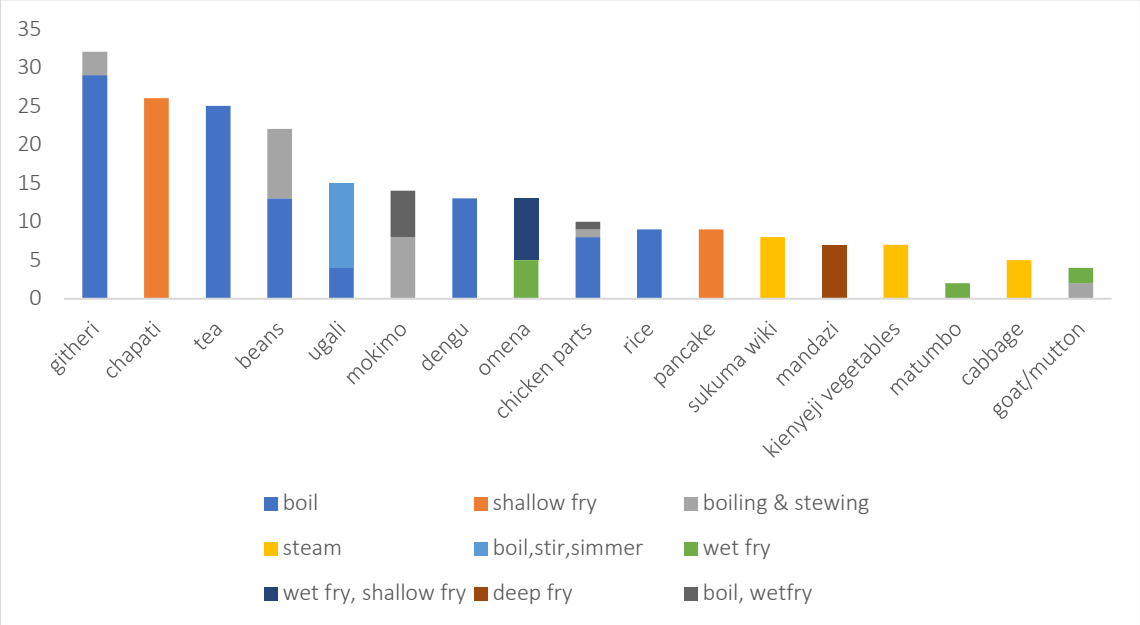


Figure 13: Cooking Techniques-Phase 2 business

4.3.3 Cooking Solutions in the Informal Settlement of Mathare

The study applied the MTF guideline assessing household cooking solutions. A cooking solution is considered as a combination of cookstove, and fuel used to meet households' cooking needs.

4.3.3.1 Household Cookstoves in Mathare

Households typically stack cooking solutions where multiple cooking solutions are commonly employed to meet household cooking needs. In evaluating the phenomenon of household stacking within the informal settlement of Mathare, the guideline provided by the MTF (Multi-Tier Framework) applied and as such the utilization of primary, secondary, and tertiary cookstoves is examined. The prevalence of stacking in Mathare is presented in the table.

*Table 8: Household Stacking+6-*5*

	Primary Cookstove	Secondary Cookstove	Tertiary Cookstove
LPG stove	58%	4%	0%
Kerosene stove	22.4%	16%	3.5%
Improved Charcoal Stove	5.4%	8.1%	2.2%
Biofuel stove	4%	1.8%	0.7%
Biogas stove	0.4%	0.0%	0.0%
Metallic charcoal stove	3.3%	8.7%	1.6%
Electric coil stove	1.5%	0.3%	0.0%
Three stone open fire	0.3%	0.7%	0.5%
Water Heater Coil	0.0%	2.3%	0.9%
Electric Kettle	0.0%	1.6%	0.9%
No Stacking		**44.5%**	**85.9%**

Within the informal settlement of Mathare, the prominence of the household cooking solutions may be summarised as follows in the order of importance: LPG Stove, Kerosene Stove, Improved Charcoal Stove, Biofuel Stove, and Electric Coil Stoves. As for secondary cookstoves, the most popular option.

- The primary cookstove of choice for the majority of households is the LPG stove, followed by the Kerosene Stove, Improved Charcoal Stove, and Biofuel Stove.
- Most popular secondary cookstove is the Kerosene Stove, followed by the Electric Coil Stove and Improved Charcoal Stove.
- It is worth noting that only a small percentage (15 percent) of households possess a tertiary stove.

Photo 6: Electric coil: photo credits, Ann Njuguna

From the household survey and the first phase of the cooking diaries:

- Use of single burner stove dominated household cooking events (table 8).
- LPG is a clean cooking fuel that is convenient to use, regulated easily during cooking, and has high fuel efficiency (Quinn *et al*., 2018).
- LPG is also readily available as depicted by participants during FGD sessions on fuel availability.

Table 9: Appliance use at the household-Phase 1

phase1	LPG single burner	kerosene stove	electric coil	ethanol stove
beans	5	2	3	3
beef	11	2		1
cabbage	7	2		
chapati		2		
dengu	4			
eggs	4	1	1	
fish	10			
githeri	7	5		
kienyeji vegetables	9	1		
liver	3			
matoke	7	2	1	
omena	9			1
piau	2	4		
porridge	5		4	
rice	20	9	3	2
sukuma wiki/spinach	8	1		1
spaghetti	2			
sweet potatoes	3			
tea	66	22	10	
ugali	56	1	1	2

The introduction of the EPCs during the second phase of the cooking diaries was key in assessing the ease with which they would prepare the dishes they typically prepare in their homes. Table 10 provides an indication that many of the dishes cooked can be prepared on the EPC except for chapati, which was exclusively prepared on LPG. From the analysis:

- The uptake of EPCs for tea and ugali preparation was notably high among households.
- In the first phase, the dominant choice among food vendors was the use of a 3-stone open fireplace, often complemented by charcoal stoves, which were recorded in cooking logs.
- The use of the 3-stone fireplace was common among food vendors due to the large size of utensils used to prepare dishes.
- In the second phase of the project, food vendors recognized the potential of utilizing electric pressure cookers, especially for preparing food items like beans and green grams that require boiling.
- Despite the introduction of EPCs, there was evidence of appliance stacking among food vendors, indicating flexibility and adaptation in cooking methods.

Table 10: Appliance use at the household-Phase 2

phase 2	EPC	LPG single burner
beans	16	0
beef	19	4
cabbage	14	1
chapati	0	1
chicken parts	3	
dengu	6	1
eggs	9	2
fish	7	0
githeri	11	2
kienyeji vegetables	4	1
liver	8	1
matoke	6	0
omena	4	0
pasta	2	0
piau	9	1
porridge	1	16
rice	30	8
sukuma wiki/spinach	12	7
sweet potatoes	10	0
tea	74	50
ugali	49	19

Table 11: Appliance used for preparing dishes in the food business-phase 1 & 2, respectively.

	Appliances			
	3 stones	metallic charcoal stove	improved charcoal stove	electric coil
beans	15		13	
Chapati	0	8	13	
fish	7	0		
githeri	4		12	
green grams	13			
kienyeji vegetables	24			
matumbo	10	1		
mokimo	1		12	
omena	18	0		
rice	13	0		
sukuma wiki	10	0	1	
tea	12	0		
ugali	8	0		
chicken parts	0	2	1	6
pancakes		6		
mandazi	7			
chicken	7			

	Appliances			
	3 stones	metallic charcoal stove	improved charcoal stove	electric pressure cooker
beans	7	1	1	13
chapati	0	6	14	
chicken	1			
chicken parts	0	1	3	9
dengu	0	1	6	11
githeri	13		14	2
kienyeji vegetables	6			1
mandazi	8			
matumbo	6			
mokimo	1	1	13	
omena	13			
pancakes		8		1
rice	9			1
sukuma wiki	8			
tea	20			5
ugali	11			

Photo 7: Appliance stacking at a food business premise. Photo taken on the same day of open fire and EPC use. Photo credits: Abigael Okoko

From the cooking diaries:

- Food vendors need multiple heating points because they prepare multiple dishes simultaneously, as seen in photo 7. Transitioning to a cleaner fuel stack would require innovative solutions to ensure multiple heating points.
- Alternatively, food vendors might need multiple Electric Pressure Cookers (EPCs) to minimize the use of polluting fuels.
- At the end of the project, feedback from food vendors indicated:
    - 40% found EPCs fast to use.
    - 20% found them fast, cheap, and easy to use.
    - Another 20% stated they were fast, cheap, easy to use, and self-regulating.
    - An additional 20% reported that they were fast, easy to use, and self-regulating.
- Speed was the most common reason for recommending the appliance to others.
- The self-regulating property of the EPC was also seen as an important factor influencing the adoption of this new cooking technology.

The cost of cooking from an electricity consumption perspective could not be practically verified by participants due to the lack of conventional electricity meters from Kenya Power & Lighting Company (KPLC) in informal electricity connections.

20% of food vendors identified the need for changes, including having a larger pot size for the appliance to better suit their food vending needs.

4.3.3.2 Fuel Types

Household fuel use tracks household cookstoves preferences. However, a more nuanced understanding can be obtained by analysing the insights derived from cooking diaries. Figure 13 indicates fuel use in phases 1 and 2, respectively drawn from the household cooking diaries. During phase 1, a wide range of fuels was used for cooking which comprised both clean and polluting fuels.

- LPG (Liquefied Petroleum Gas) was the dominant fuel used by households for cooking during this phase, followed by kerosene.
- Surprisingly, the use of electricity for cooking in phase 1 was higher than that of charcoal.

This corroborates views held by FGD participants in Mathare, Mukuru and Kibra that:

- Charcoal usage for household cooking has declined due to the high cost of charcoal exacerbated by the charcoal ban, worsened by the charcoal ban, leading to scarcity and subsequent price hikes.
- Consequently, many view LPG as a more affordable option compared to charcoal.

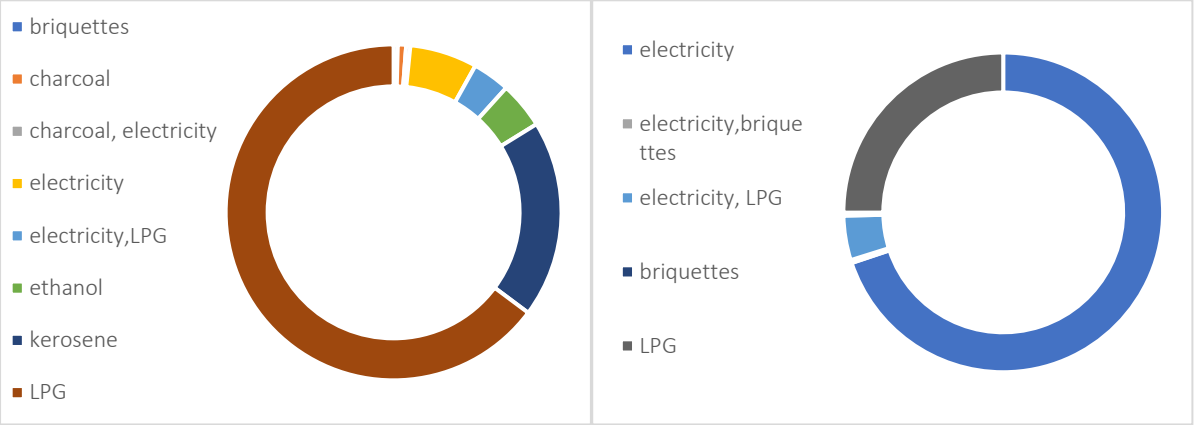


Figure 14: Energy use at the household level in Mathare: Left-phase 1; Right-Phase 2

In the second phase:

- Use of electricity to prepare the main dishes increased substantially overtaking LPG.
- Electricity displaced charcoal, ethanol and kerosene[19].

This points to the fact that using electricity as a cooking fuel can contribute to clean cooking even in the urban informal settlements. This can be said for the efficient appliances such as electric pressure cookers, which were used in this study. In Mathare, Kibra and Mukuru, electric coils are dominant since they are cheap and readily available within reach the settlement. However, their use for cooking is often limited more so during peak times as explained by participants in FGD sessions due to voltage fluctuations which would cause a drop or a blackout. However, from this study, the participants were able to use the EPCs with the same electricity connections they have been using. A major advantage of electric cooking is that it is emission-free at the point of use. When used exclusively or with other clean energy options, electric cooking has the potential to eliminate kitchen concentrations of, and hence exposures to, health damaging household air pollutants (Parikh et al., n.d.), consequently reduce morbidities and mortalities related to indoor air pollution.

[19] Please note that the transition to using electricity for cooking was to a larger extent prompted by the introduction of electric pressure cookers to the households in our study. It is equally significant to highlight that these households preferred using these EPCs over other cookstoves, as long as they were available.

Figure 14 also indicates that fuel stacking happened in both phases. The fuel stack, however, changes with the introduction of the EPCs therefore electricity and LPG became the main fuel stack displacing the charcoal electricity stack. This outcome also indicates the potential for diffusion of a clean fuel stack among households in the urban informal settlements.
The use of firewood and charcoal by the food vendors was dominant in both phases as indicated by figure 14.

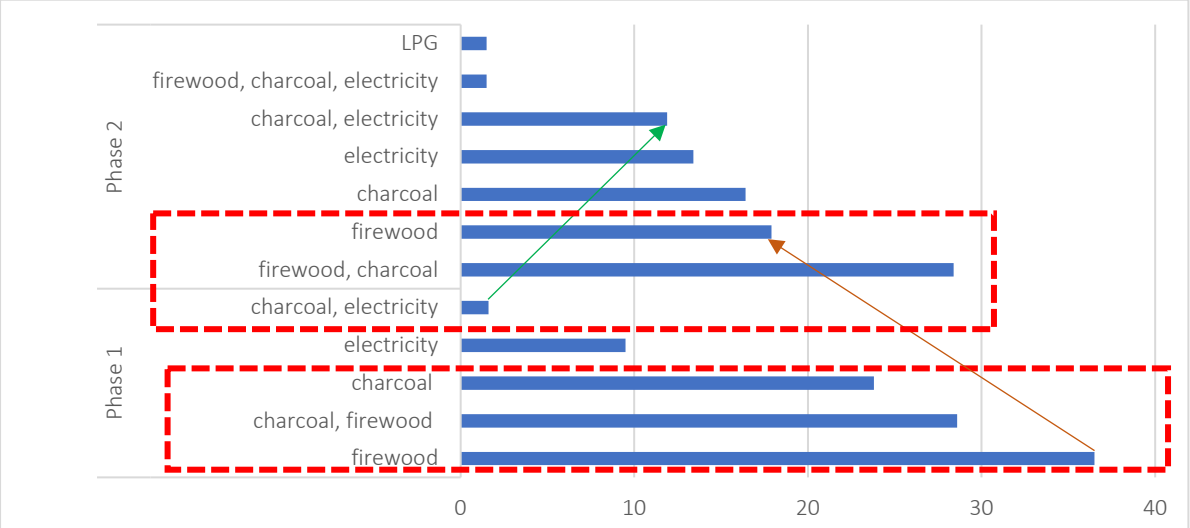


Figure 15: Percentage fuel use by food vendors in Mathare

- In Phase 2, firewood usage reduced by almost half compared to Phase 1, while charcoal usage increased slightly.
- Cooking events using electricity notably increased in Phase 2, along with a substantial rise in the use of the charcoal-electricity stack.
- Analysis of fuel use by vendors suggests the necessity for more interventions to encourage the adoption of clean cooking fuels in informal settlements.

Intervention efforts need to consider the quantities of food cooked by food vendors. In addition, the average number of cook stoves required by a food vendor is key since they cook multiple foods at the same time, which necessitates use of multiple fireplaces or cook stoves in order to serve their clients on time. These considerations are key for the development of appropriate cook stoves for the food vendors.

4.3.3.3 Energy consumption

Energy use per day

We computed the daily energy consumption considering the total daily consumption and the number of households using the specific fuel. The calorific values of the specific energy streams summarized in table 12 is used to determine the energy content of the fuels used to enable comparison among the fuels used.

Table 12: Calorific values of fuel

Fuel	Calorific value
Charcoal	30MJ/kg
Ethanol	29.78
Kerosene	43.1
Firewood (oven dry)	18.6
Electricity	3.6
LPG	49

The household energy consumption analysis excluded charcoal and briquettes since their data points were few, and we could therefore not use them an informed comparison. Ethanol computation has also not considered the evaporative nature of the fuel and therefore, may not be sufficient to draw accurate conclusions. Again, only one participant recorded use of ethanol in phase one and therefore lacks the basis for comparison.

Table 13 and Table 14 provide a daily electricity consumption per household, which indicates an increase in the frequency of its use in Phase 2 compared to Phase 1.

In phase 1, households that used electricity for the heating events used the electric coil for cooking and water heater for heating water. Some of the water heating events were for making tea and for making ugali and a few used for bathing, especially for babies. Only one participant used the electric coil to prepare meals phase 1. From table 13, some water heating events occurred within the cooking times for which records were not kept. Upon follow up with the households, there was an indication that water-heating using a water heater happened for heating the water used for cooking ugali. Once the water was heated in a jug or jerrican, it was transferred to a sufuria where the cooking continued. With this premise, we do the energy analysis based on a daily household energy consumption.

Table 13: Electricity energy use per day by household participants-Phase1

Row Labels	28/05/2023	29/05/2023	/05/202	31/05/2023	01/06/2023	02/06/2023	03/06/2023	04/06/2023	05/06/2023	06/06/2023	07/06/2023	08/06/2023	09/06/2023	Grand Total
MA		0.73												0.73
AW							0.03							0.03
EM		1.82	0.82	1.72	3.3	1.68	1.3	2.95	2.8	0.805	0.765	1.75	0.69	20.4
KO	0.16	0.195	0.195	0.31		0.365	0.125	0.2					0.27	1.82
LO			0.56		0.27	0.75		1.365	1.38	0.775	0.26	2.635	1.815	9.81
MM		0.16	0.125		0.11	0.125	0.145		0.215					0.88
VW				0.04		0.93	0.39	0.79						2.15
Grand Total	**0.16**	**2.905**	**1.7**	**2.07**	**3.68**	**3.85**	**1.99**	**5.305**	**4.395**	**1.58**	**1.025**	**4.385**	**2.775**	**35.82**

Source of data: A2EI smart meter platform

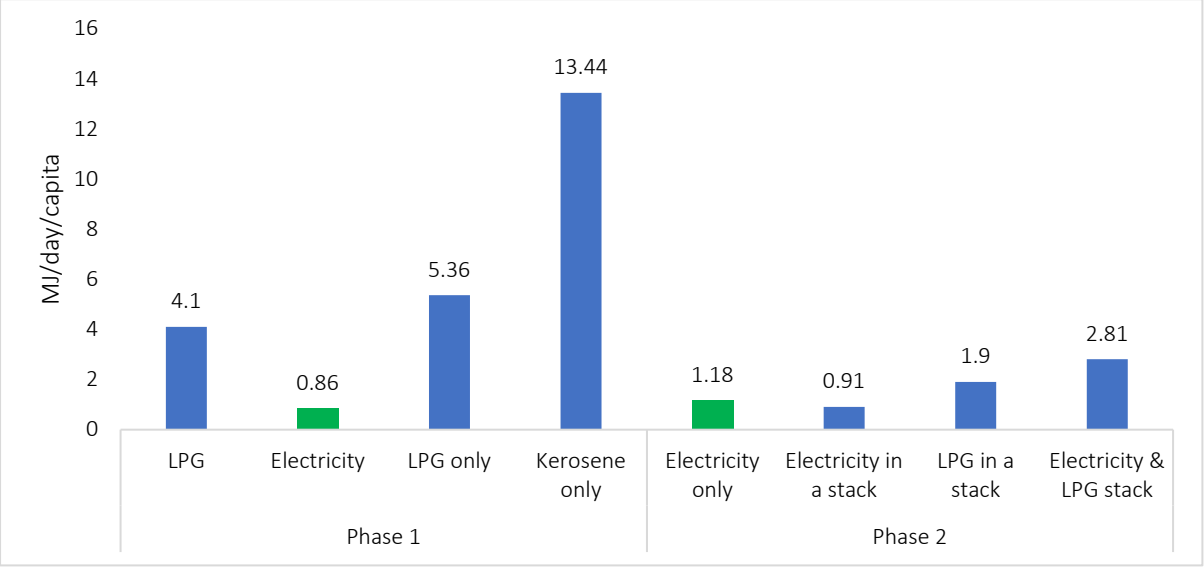
Table 14: Electricity energy use per day by household participants-Phase2

	Date																		
Participant	09-Jun	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun	15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	Grand Total
MA	0.67	0.695	0.085	0.275	0.8		0.105	0.785	0.62		0.15			0.32					4.505
AW	0.935	0.52	2.45	2.805	2.765	1.58	1.955	1.895	1.75	1.99	1.84	2.81	2.61	1.915	2.51	1.76	1.565	1.185	34.84
EM	0.23	0.85	0.64	0.29	0.38	0.57	0.43	0.48	0.53	0.46	0.39	0.29	0.14	0.29	0.85	0.2	0.46	0.6	8.08
HO						0.4	0.305	0.23	0.54	0.63		0.22	0.87			0.6	0.3	0.295	4.39
KO	0.27	0.115			0.3		0.22	2.855	0.63	0.215	0.055	0.205	0.23	0.36	0.225	0.98		0.32	6.98
LO	0.34	2.13	0.525	1.67	1.68	2.895	1.7	1.705	1.685	0.18	2.05	1.56		0.73	2.57	1.87			23.29
MM				0.355	0.46	0.18	2.54			0.445	2.845	0.34	0.91	0.53	0.985				9.59
NO	0.54	1.48	1.1	0.46	0.7	1.01	0.99	0.69	0.9	0.87	1.63	0.68	0.945	0.275	0.59	0.48		1.25	14.59
SW			1.065	1.02	0.69	1.82	0.97	0.42	0.57	0.64	0.515	0.445				0.26	0.2	0.23	8.845
VW	0.53	0.56	0.82	1	0.655	0.955													4.52
Grand Total	**3.515**	**6.35**	**6.685**	**7.875**	**8.43**	**9.41**	**9.215**	**9.06**	**7.225**	**5.43**	**9.475**	**6.55**	**5.705**	**4.42**	**7.73**	**6.15**	**2.525**	**3.88**	**119.63**

Source of data: A2EI smart meter platform

We identified households that did not use electricity in the first phase and conducted a stand-alone household energy consumption analysis. Where they used it once, we exclude that date from the analysis. We did this particularly for kerosene and LPG where they were used for most of the cooking. Table 14 indicates that use of kerosene for heating events at the household required 2.5 more energy than LPG while heating using electricity consumed the lowest energy.

Table 15: Fuel consumption at the household level-Phase 1 and 2



Electricity use spiked in the second phase of the study once the households introduced use of the EPC thereby recording an increase in the frequency of use and even the total amount of electricity used by the households.

In phase 2, using electricity as a stand-alone fuel required less energy to perform the heating functions than total energy required when electricity was used in an LPG stack. As seen from the results presented in Table 15, LPG contributes twice the energy required when used in an energy stack with electricity thus reducing the energy efficiency of the household, thereby increasing household energy consumption. Nevertheless, the electricity- LPG fuel stack required almost 5 times less energy than when kerosene alone was used, and half the energy required when only LPG was used for the heating events. The information presented by this energy consumption analysis is important for informing intervention on energy use at the household level. Since energy stacking is common, knowing the contribution of each fuel to an energy stack is key for the optimization of fuel use within the fuel stack.

Food vendors in Mathare purchase the fuel the use on a daily basis. We use the daily average expenditure on fuel to compute their energy consumption.

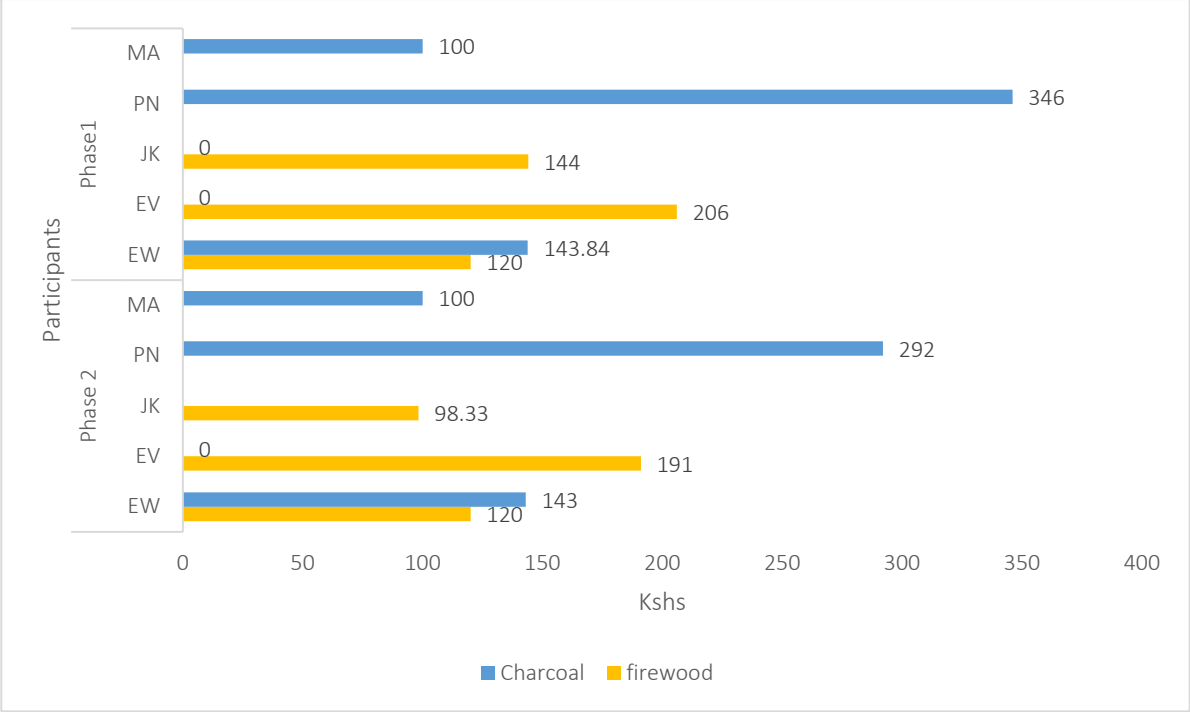


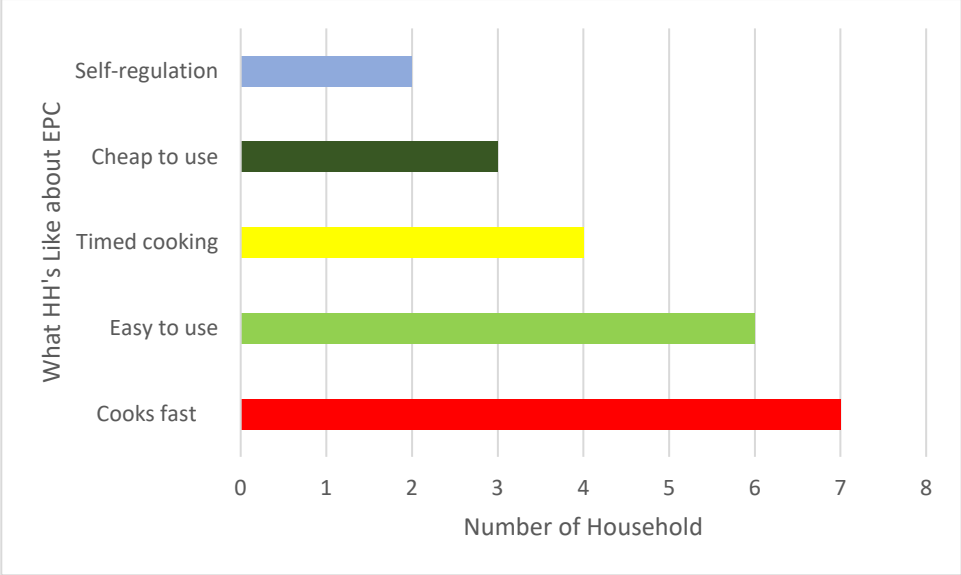
Figure 16: Average fuel expenditure by food vendors

Figure 15 presents the average daily expenditure on fuel mainly charcoal and firewood. Phase 2 of the project recorded a reduction in the total direct expenditure on fuel for 4 out of the five food vendors. This reduction was experienced in different scales probably because the of the type of food cooked by the vendor. For instance, EW prepared chapati, pancakes and githeri and had to continue using the same quantity of charcoal for preparing the chapatti and pancake since the EPC was not able to serve this purpose. On the other hand, JK who prepared vegetables, omena, matumbo, beans, ugali etc while relying mainly on firewood in phase 1 recorded a reduction in their direct expenditure. We can attribute the reduction in the direct daily expenditure on fuels to the use of EPC for preparing some of the dishes as shown by Table 15.

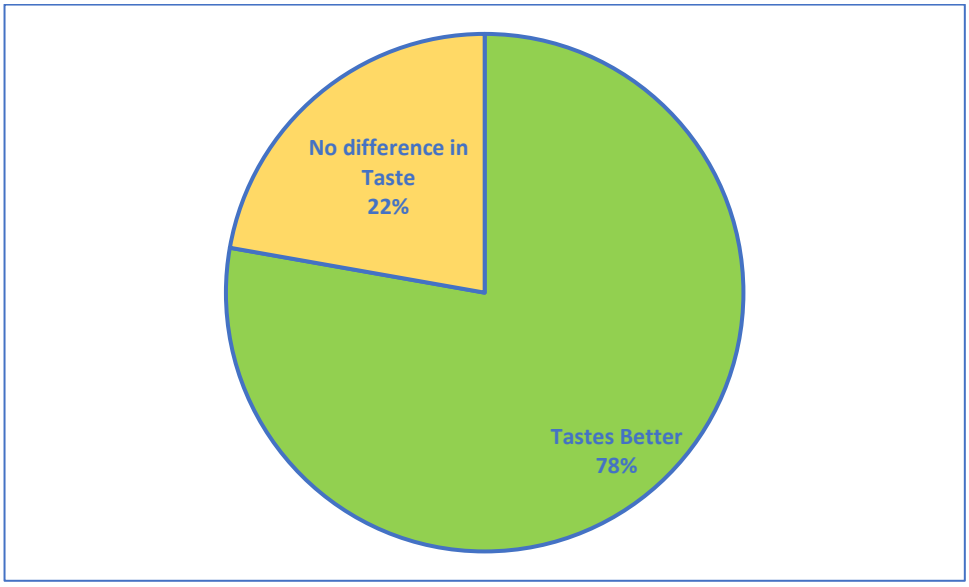
4.4 User Experience of eCooking in Mathare Informal Settlement

Household user experience

The EPC was highly compatibility with the dishes cooked in Mathare informal settlement. Specifically, most households continued with their typical cooking practices (6 households). However, it is interesting to note that the three households that started cooking new dishes mostly cooked long boiling dishes, specifically Githeri, Matumbo, and Kienyeji vegetables. This implies that the EPC was not only compatible with the typical dishes but also enable households diversify their menu. When asked about the what they liked most about the EPC, almost all households cited speed cooking as their preferred feature of the EPC.



Further, while most households were content with the EPC, the households that were not content with electric pressure cooker (2 households), cited the size of the pot as a feature that that they would like to be changed. Additionally, almost all households (8 households) perceive cooking with electricity to be cheaper than the fuels that they typically use. However, one household perceives the cost of cooking with electricity to be equal to the cost of fuel they use daily. All households state that food cooked using EPC tastes at least as good as food cooked with their typical fuels. Specifically, 78 percent (8 households) state that food cooked on EPC taste better relative to food cooked using their typical cooking fuel.

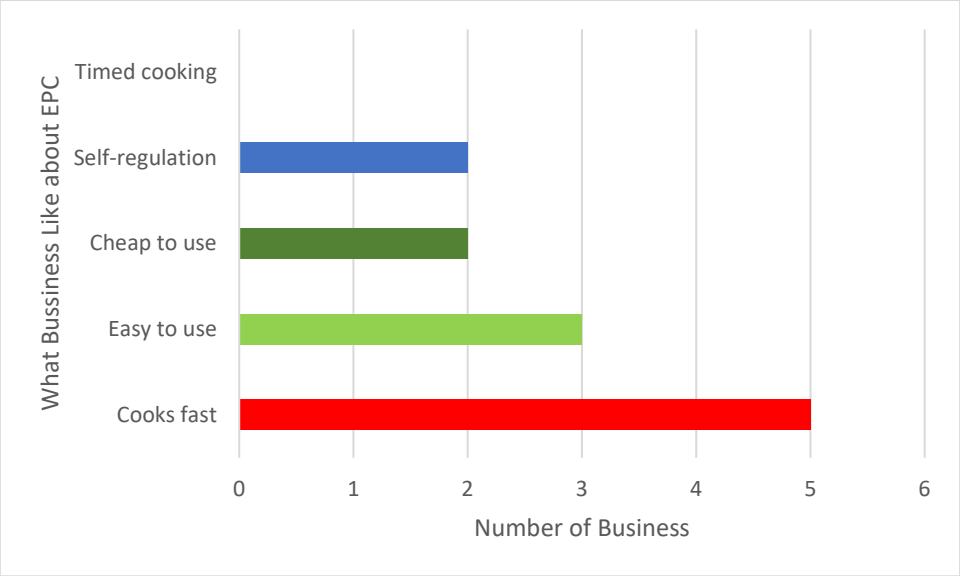


All households report that their perception about electric cooking positively changed after the study period. Further, after the study, most households (7) expressed the willingness to pay for an electric cooking appliance with the preferred mode of payment being installments.

Interestingly, all household would recommend the EPC to other households based on their experience during the study. In fact, 8 out of 9 households had already recommended the EPC to other households during the period of the study. The recommendation was based on other household showing interest in acquiring the EPC. While most households recommended acquiring the EPC from supermarket (6 households), two households did not know where the appliances could be bought. While 1 household suggested the research team.
Adversely, most household (7) experienced power outages during the period of the study. This suggest that stability in power supply would help in improving household seamless user experience.
Overall, all households indicated that they would continue using the EPC after the study period.

User Experience of Food Vending Businesses

Similarly, three out of the 5 business continued preparing their typica foods while two businesses introduced Githeri, Mukimo, and soup in their menu. It is interesting to note that the new foods introduced are similarly long boiling foods. Compared to households, businesses unanimously cited speed of cooking as the most dominant feature of EPC followed by Ease of use. Surprisingly, timed cooking was not viewed as critical feature by business users.



Equally, business unanimously agreed that the cost of cooking with an EPC was cheaper relative to their typical cooking solutions. Similarly, there was unanimity that food cooked on EPC tasted better than food cooked on alternative cooking solutions. When asked about the change in perception about eCooking, only 3 business indicated that their perception of eCooking has changed as a result of the study while the perception of the other 2 businesses did not change. This implies that more interventions may be needed in influenced the perception of business towards eCooking. Conversely, all business expressed willingness to purchase the EPC albeit on installment basis with personal saving and merry go round as the source of funds.

Similar to households, business indicate that there was expression of interest on EPC from people close to the business owners on acquisition of EPC. Similarly, the most common recommendation from the business owner was to acquire the EPC from the supermarkets.
Power outages is also mentioned by the business with 3 out of 5 businesses having experienced power outages during the period of the study. However, the no business experienced any incident of safety concern during the study period. In addition, almost all business (4) expressed awareness of what they would do incase the EPC broke down with most indicating that they would take to a technician within the informal settlement or service centre. Only one business indicated that they would not know what to do.

In terms of impact on the business, 4 business expressed that there was an increase in the number of clients they served. However, one business reported that the number of clients remains the same during the period of study. This was on the effect on the revenue with the 4-business reporting and increase in revenue and one reporting lack of a change in revenue. The businesses that experienced an increase in number of clients and revenue expressed a desire to acquire more EPCs for their business. Interestingly when asked about customer feedback, all business unanimously indicated that customers indicated that food tasted better. Overall, all business indicated that they would continue using the EPC post the study period when asked about integrating EPCs in their cooking solutions.

5 Market Scoping

The market scoping component of the study primarily concentrated on identifying and mapping the existing distribution channels for cookstoves and fuels within the Mathare informal settlement. The study categorized the vendors into three types:

- Cookstove vendors
- Cooking fuel vendors
- Vendors who deal with both cookstoves and fuels

By conducting a thorough vendor mapping exercise, valuable insights were obtained regarding the distribution patterns and spatial distribution of vendors across the informal settlement of Mathare. Figure 16 illustrates the spatial distribution of these vendors within the Mathare settlement.

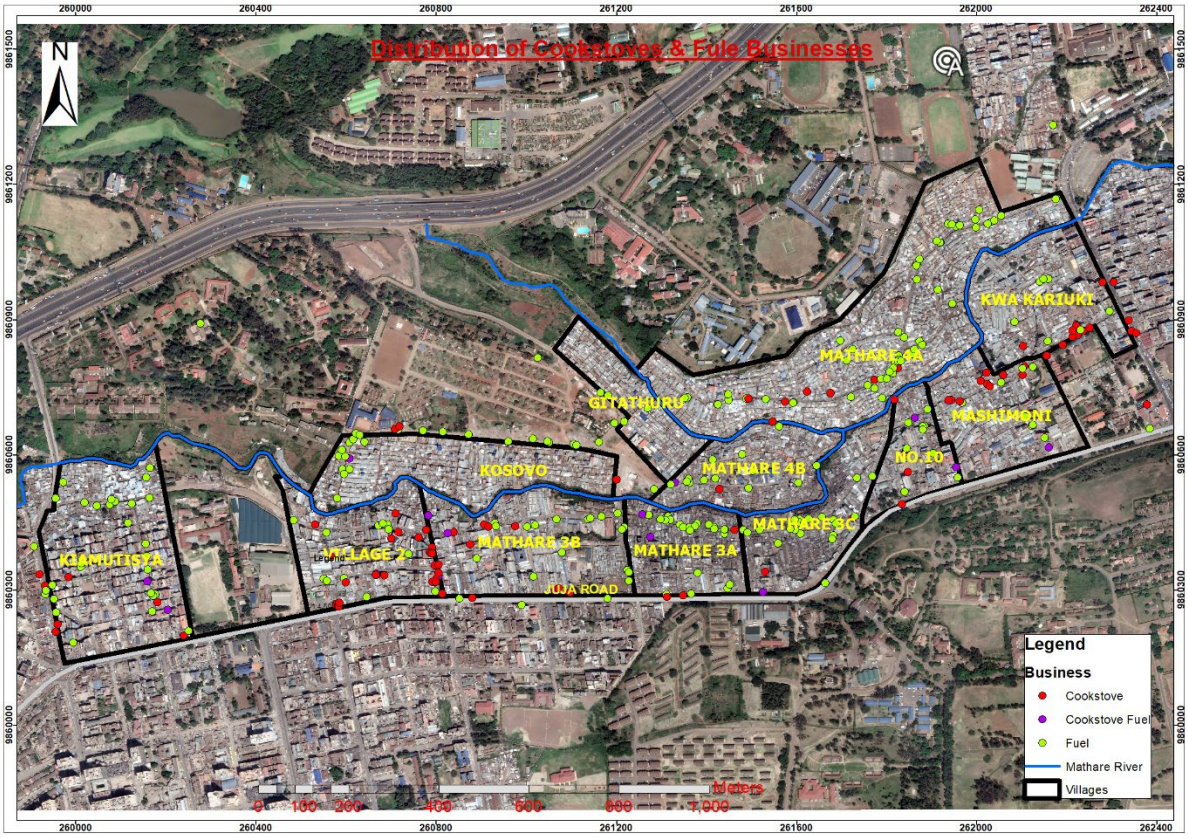


Figure 17: Distribution of cooking solutions businesses in Mathare

This report provides insights into the cooking solutions market in Mathare informal settlement. As shown in figure 18:

- 24 percent of businesses exclusively focus on selling cook stoves and cooking appliances.
- 4 percent offer both cook stoves and cooking fuels, catering to comprehensive customer needs.
- 72 percent of businesses specialize in selling cooking fuels, ensuring a steady supply for the community.

- The higher percentage of cooking fuel businesses suggests ready availability within Mathare.
- A small number of cook stove businesses are located within Mathare Settlement, with the majority located outside its borders and residents may need to venture beyond the settlement for a wider variety of cookstoves and cooking appliances.

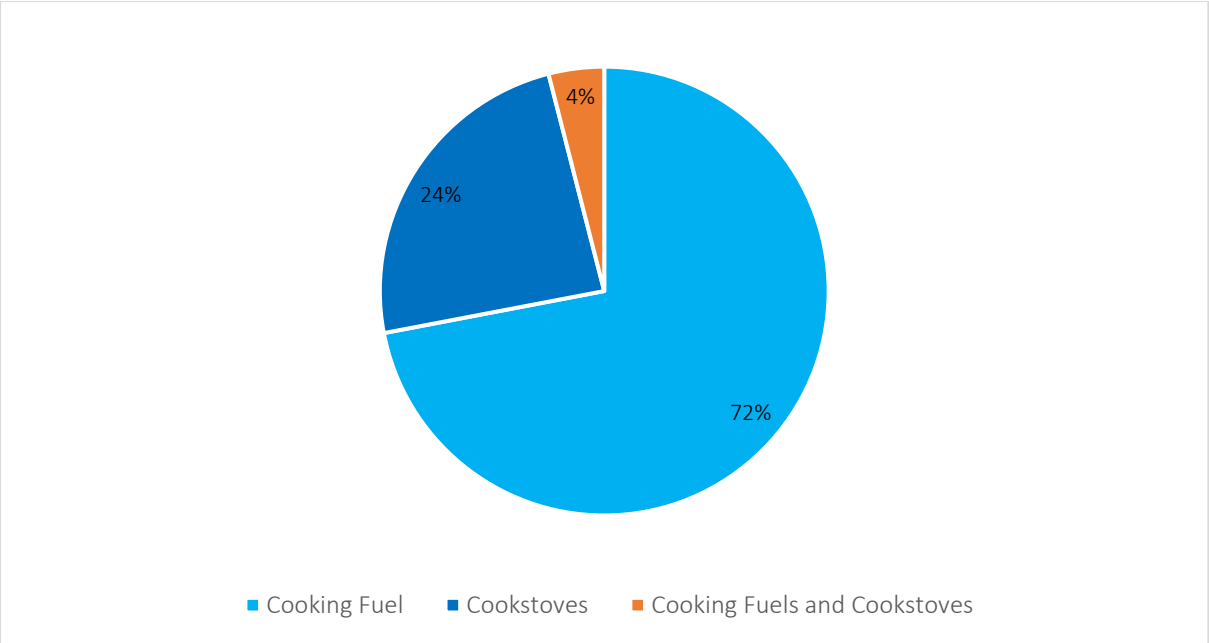


Figure 18: Distribution of Cookstoves and Fuel Vendors

In the cooking fuel business,

- A significant majority (30.5 percent) of cooking fuel businesses primarily sell kerosene.
- Factors contributing to its widespread usage include affordability, availability, and familiarity.
- Kerosene is affordable in small quantities for households and easily sourced by vendors from petrol stations, ensuring availability. Smaller quantities of kerosene can be bought for resale, creating favourable demand and supply conditions.
- A significant proportion of businesses (25.7 percent) offer liquefied petroleum gas (LPG) due to policies, incentives, and awareness campaigns. The LPG market growth has been supported by these factors.
- 18.2 percent of businesses sell charcoal, indicating significant usage as a cooking fuel within Mathare settlement.

Figure 18 summarises the market share of different fuels within the informal settlement of Mathare.

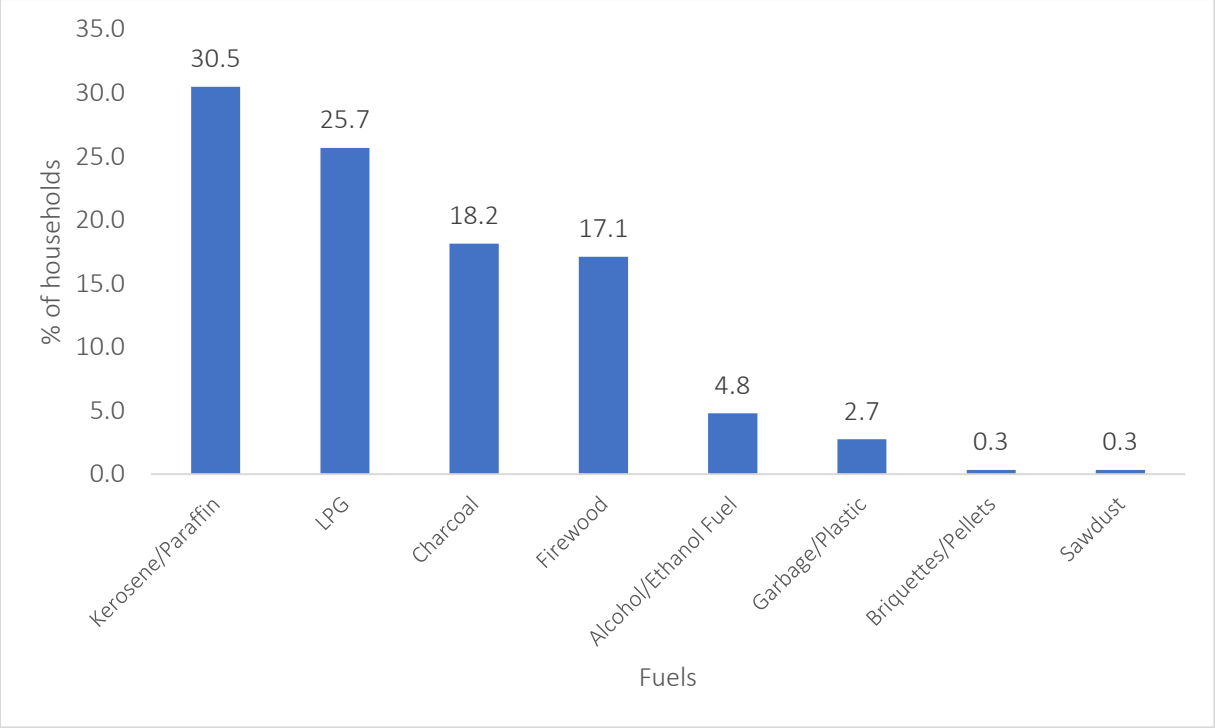


Figure 19: Distribution of Fuel

Market Dynamics in the Cooking Solutions Market

Examining the market dynamics within the cooking solutions market in Mathare:

- Cooking fuel businesses serve an average of 86 customers per week.
- Cook stove businesses serve an average of 33 customers per week.
- 70.6 percent of fuel businesses experience weekly fluctuations in customer numbers.
- 41.7 percent of cook stove businesses report fluctuations in customer volume.
- For cooking fuel businesses, cost/pricing of fuels is the primary reason for customer fluctuations.
- Additionally, 19.42 percent mention that fuel availability and accessibility impact customer numbers.

Figure 20: Summarizes the key factors driving demand for cooking solutions in Mathare.

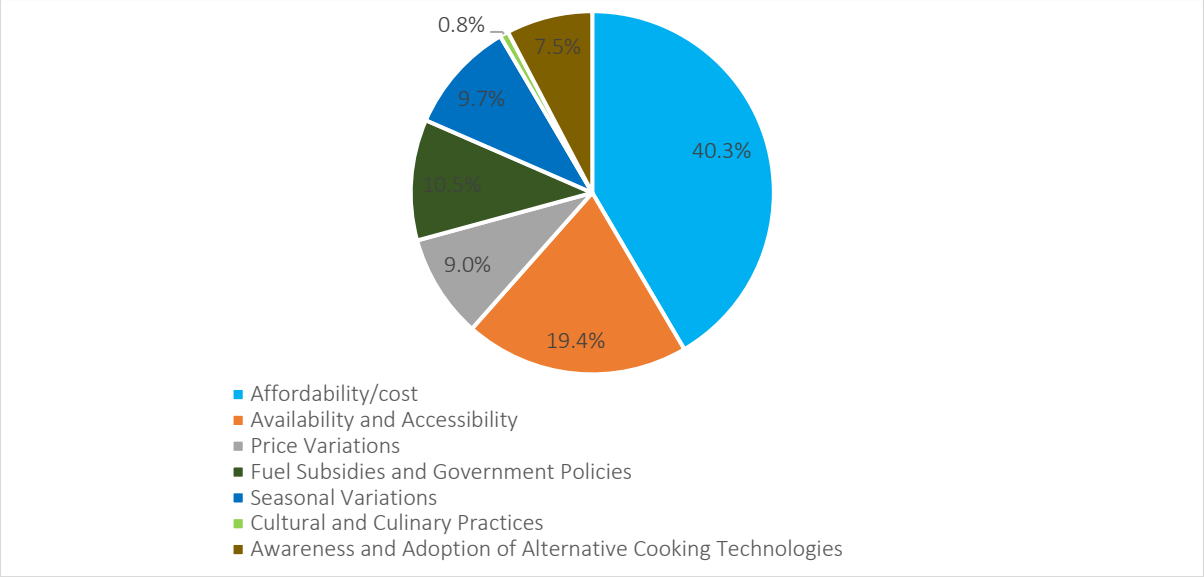


Figure 20: Drivers of Demand

Dynamics in distribution channels

Regarding the distribution channel dynamics within the cooking solutions business sector, focusing on supplier intentions, partnerships, operational hours, and sales volume factors, it is interesting to note that:

- 22.5 percent of cooking fuel businesses and 28.3 percent of cook stove businesses expressed their intention to change suppliers in the near future.
- In both types of businesses, price is the primary driver behind the decision to consider a new supplier (66.7 percent for fuels and 68.8 percent for cook stoves).
- 6.3 percent of cooking fuel vendors engage in partnerships under contract, mainly for the sale of alcohol/ethanol fuel. This aligns with the business model of industry leader KOKO networks.
- The average partnership duration is 1.8 years, indicating a relatively new business model in the settlement.
- Cooking fuel vendors and cookstove vendors operate approximately 47 hours per week.
- Sales volume differences are primarily influenced by the product nature: fuels as fast-moving goods vs. cookstoves as capital goods with lower replacement frequency.

Business Growth Prospects

Lack of capital is the most significant obstacle hindering the expansion of both cooking fuel and cook stove businesses within the settlement and this potentially restricting their growth opportunities.

Additionally, insecurity issues emerged as another major factor impeding the expansion of both cooking fuels and cook stoves businesses, as illustrated in table 16. These security concerns contribute to a challenging business environment, further hindering the potential for business expansion in the settlement.

Table 16: Constraints to Expansion

Constraints preventing business from expanding	% of cooking fuels businesses	% of cook stoves businesses
Lack of own capital	61.3	70
Lack of credit/credit is too expensive	29.8	20
Low or varying quality of produce (supply)	10	11.7
Low or irregular quantity of produce (supply) including trade restrictions	5.8	10
Lack of means of transport	10.5	1.7
Poor Road infrastructure/ transport cost too high	2.1	0
Too much insecurity	17.3	18.3
Lack of storage	18.3	13.3
Low profit margin (low sales price, high purchase price)	8.4	8.3
Lack of demand	8.4	10
Competitors would not allow me to grow so much	6.3	3.3
Government would not allow me / taxes too high	2.1	0

Drivers of Demand for Cooking Solutions

Both cooking fuels and cook stoves vendors highlighted affordability as the primary concern for their customers when purchasing these cooking solutions. The cost of acquiring the cooking solution was identified as the most significant factor influencing the pricing of products for both cooking fuels and cook stoves businesses. Additionally, market competition, demand and supply dynamics, and operating costs were cited as key determinants for product pricing in both sectors. There is no price discrimination in the cookstove market in Mathare.

In addition, the price safety and durability of cookstoves exert significant influence on demand for cookstove businesses. Table 17 provides additional factors that influence demand for cooking solutions in Mathare informal settlement.

82.5 percent of cooking fuels vendors and 73.3 percent of cook stoves vendors reported selling their products at the same price to all customers.

Table 17: Determinants of Prices

Price determinant	Cooking fuels businesses	Cook stoves businesses
Cost of acquisition	51.9	70
Market competition	30.7	21.7
Demand and supply	36	23.3
Operating costs	17	18.3
Profit margins	29.1	18.3
Taxes	5.8	5
Consumer perceptions	9	6.7

Other	1.6	1.7

Effective Cookstove Marketing Strategies in Mathare

From the analysis:

- More than half of the businesses in Mathare (54.5 percent of cooking fuels vendors and 53.3 percent of cook stove vendors) prioritize identifying their target audience as the optimal marketing strategy[20].
- Additionally, effective marketing methods include offering flexible payment options, discounts, and demonstrating cost-saving techniques to customers, as shown in Figure 21.

These findings highlight the importance of understanding household needs and preferences, as well as providing value and cost-saving solutions, when marketing cooking fuels and cook stoves within the Mathare Settlement.

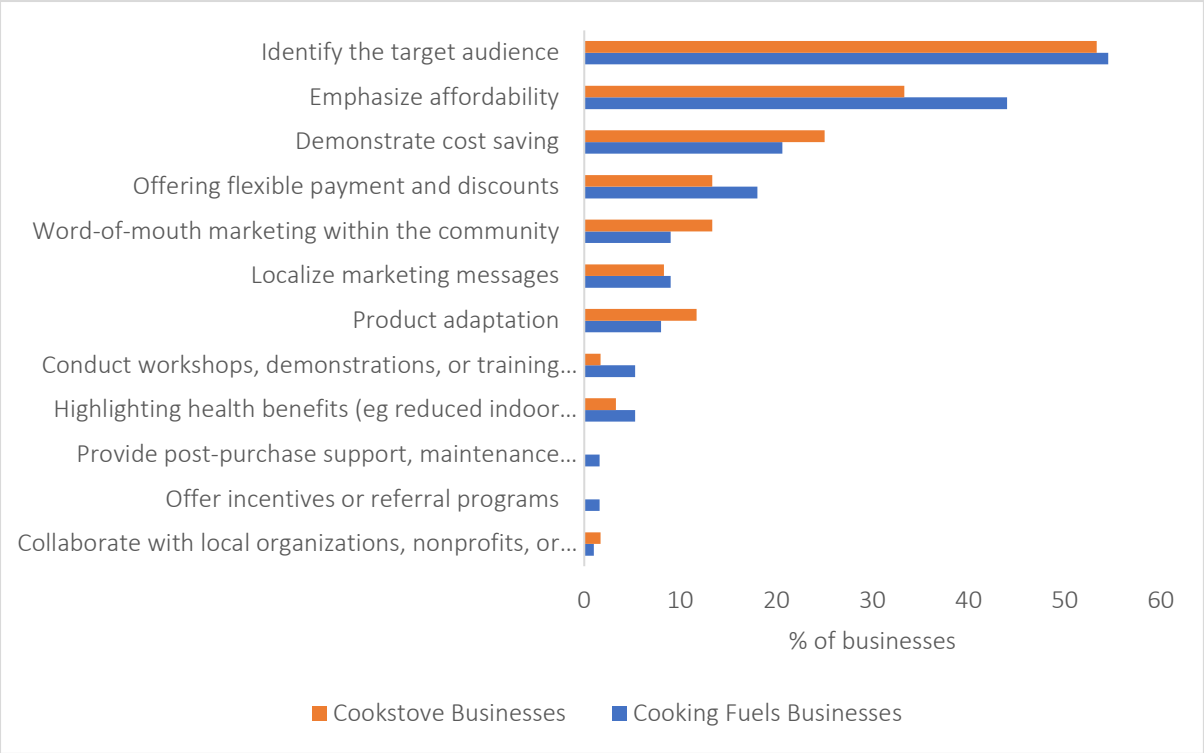


Figure 21: Marketing strategies

Vendors of cooking solutions identify energy efficiency of cooking solutions as a key aspect providing them with a competitive edge in their respective markets.

- 42.9 percent of cooking fuel businesses and 48.3 percent of cook stove businesses recognize energy efficiency as a distinguishing aspect.

[20] Identifying a target audience in marketing means finding the people most interested in your product. It helps focus marketing efforts on the right group, saving time and money. By understanding their needs, you can create effective messages tailored to them, making marketing more efficient and successful.

- Safety, ease of use, and effectiveness are also identified as important factors contributing to their competitive advantage (Figure 21).

While energy efficiency, safety, ease of use, and effectiveness are easy to reconcile with prevalence of LPG stove among households, the findings are at odd with the prevalence of kerosene stove, electric coil stove, and charcoal stoves. This implies that for these vendors their competitive advantage is perceived rather than real.

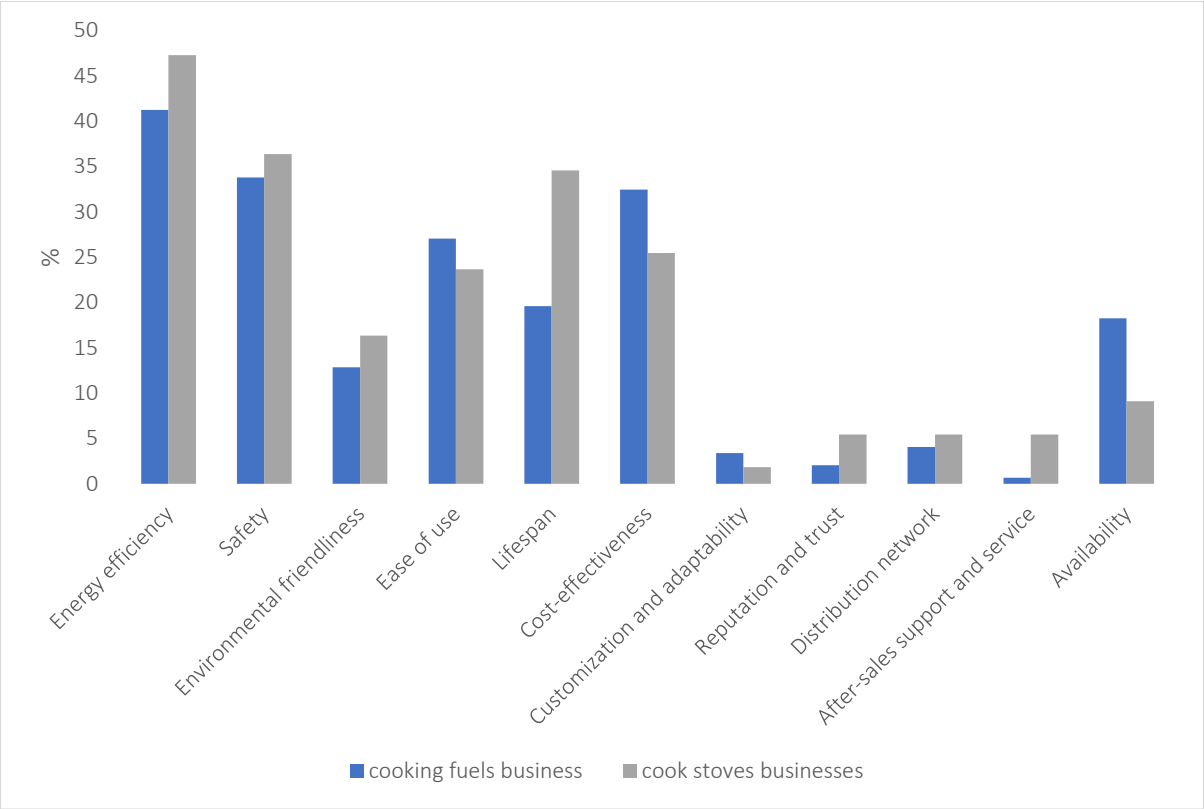


Figure 22: Determinant of Competitive Advantage

Challenges Facing Cooking Solution Businesses in Mathare

Cooking solutions businesses operating in the informal settlement of Mathare encounter a multitude of challenges such as:

- Affordability issues due to a low-income customer base (34.5 percent and 36.4 percent of cooking fuels businesses and cookstove businesses respectively).
- Concerns about insecurity (20.3 percent and 29.1 percent of cooking fuels businesses and cookstove businesses respectively).
- Lack of awareness and education (20.3 percent and 27.3 percent of cooking fuels businesses and cookstove businesses respectively) among others as depicted in Figure 10.

These findings emphasize the importance of addressing affordability barriers, enhancing awareness and education, and implementing strategies to mitigate competition and improve

security conditions in order to support the growth and sustainability of cooking solutions businesses in the informal settlement of Mathare.

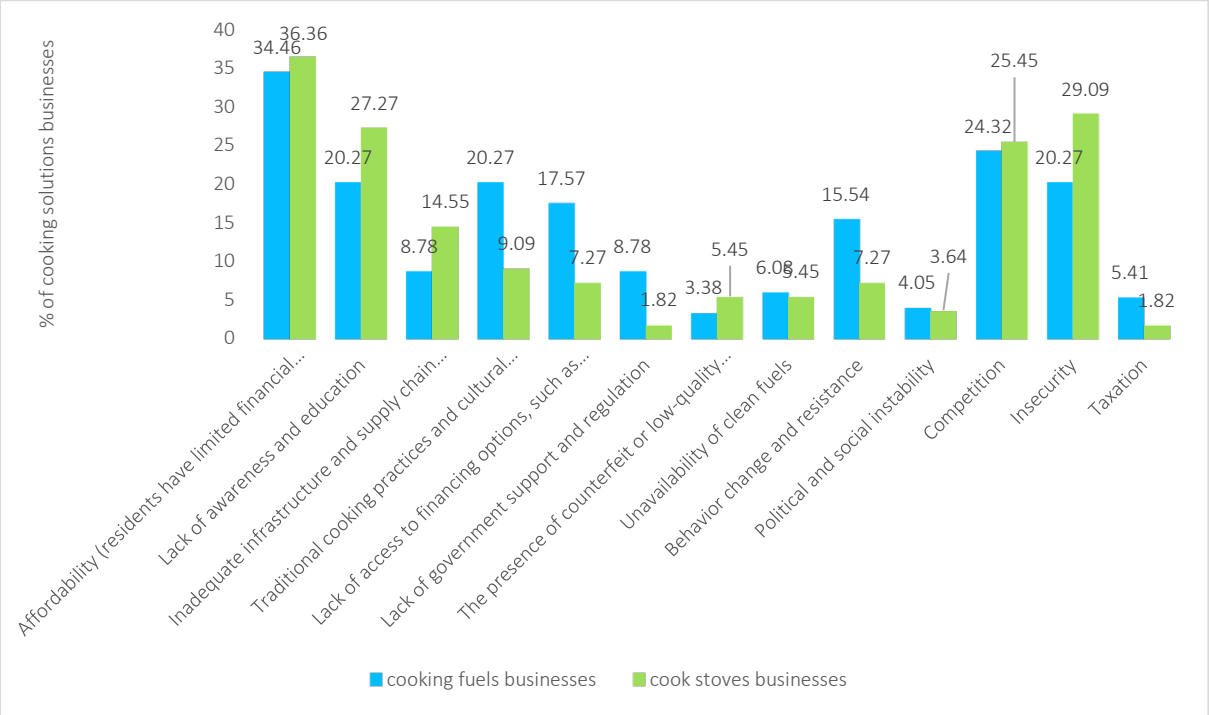


Figure 23: Challenge Facing Vendors

Regulatory and Legal Framework of Cooking Solutions Business in Mathare

- Approximately 61.8 percent of cooking fuels businesses and 68.3 percent of cook stove businesses believe they do not need a license to operate (Figure 23).
- Over 20 percent of businesses declined to answer the licensing question, possibly due to concerns related to proposed taxation changes in the finance bill 2023/24. They were cautious due to perceived taxation consequences, leading to hesitancy in responding to the study's licensing inquiries.

Do traders need a license to operate on this cooking fuels market? *Do traders need a license to operate on this cookstoves market?*

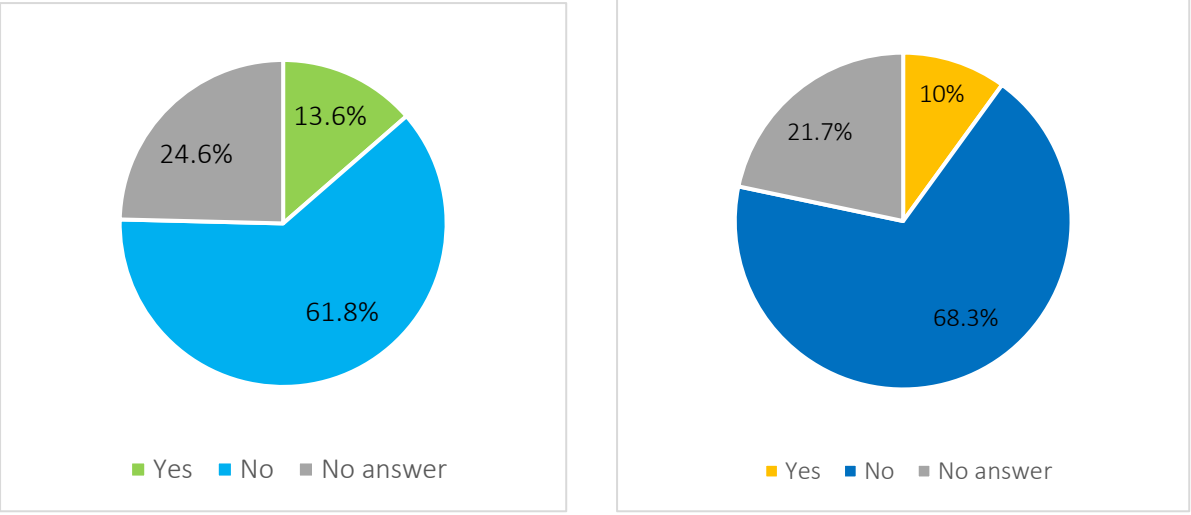


Figure 24: Licensing Requirements

Supply Chain Challenges Faced by Cooking Solution Business in Mathare

As depicted in figures 25 and 26, vendors of cooking (cooking fuel businesses and cook stove businesses) face several supply chain challenges. From the analysis:

- 40.7 percent of cooking fuel businesses and 40 percent of cook stove businesses identified high transportation cost a major obstacle. This challenge may be attributed to the costs associated with transporting goods and potential transportation barriers within the densely populated settlement.
- 13.2 percent of cooking fuel businesses and 15 percent of cook stove businesses encounter challenges related to the lack of accessibility, which can further hinder their operations.
- 24.3 percent of cooking fuel businesses and 18.3 percent of cookstove businesses reported experiencing supply chain disruptions. The politically volatile nature of the Mathare Informal Settlement contributes to these disruptions.
- The lack of transport infrastructure affects 20.1 percent of cooking fuel businesses and 33.3 percent of cook stove businesses, suggesting that the existing infrastructure may not adequately support the efficient movement of goods for these businesses.

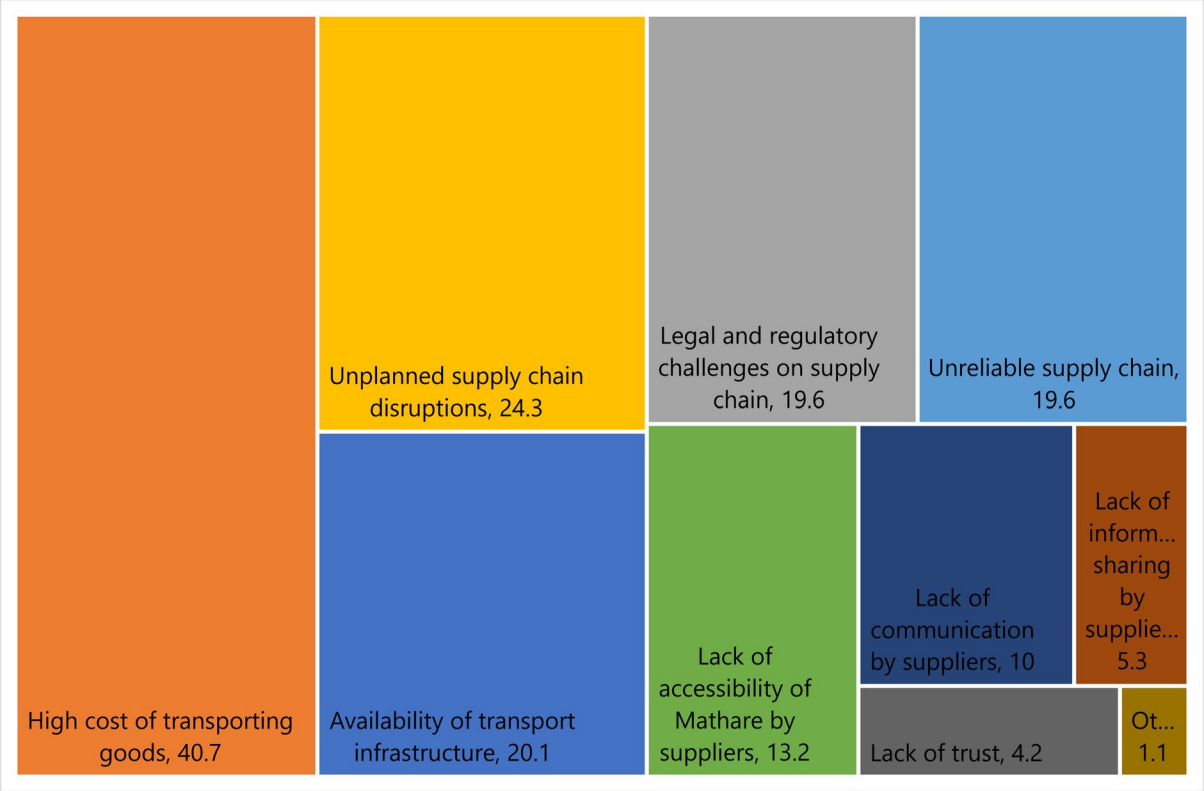


Figure 25 Supply Chain Challenges-Cooking Fuel

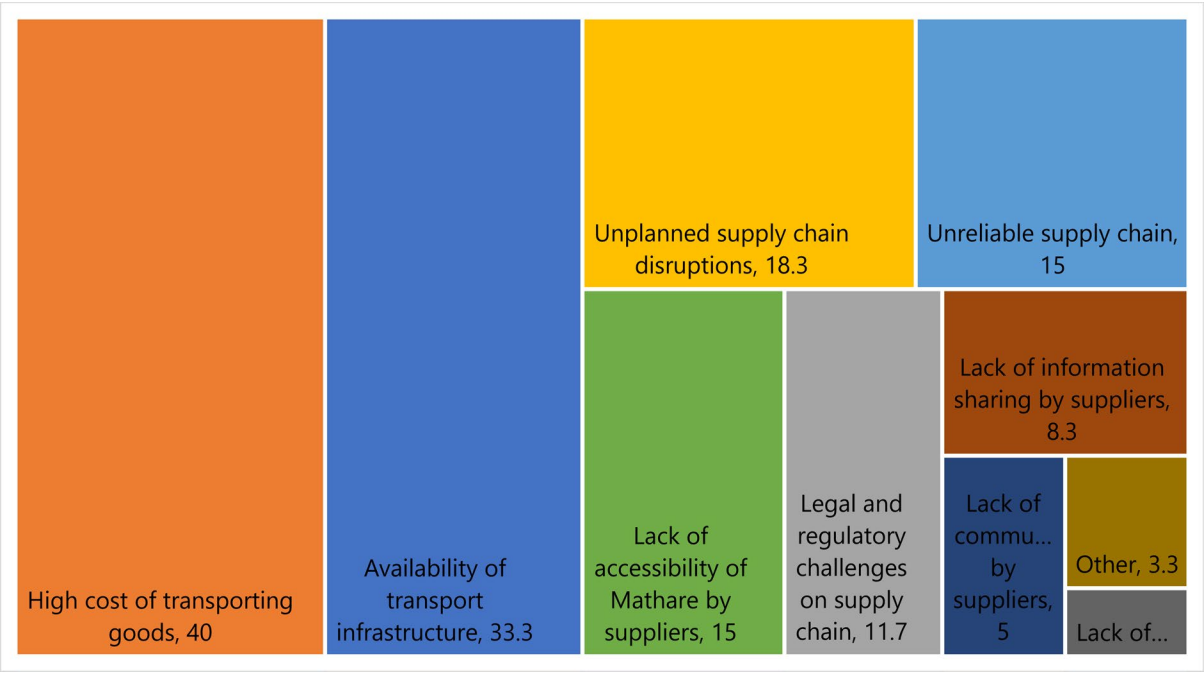


Figure 26: Supply chain challenges-cook stoves businesses

Sourcing of Cooking Solutions in Mathare

In the Mathare informal settlement, both cooking fuel businesses and cook stove businesses employ diverse sourcing channels to ensure the availability and accessibility of their products to their customers as shown in figure 27. For cooking fuel businesses:

- 28.6 percent directly source their supplies from manufacturers or suppliers, establishing a closer relationship and potentially securing favourable pricing and consistent supply.
- The distribution channels of wholesalers and distributors play a significant role, accounting for around 52.4 percent and 32.3 percent of the businesses, respectively. These intermediaries facilitate the efficient and competitive distribution of bulk quantities to retailers.
- Approximately 12.2 percent of cooking fuel businesses source their products from other retailers within the settlement, indicating a local market network.
- 2.1 percent of cooking fuel businesses rely on street vendors to meet their customers' needs.

For cook stove businesses:

- Approximately 40 percent directly source their products from manufacturers or suppliers, similar to cooking fuel businesses.
- Wholesalers and distributors contribute significantly, accounting for approximately 41.7 percent and 25 percent, respectively.
- 11.7 percent of cookstove businesses source their products from other retailers within the settlement, suggesting a local market for cookstoves as well. The role of community-based organizations in cook stove distribution is not specifically mentioned.

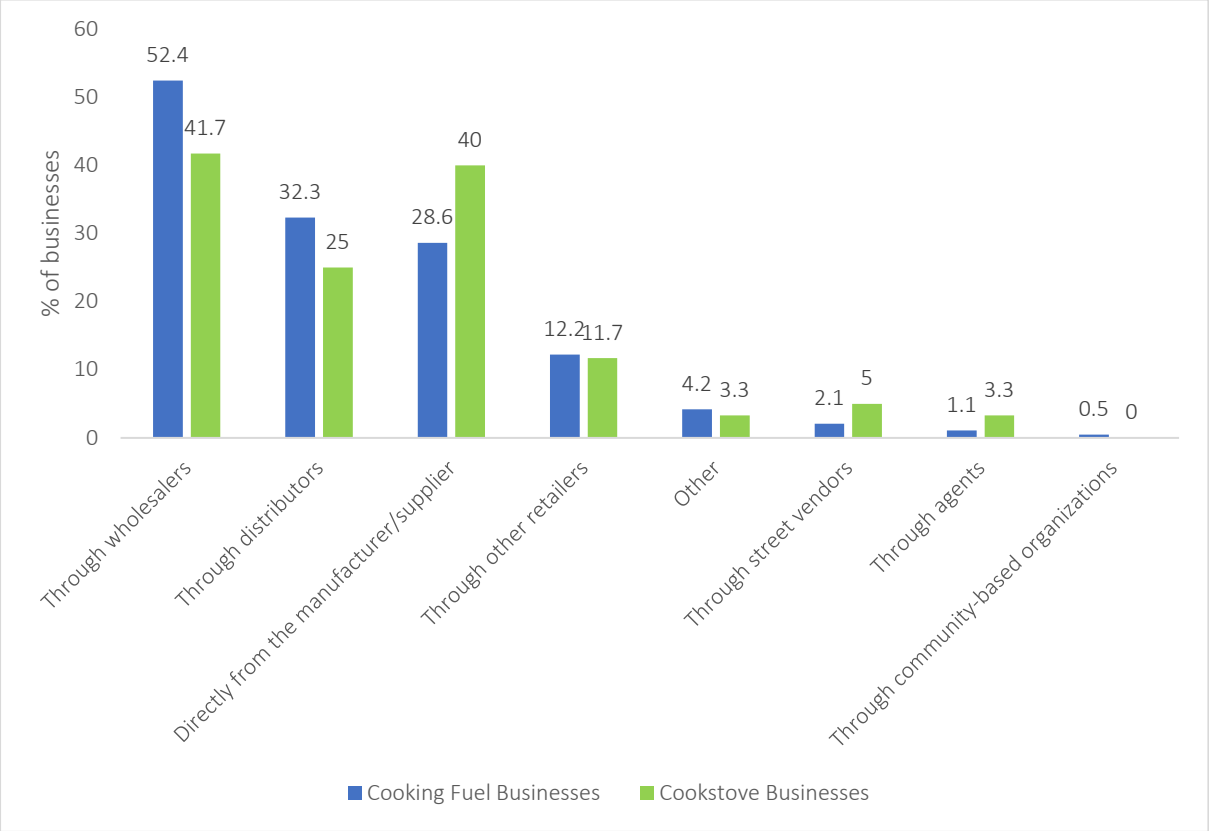


Figure 27 Cooking solutions sourcing within Mathare Informal Settlement

Determinants of Choice of Sourcing

In the context of the Mathare Settlement, the reach or coverage of distribution channels emerges as a crucial factor for both cooking fuel businesses and cook stove businesses, as depicted in the figure 27 below.

- Approximately 39.1 percent of cooking fuel businesses and 28.3 percent of cook stove businesses consider the reach or coverage of the channel when selecting their sourcing options, highlighting the importance of accessing a broad market for their products.
- The cost of distribution also plays a significant role in decision-making, with 46.6 percent of cooking fuel businesses and 56.7 percent of cook stove businesses considering this factor. This demonstrates that businesses carefully evaluate expenses related to acquiring and delivering cooking fuels and cook stoves.
- 31.6 percent of cooking fuel businesses and 16.7 percent of cook stove businesses take into account the speed of delivery. Timely and efficient distribution is vital for meeting customer demands promptly.
- Reliability of the channel is a priority for 31.6 percent of cooking fuel businesses and 28.3 percent of cook stove businesses, as consistency and dependability help avoid supply chain disruptions.
- Considering customer preferences and convenience is also important, as noted by 30.2 percent of cooking fuel businesses and 23.3 percent of cook stove businesses, reflecting the significance of understanding the needs and preferences of the households.
- Regulatory requirements have a relatively smaller impact on sourcing decisions, with approximately 4.2 percent of cooking fuel businesses and 3.3 percent of cook stove businesses considering such factors.

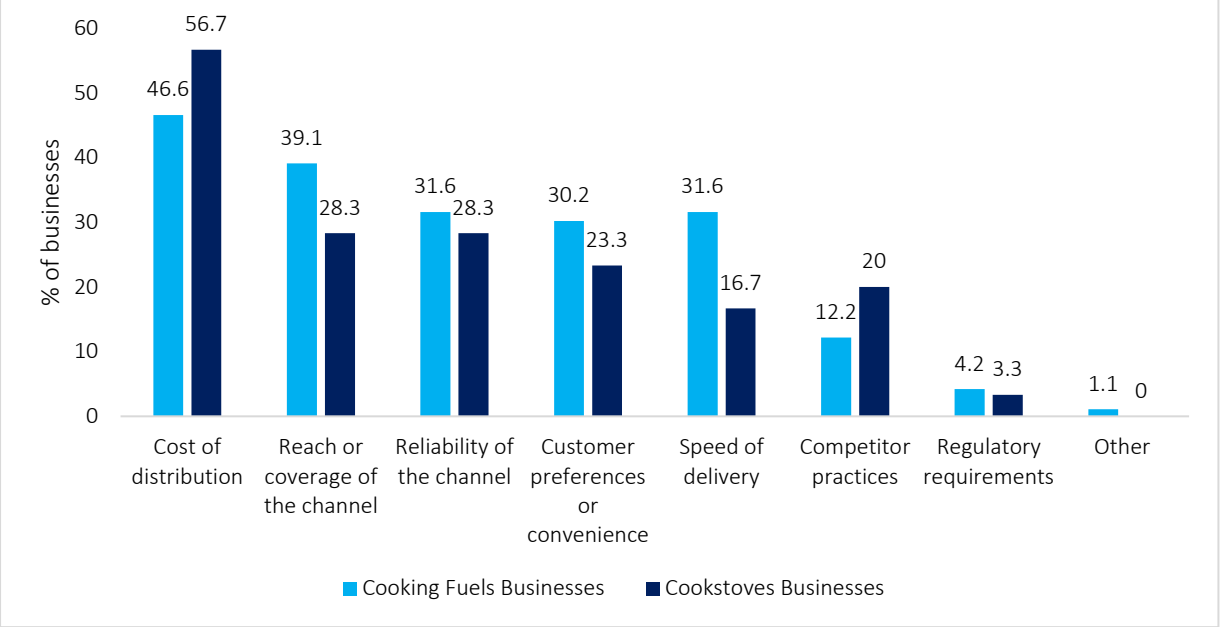


Figure 28 Factors influencing choice of cooking solution sourcing.

Emerging Distribution Channels or Trends in Mathare

E-commerce platforms

E-commerce platforms have witnessed remarkable growth in Kenya, with platforms like Jumia, Killimall, eBay, and Alibaba gaining significant traction. This growth trend is expected to extend to the market for cooking fuels and cook stoves.

- 39.9 percent of cooking fuel businesses recognize the potential of online platforms for distribution.
- 36.4 percent of cook stove businesses also acknowledge the value of e-commerce platforms for reaching a broader market.

These businesses anticipate that e-commerce platforms will improve accessibility and provide a broader market reach for businesses in the Mathare settlement.

Mobile applications/online marketplaces

- 45.5 percent of cooking fuel businesses and 38.3 percent of cook stove businesses anticipate the significant role of mobile channels in enabling businesses.

Direct-to-Consumer Models

- 36.5 percent of cooking fuel businesses and 33.3 percent of cook stove businesses have adopted direct-to-consumer models to establish a direct connection with customers.

Social media platforms

- 31.2 percent of cooking fuel businesses and 36.7 percent of cook stove businesses are increasingly leveraging on social media platforms such as Facebook, Twitter, and Instagram for sales and marketing purposes, recognizing the interactive and engaging avenues they offer.

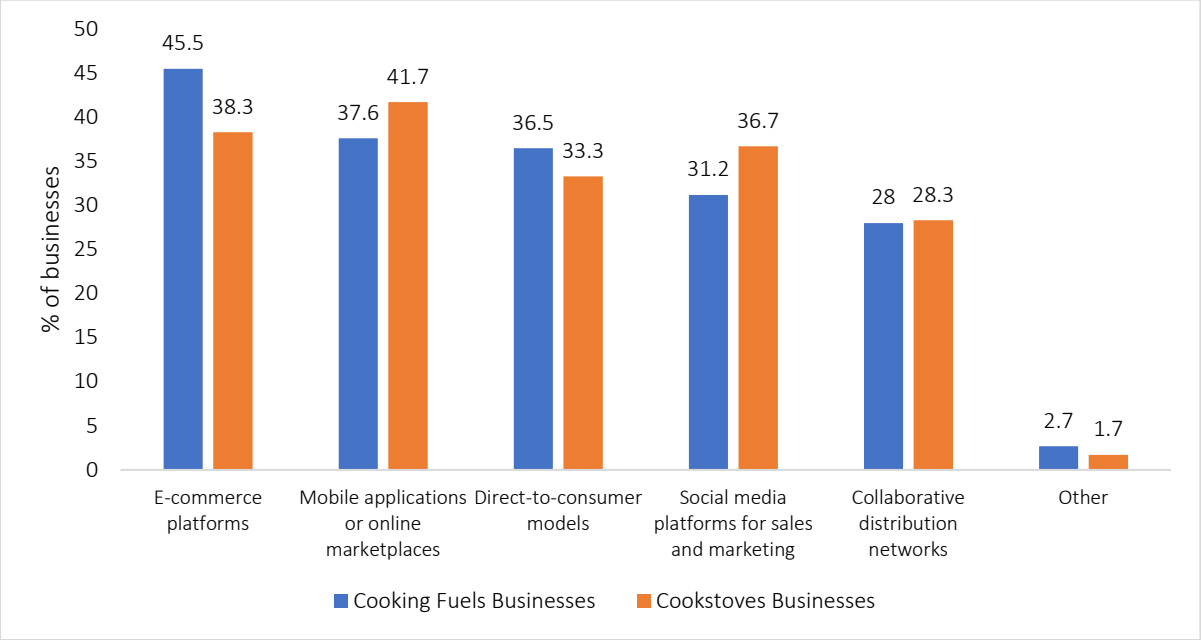


Figure 29 Emerging distribution channels for the cooking solutions businesses in Mathare

5.1 The Market for Electric Cooking Appliances in Mathare

The data provides valuable insights into the purchasing behaviour of households in the informal settlement regarding electric cooking appliances. As shown in figure 29,

- 11.9 percent of households preferred small retail stores (kiosks), reflecting their prevalence in the densely populated Mathare Informal Settlement.
- 16 percent of households purchased electric cooking appliances from wholesale retail shops, while 25.4 percent acquired them from supermarkets, indicating the need to venture outside the settlement due to limited availability within.[21]

Borrowing from the ease of access to appliances such as the electric coils as elaborated in FGD sessions, establishment of outlets within the reach of the residents will go a long way in easing access to the efficient electric cooking appliances by residents of the informal settlements.

"They should first open a shop". FGD participant.

Authorized Dealers and Distributors:

- 25.7 of households purchased electric cooking appliances from specialized stores like Burn and LG distributors, despite their limited presence within the Mathare Informal Settlement.

2.9 percent of households obtained their electric cooking appliances from second-hand dealers known as "orodha."

In addition to electric coils, the market for electric cooking appliances within the settlement primarily consists of second-hand appliances, such as rice cookers. These unique establishments operate on specific business models, offering loans in exchange for household appliances and electronics as collateral. In cases where borrowers default on their loans, the *orodhas* sell the appliances at a lower price. The affordability factor associated with this model makes *orodhas* a popular choice among many households. Another model involves *orodhas* acquiring functioning appliances and electronics from landfills and garbage, which they then repair and sell to end consumers. These individuals actively search for valuable items in the trash, considering them excellent and valuable commodities. Among the items sought after are various electrical equipment, including functional appliances or their components, cables, and extension cords (Chułek, 2020).

It is important to note that the lifespan of second-hand appliances purchased from *orodhas* is not guaranteed, and they typically lack after-sales services such as warranties. However, if a system is developed to provide appliances that are still in good condition, it could present an opportunity to introduce residents of informal settlements to efficient electric cooking as they

[21] The Mathare Informal Settlement, spanning 88.37 hectares, experiences high population density, making small retail stores the go-to option for residents' daily needs. This observation is intriguing considering the scarcity of such establishments within the settlement. It suggests that residents had to venture outside the settlement to access these outlets and fulfilling their appliance requirements. The limited available land and other related concerns might have deterred major supermarket chains from establishing a presence within the settlement itself.

progress towards acquiring new appliances. This blended approach would strike a balance between purchasing power and the effort to adopt an efficient electric cooking system within informal settlements.

0.4 percent of households reported acquiring their appliances from black markets.

This worrisome finding sheds light on the prevalent issue of theft and insecurity within the settlement. Black markets are notorious for trading stolen goods, indicating a concerning level of criminal activity and a lack of adequate security measures. The insecurity threatens market development as vendors may be concern about the security of their stocks.

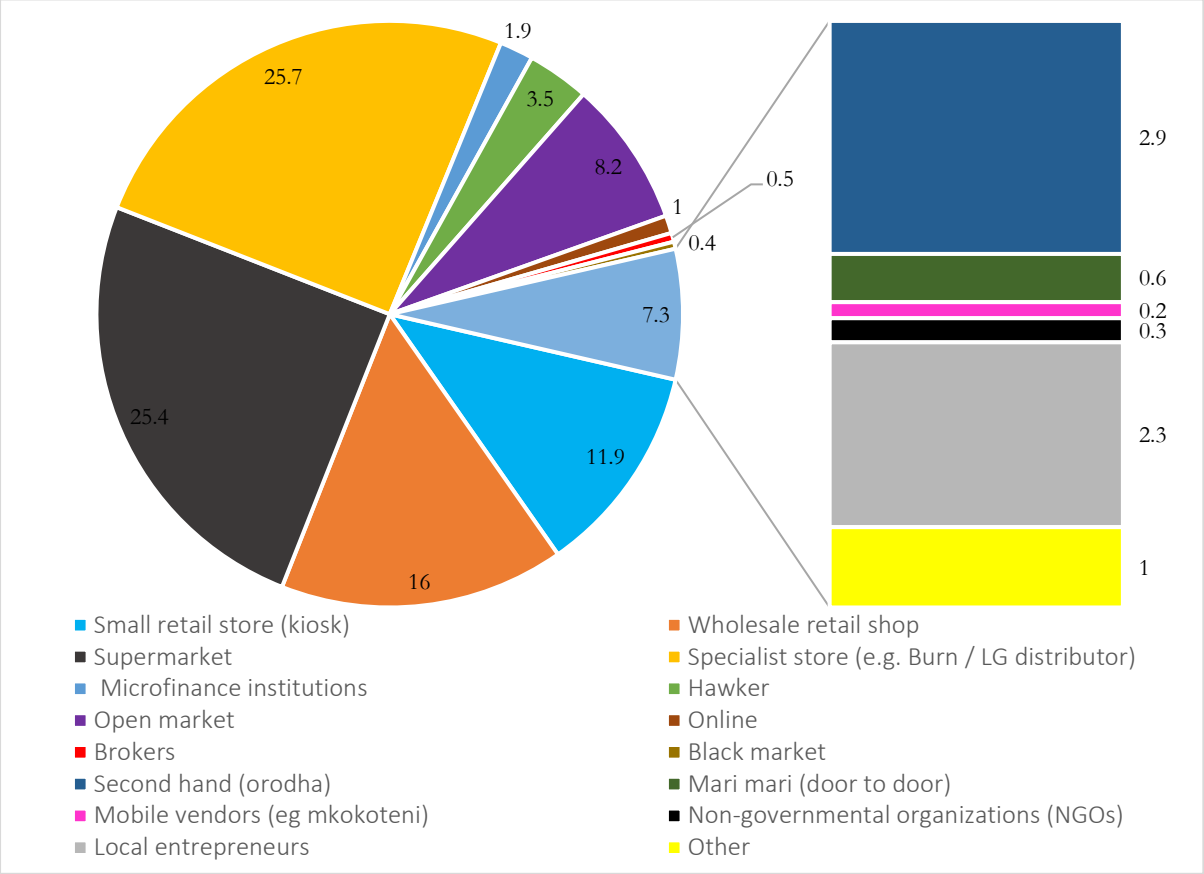


Figure 30: Households Preferred Retail Channels

Majority of households expressed their preference for purchasing electric cooking appliances from various retail options.

- 25.4 percent of households indicated a preference for supermarkets, citing convenience and a wide array of product offerings.
- 25.7 percent of households favoured specialist stores like Burn and LG distributors, highlighting their preference for specialized services and higher-quality products.
- Specialist stores, such as Burn and LG distributors, were favoured by 22.84 percent of households, indicating a desire for specialized services and higher-quality products.

This aligns with the earlier observation that despite the limited presence of specialist stores within the settlement, households prioritize their offerings.

- 11.9 percent of households preferred small retail stores or kiosks, emphasizing the importance of these local establishments in providing accessibility and convenience to a significant portion of the population.

These findings demonstrate the diverse retail preferences within the settlement, reflecting the different factors and considerations influencing households' choices when purchasing electric cooking appliances.

Last mile distribution

According to a key informant, the adoption of innovative distribution channels, such as utilizing last-mile distributors, will play a significant role in reaching people within the informal settlement with eCooking appliances. This approach presents an opportunity for developing and expanding the market for electric cooking appliances in informal settlements. Last-mile distribution involving using individuals who utilize basic forms of transport, such as motorcycles (*boda bodas*), to access the settlements will address transport challenges in Mathare. This mode of distribution is crucial in ensuring the availability and accessibility of electric cooking appliances to residents.

The establishment of distribution networks through groups has shown promising results in the past. Women's groups and more recently, youth groups, have become important channels for disseminating new ideas to their members and the wider community. These groups have utilized their social capital as a means of economic security, as highlighted in the focus group discussions. By utilizing these existing groups within the informal settlements, information dissemination and the sale of electric cooking appliances can be facilitated. These groups provide platforms for developing and building their members' entrepreneurial capacities, who can then explore and achieve the delivery and sale of efficient electric cooking appliances within the community.

"I think it will work if you go through the groups, you see women are in these groups, so you introduce yourself to these groups. If you through the group, it will be successful and you know women know how to talk" …FGD Participant

"Or you bring it on offer. We love offers" ….

This approach not only enhances access to appliances but also contributes to the overall development and empowerment of individuals within the informal settlements.

After sales services

Upon completion of the cooking diaries, there were diverse responses regarding the repair of the Electric Pressure Cooker (EPC) in the event of a breakdown.

- Surprisingly, 33.3 percent of households preferred to contact the research team, either seeking assistance in identifying authentic repair centres or assuming that the research team can handle the repairs themselves.
- Some participants admitted not knowing about the appropriate steps in such situations, highlighting a need for capacity development among EPC users regarding repairs and warranties.

The findings underscore the critical need for capacity development among EPC users concerning repairs and warranties of their appliances, as well as the importance of enhancing the skills of local technicians in handling EPC repairs. Addressing these gaps will promote self-sufficiency among users and ensure effective maintenance and repairs of EPCs in the community.

Sources of information for households

From the findings:

- 56.6 percent of households primarily receive information from friends and family.
- 56.1 percent get information through media and advertisements.
- Friends and family, along with media and advertisements, play a significant role in disseminating information within the settlement.
- Community forums like churches and local administration are crucial platforms for raising awareness.
- Social media is important for reaching households within the settlement (figure 31).

These findings underscore the diverse channels through which information reaches households, emphasizing the significance of interpersonal connections, media outreach, community engagement, and digital platforms in creating awareness and promoting knowledge dissemination within the settlement.

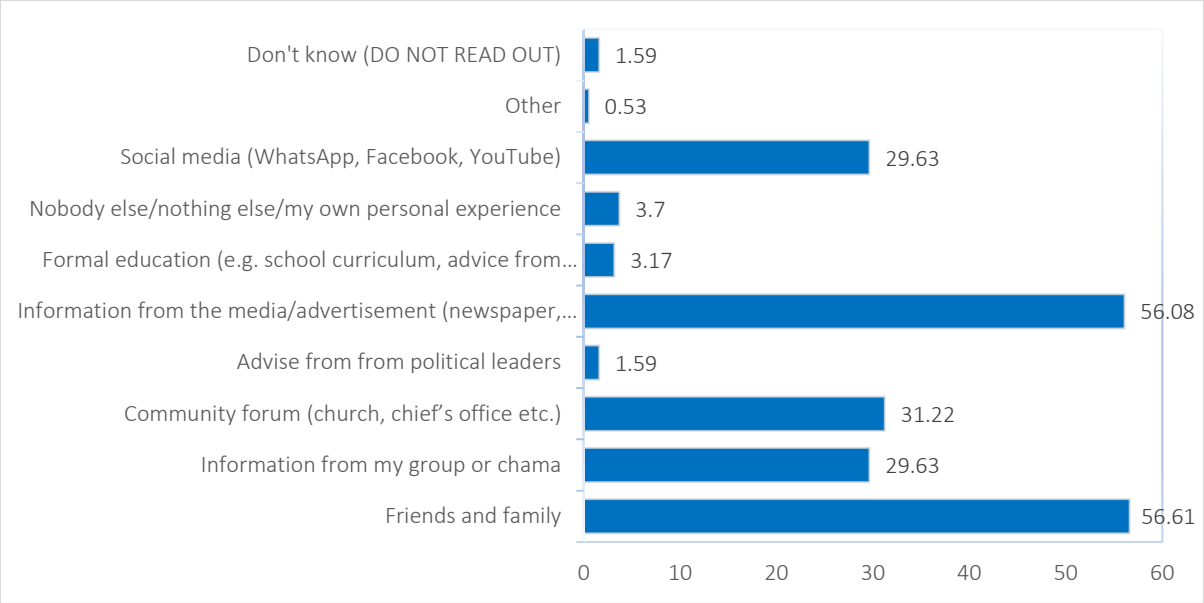


Figure 31: Sources of Information

Online Purchase of Electric Cooking Appliances

There is substantial potential for mobile phone-based marketing strategy.

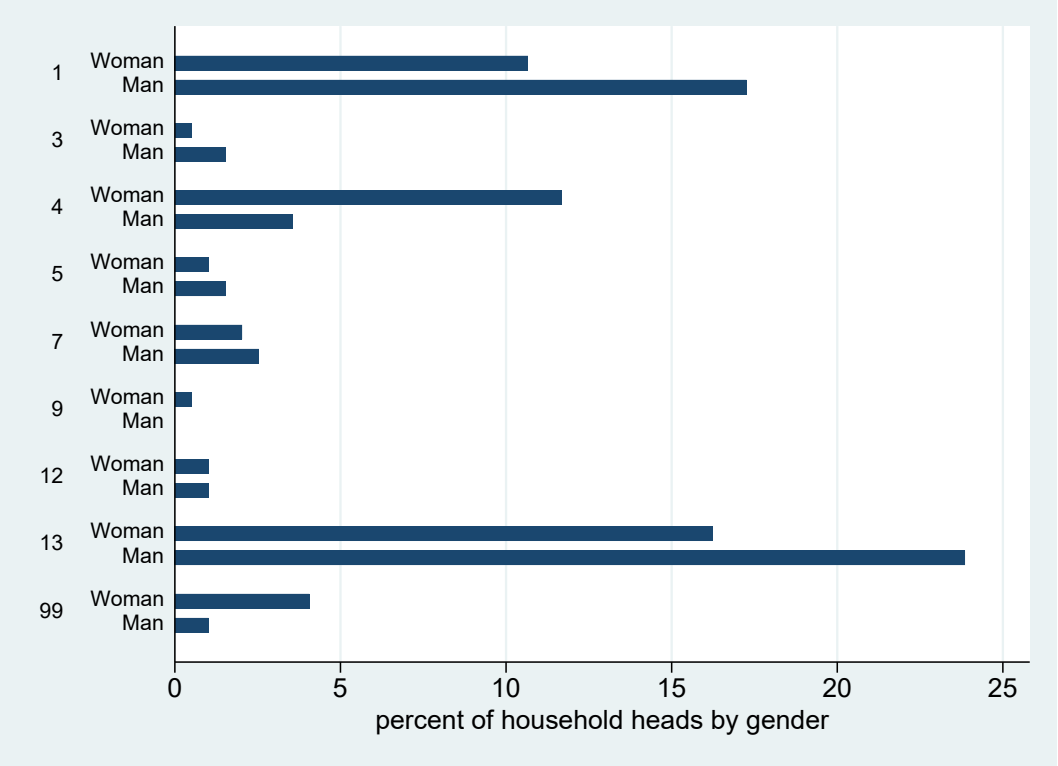
- A significant 70.2 percent of residents reported owning a mobile phone, which could facilitate purchase and payment for eCooking appliances.
- The potential for mobile phone-based marketing further increases with the increase in prevalence of smart phones.
- Leading online marketplaces such as Jumia Kenya, Kilimall, Masoko, and HotPoint Appliances have established a strong presence, complementing their physical stores with online shops.
- 10.1 percent of households reported making appliance purchases through social media and online platforms.
- Nearly 9.76 percent of households identified online platforms as their primary source for buying electric cooking appliances.

While the prevalence of internet access in Kenya presents ample opportunities for selling appliances online, it also brings certain challenges. With such a high internet penetration rate, thanks to investments in fibre optic connectivity and widespread use of cellular phones, Kenyan consumers are becoming more comfortable with online shopping. This trend is further facilitated by popular payment systems like M-Pesa and debit cards, which provide secure and convenient payment options.

5.2 Financing Mechanisms

Cash is the preferred financing model for e-cooking among both male and female household heads. Following cash, the pay-as-you-go (PAYG) model is the next most preferred option, while rent-to-own programs are the least favoured. Table 2 provides further insights, showing that the percentage of male household heads preferring PAYG is twice as high as that of female household heads. However, when it comes to rent-to-own programs, the proportion of female household heads opting for this financing option is four times higher compared to their male counterparts. Overall, out of every 100 respective household heads, 45 female households and 53 male households consider cash as a viable financing model for e-cooking stoves.

Figure 32: e-Cooking Financing Preferences



Preferences key: 1-Pay-as-you-go (PAYG), 2-Microfinance loan, 3-group savings and loans, 4-rent-to-own program, 5-subsidized financing, 6-community savings and loans, 7-mobile money-based financing, 8-collaborative financing platforms, 9-appliance rental programs, 10- product building, 11-energy-efficient appliance trade-in programs, 12-government subsidies or grants, 13-cash, 99-other

Table 18: Financing Models

Financing mechanism	Combined	Female household head	Male household head
(sub)population	58913	33018	25895
Pay-as-you-go	17.26%	11.58%	24.50%
Group savings and loans	4.26%	1.02%	8.39%
Rent-to-own program	17.35%	26.15%	6.12%
Subsidized financing	1.63%	1.61%	1.66%
Mobile money-based financing	4.77%	5.56%	3.77%
Appliance rental programs	1.33%	2.37%	
Government subsidies and grants	2.56%	2.96%	2.06%
Cash	48.15%	44.61%	52.66%
Other	2.69%	4.13%	0.85%

Loan financing for e-cooking

When it comes to preferences for loan financing in e-cooking for Mathare Informal Settlement residents':

- Majority not interested in loan-financed e-cooking; prefer alternative financing.
- High-interest rates deter 53 percent of residents from considering e-cooking appliance loans.

- Proportion of residents open to loan-financed e-cooking decreases with lower income levels.

Again:

- Incentives like appliance maintenance or extended warranties increase willingness for appliance financing as suggested in figure 4.
- Majority willing to trade in current cooking appliance for electric cooking appliance as shown in figure 6.
- Majority of the households are willing to contribute to a community-based e-cooking financial resources pooling program, demonstrating support for collective e-cooking solutions as depicted in figure 5.

. *Figure 33: Attitude Towards e-Cooking Loan Financing*

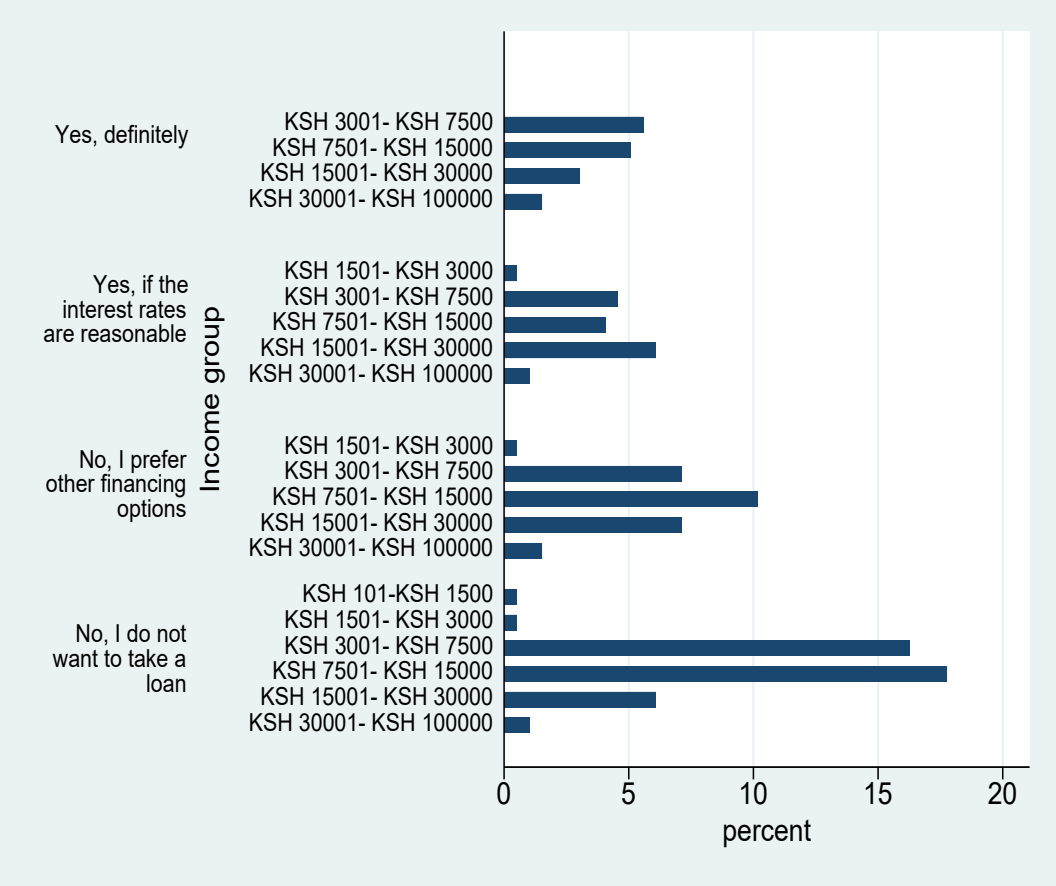
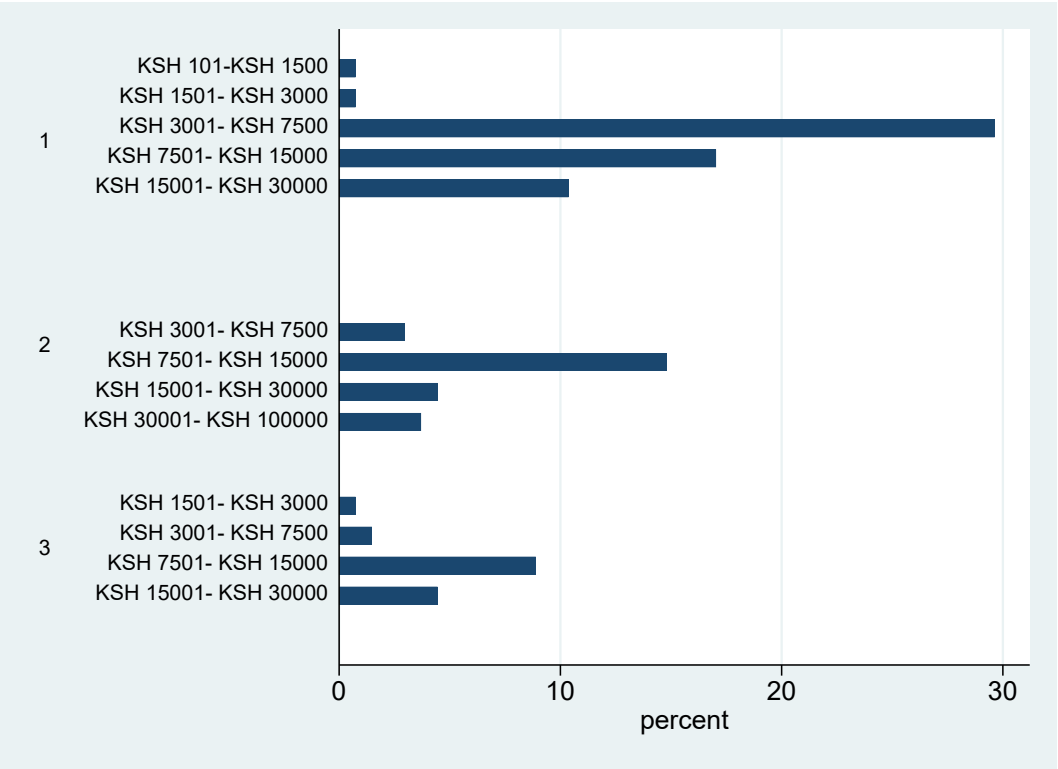
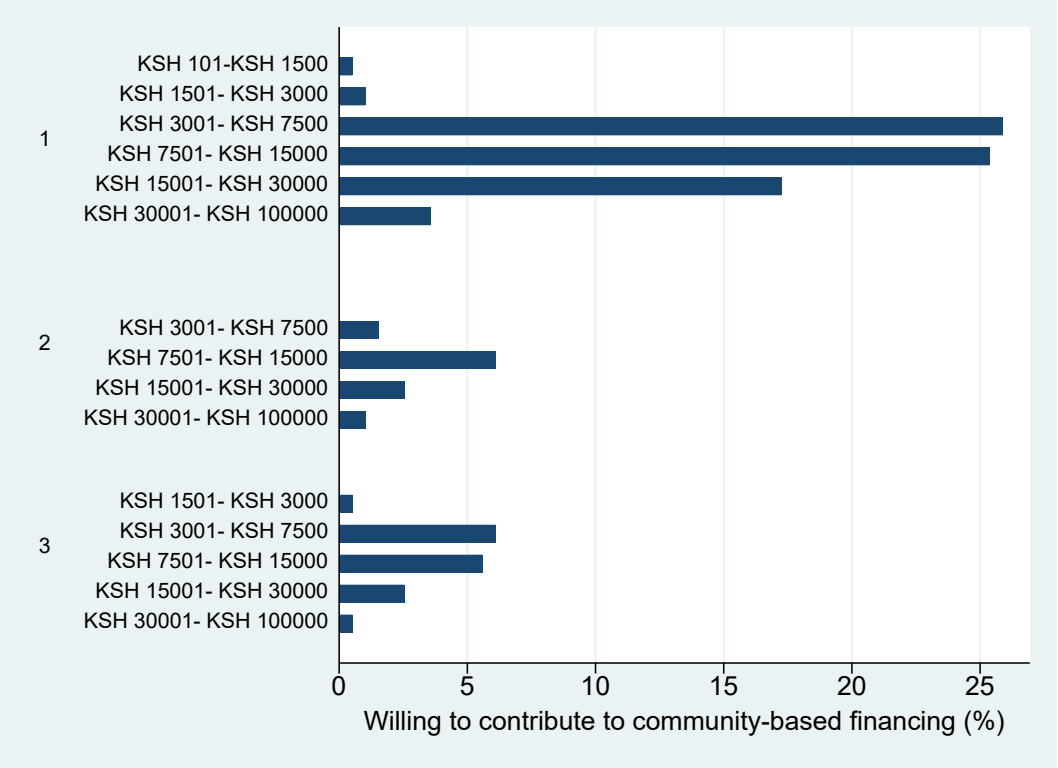


Figure 34: Incentives-based appliance financing program participation



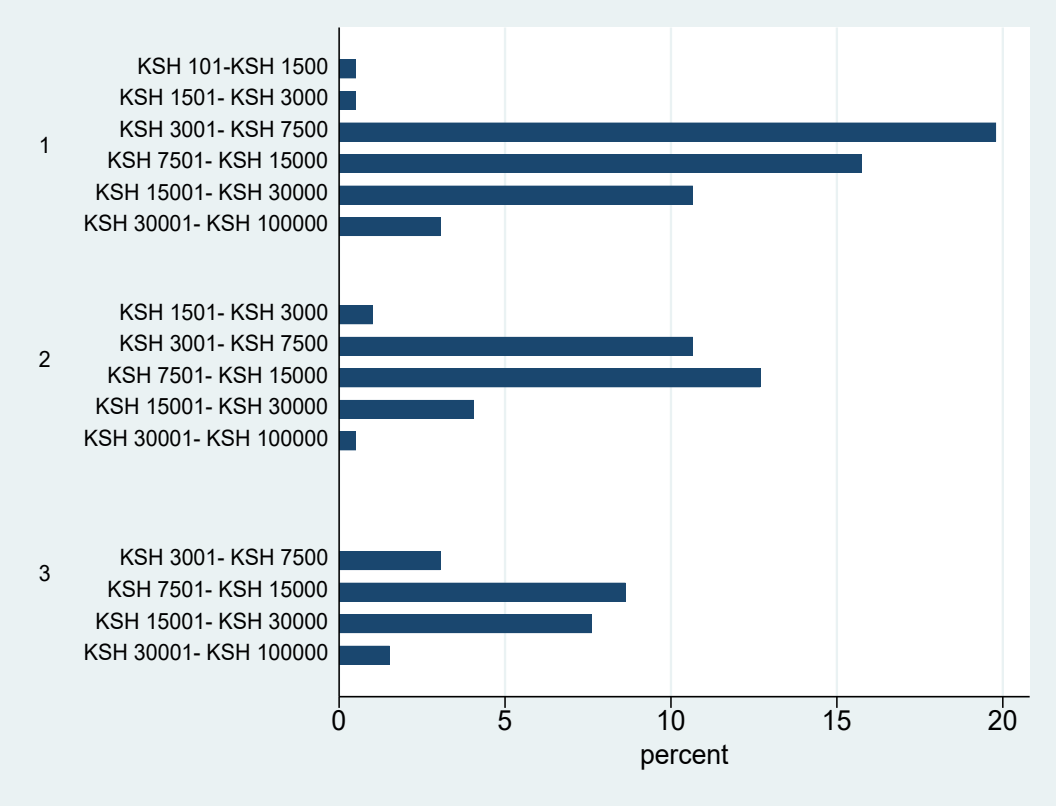
Participation key: 1-yes, 2-maybe, 3-n

Figure 35: Community-Based Financing



Contribution key: 1-yes, 2-no, 3-unsure

Figure 36: Willingness to Trade-in



Trade-in key: 1-yes, 2-no, 3-unsure

Financing Mechanisms (Cooking Solutions Businesses)

In the Mathare informal settlement, cooking solutions businesses rely on diverse funding sources, as depicted in figure 37 below:

- A significant portion of these businesses (72.4 percent) use their own funds to sustain their operations.
- Around 10 percent of the businesses obtain credit from suppliers or advance payments from customers.
- Interestingly, 6.3 percent of the businesses acquire financing from chamas, underscoring their pivotal role as a funding source within the informal settlements.
- Approximately 2.1 percent of the businesses secure funding from banks, while 1.3 percent resort to microfinance institutions. This data suggests that access to credit facilities from banks and microfinance institutions remains constrained within the settlement.

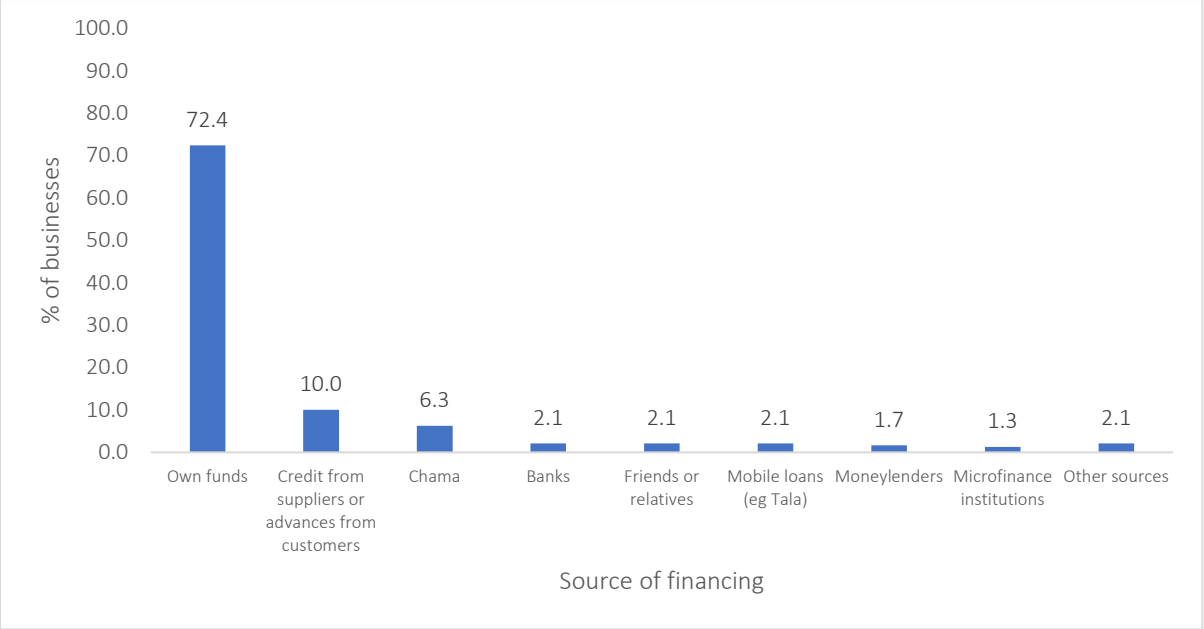


Figure 37: Main source of financing for cooking solutions vendors

From the analysis:

- 20.9 percent of the cooking solutions vendors reported to have secured loans to finance their businesses as shown in figure 38 below.

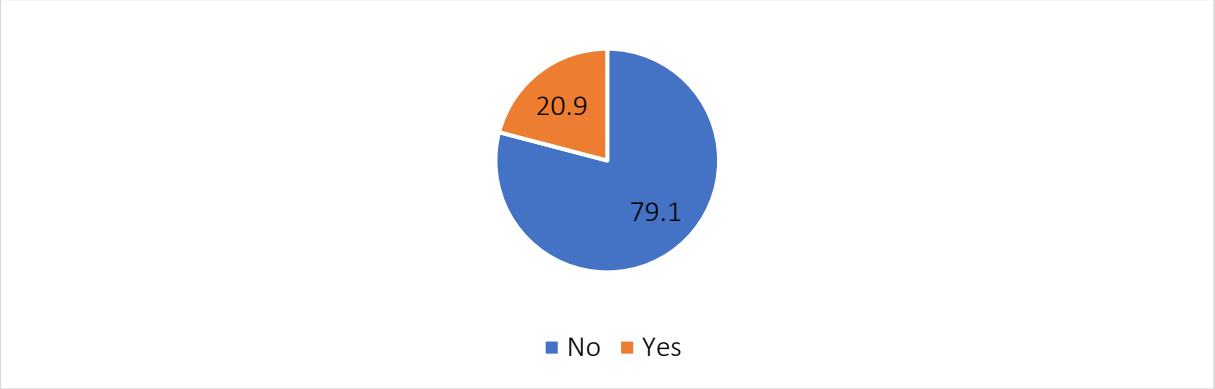


Figure 38: Loans to finance business

As depicted in figure 39 below, out of the 79.1 percent of the businesses who do not use loans to finance their operations:

- 69.3 percent of these businesses indicated that they do not require loans.
- 13.2 percent of the businesses find the loans to be costly, highlighting how the high interest rates limit the uptake of credit by small businesses in the urban informal settlements.
- 4.8 percent of the businesses pointed out the complex application process as the primary obstacle in accessing loans, highlighting the need to simplify the process.
- Interestingly, 10.6 percent of the vendors didn't think they would be able to obtain the loans as they were not registered, underscoring the importance of raising awareness and providing education about securing loans more easily.

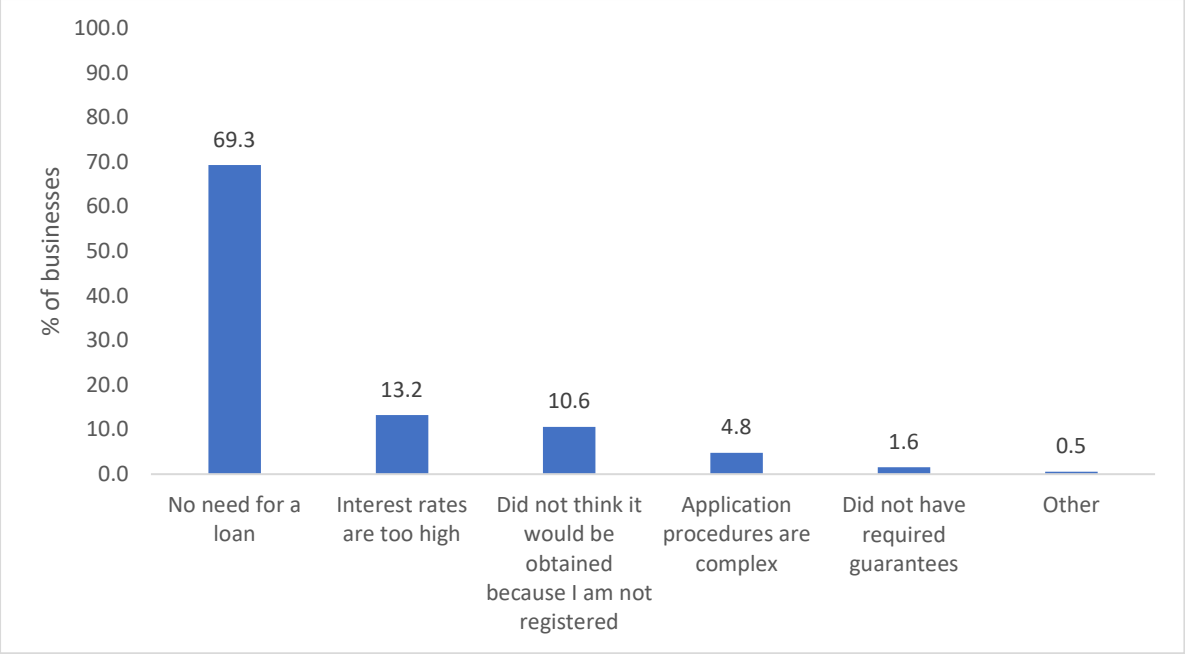


Figure 39: Reasons for not taking loans.

Willingness to pay for the EPC.

At the conclusion of the cooking diaries, it was observed that all food vendors expressed their willingness to pay for the Electric Pressure Cookers (EPCs), as reflected in Table 20[22].

- On average, households were willing to pay 957 ksh more than food vendors for the EPCs.
- Excluding the outlier with an exceptionally low value from the household participants, the average cost they would be willing to pay for the EPCs is 7,250 ksh.

Table 19: Willingness to pay for the EPC

	N	Minimum	Maximum	Mean	Std. Deviation
Food vendors	5	3,000	9000	5,300	2588.436
Households	7	300	10,000	6,257.14	3,769.994

The average amount that food vendors expressed their willingness to pay for the Electric Pressure Cookers (EPCs) aligns with the sentiments expressed during a Focus Group Discussion (FGD).

"From four thousand to five thousand shillings, many people can manage because it is fair enough".

[22] However, there appeared to be a discrepancy in the minimum amount mentioned by one participant, which was unusually low. It is possible that this value was a typing error during data entry, and unfortunately, due to the anonymization of the exit interviews, a follow-up to verify the stated figure was not possible.

Out of the 7 household participants who expressed their willingness to pay for the Electric Pressure Cookers (EPCs), one participant (10 percent of all participants) stated a preference for cash payment. On the other hand, the remaining 6 participants (60 percent of all participants) opted for payment through instalments, which they planned to finance through savings, loans from Sacco (savings and credit cooperative societies), and merry-go-rounds. Among the food vendors, all of them preferred payment in instalments, which they intended to fund through personal savings and participation in merry-go-round savings groups. The preference for payment in instalments rather than a lump sum payment indicates a trend among residents in informal settlements, as also observed during the conducted FGD sessions in Mathare, Kibra, and Mukuru.

"Maybe it costs six thousand shillings, I pay one thousand shillings then I pay the rest in instalments that would be very easy" …FGD participant

"If it comes right now there are some people who can pay cash and go with it. Another one will be able to pay in instalments". FGD participant.

5.3 Awareness (Source of information, information sharing)

The report presents findings on the effectiveness of various awareness creation methods within households. Respondents' preferences are summarized below:

- Community Workshops: 61.41 percent of households find them the most effective.
- Door-to-Door Campaigns: 48.2 percent consider this method effective.
- Local Community Leaders/Organizations: 28.54 percent find them helpful.
- Mobile Information Sessions: 24.04 percent of households prefer this approach.
- Peer-to-Peer Awareness Campaigns: 21.97 percent find them effective.

Less Effective Methods:

- Performance Arts: Only 0.39 percent of households believe it to be effective.
- Informational Videos and Presentations: Just 0.33 percent of respondents find them effective.

These findings are summarized in Table 4, providing valuable insights into the preferred approaches for generating awareness within the community.

Table 20: E-Cooking Public Awareness Promotion Media

Awareness activity	Percent
community workshops	61.41
mobile information sessions	24.04
community events	17.19
Local community leaders or organizations	28.54
Peer-to-peer awareness campaigns	21.97
Door-to-door campaigns	48.2
Radio programs and advertisements	17.6

Performance arts	0.39
Social media campaigns	11.21
Partnerships with local businesses	5.73
Cooking demonstrations	16.11
One-on-one consultations	7.53
Informational videos or presentations	0.33
Testimonials from community members	2.24
None	1.56

Opportunities for electric cooking in Mathare Informal Settlement

Despite In Mathare Informal Settlement, while electric cooking remains at relatively low levels, there are discernible prospects for its growth and adoption. Analysis from the survey indicates a significant willingness among households and cooking solutions vendors to embrace electric cooking, thereby signifying a shifting trend in the settlement's cooking practices.

Notably:

- 87.8 percent of households expressing their willingness to transitioning to electric cooking.
- 38.9 percent of cooking solutions vendors showcasing a readiness to exclusively sell electric cooking appliances, thereby transitioning away from their current products.
- The primary driving forces behind this willingness of the cooking solutions vendors to switch are the affordability of the appliances (74.2 percent), followed by concerns for safety (54.8 percent), durability (44.1 percent), and efficiency (36.6 percent), among other factors.
- Conversely, the versatility of the appliances (11.8 percent) and the availability of spare parts and repair services (9.7 percent) ranked comparatively lower on the list of considerations, as depicted in figure 40 below.
- This data not only underlines the changing dynamics of cooking methods in the settlement but also emphasizes the need for strategic initiatives and policies that support the wider adoption of electric cooking technologies, fostering a sustainable and safer cooking environment for the community.

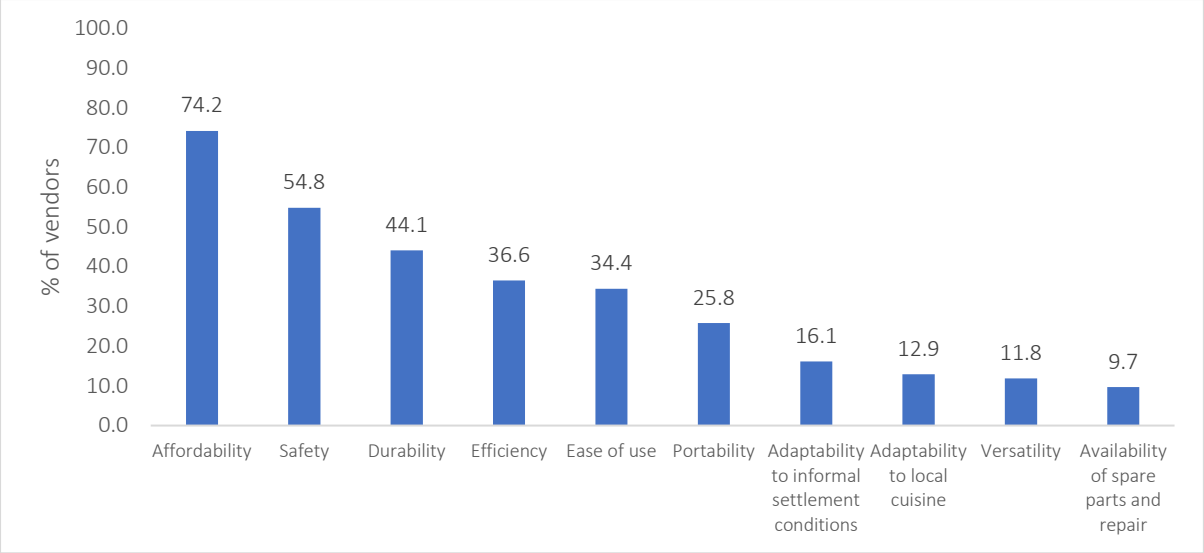


Figure 40: Factors influencing business transition to eCooking appliances.

To successfully introduce electric cooking in Mathare Informal Settlement and encourage widespread adoption, cooking solutions vendors offered several key pieces of advice, emphasizing a holistic approach to community engagement and support. Remarkably:

- 67.0 percent of the cooking solutions vendors recommended conducting awareness campaigns and educational programs to inform the community about the benefits of electric cooking.
- 43.1 percent suggested demonstrations and trial programs within the settlement, allowing residents to experience electric cooking firsthand as the best way of encouraging ecooking adoption.
- Providing training programs and skill development initiatives to the community, focusing on electric cooking techniques, maintenance, and safety practices was recommended by 26.8 percent of these vendors.
- 13.0 percent highlighted the importance of enhanced energy infrastructure within the settlement, such as expanded access to electricity, reliable power supply, and the installation of communal charging points for electric cooking appliances as shown in figure 41 below.

Figure 41: Strategies to promote adoption of ecooking appliances in Mathare.

Regarding the preferred payment options or pricing models, insights from the cooking solutions vendors in the area provide a nuanced understanding of the customer preferences. Key findings include:

- 46.9 percent of the vendors highlighted that cash payments remain the most preferred mode of transaction among their customers, indicating the prevalence of traditional payment practices in the region.
- 21.9 percent emphasized the growing significance of layaway savings (commonly known as "lipia pole pole") as the most appealing pricing model for the customers. This trend underscores the increasing popularity of this payment method, particularly within

50.2 percent of cooking solutions vendors point out that pricing is important for success of eCooking appliances business in Mathare.

low-income segments of the population, as depicted in figure 42 below.

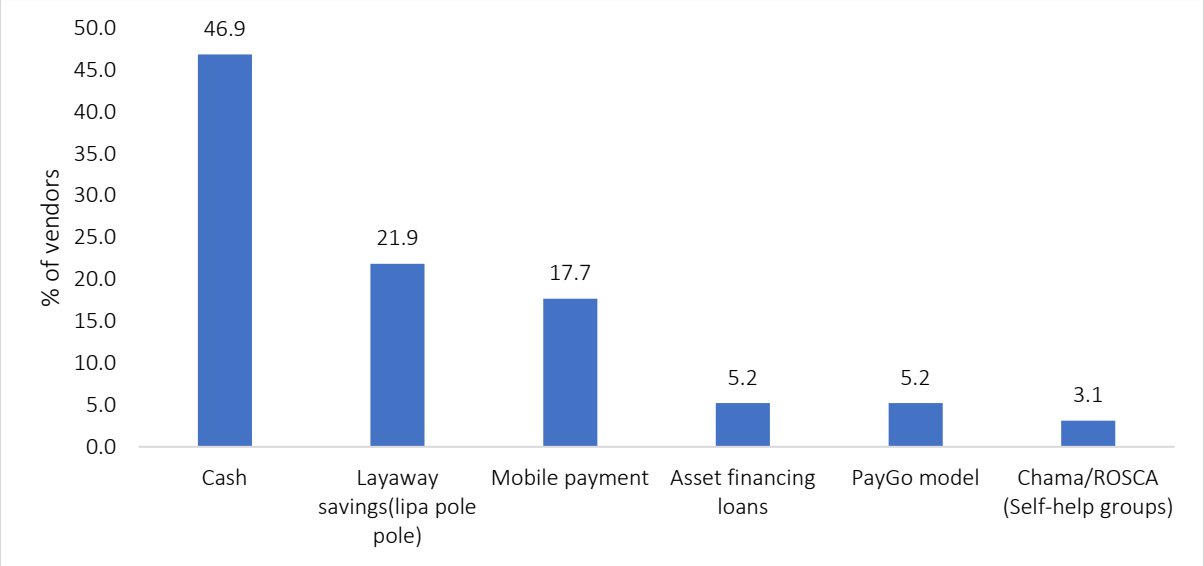


Figure 42: Preferred pricing model and payment options for customers.

Again, as depicted by figure 43, based on the insights provided by the cooking solutions vendors, the key channels for accessing eCooking appliances in partnership with an eCooking appliances dealer, crucial for ensuring widespread adoption, are as follows:

- Leveraging on the established network and accessibility of local appliance stores within the settlement to facilitate easy and convenient access to a diverse range of eCooking appliances, (61.9 percent of the vendors).
- Collaborate with non-governmental organizations (NGOs) and community-based organizations (CBOs) working within the informal settlement (19.3 percent recommended this collaborative approach).
- Microfinance Institutions: 2.5 percent of the vendors stablishing partnerships with microfinance institutions to provide accessible financing options for residents looking to purchase eCooking appliances, thereby promoting affordability and ease of access.
- Collaborating with Energy Service Companies (ESCOs) to ensure the availability and accessibility of eCooking appliances, facilitating a reliable supply of these appliances to the settlement (2.5 percent of the vendors)

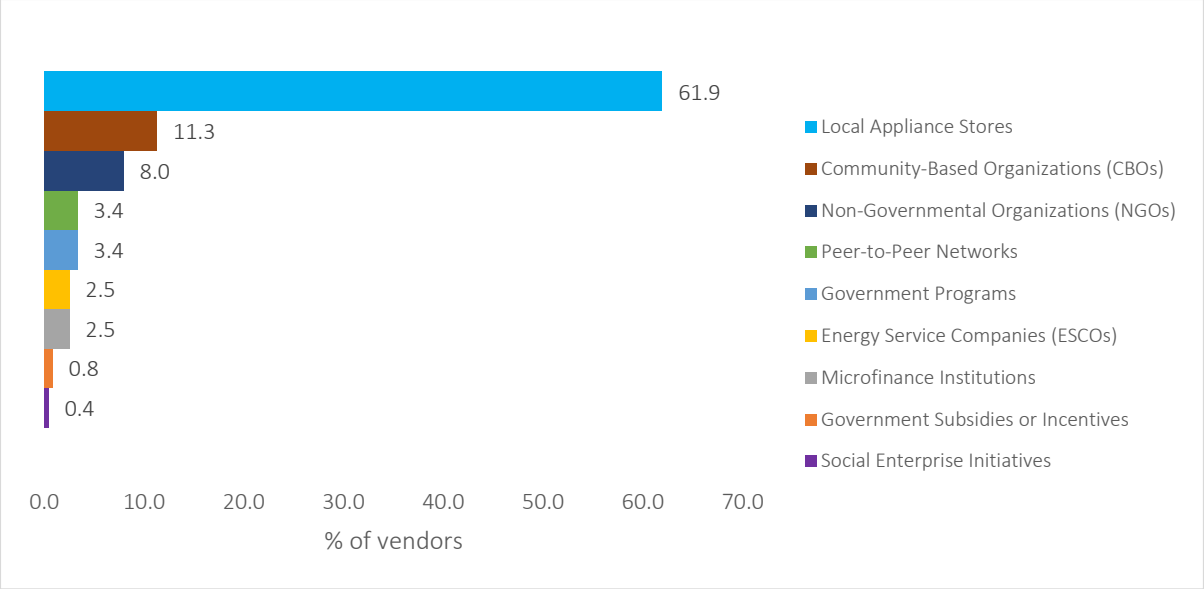


Figure 43: Preferred channels for accessing eCooking appliances through partnership.

6. Conclusions and Recommendations

The goal of the study was to assess the potential for the adoption of electric cooking in urban informal settlements to aid in the development of interventions to promote access to and usage of electric cooking appliances. By understanding the current cooking practices, energy use, and external and internal factors influencing energy choices in these settlements, the study aimed to identify barriers and leverage points for the promotion of electric cooking. Consumer financing and market interventions to address upfront costs were also evaluated to stimulate the use of electric cooking technologies in households and food businesses in these settlements.

In conclusion:

- Economic factors play a significant role in determining the likelihood of a household having formal electricity connection as the proportion of formal connections increases with an increase in wealth quintiles.
- The market ecosystem of household electricity access is generally complex as characterized by structured market systems that respond to households' needs through affordability on the one hand and high risk of appliance damage and bodily injuries driven by poor household wiring installation.
- LPG stoves are the dominant choice for cooking, followed by kerosene, biofuel stoves, charcoal stoves, and electric coil stoves.
- The introduction of Electric Pressure Cookers (EPCs) showcased their potential as an alternative cooking solution, particularly for specific dishes like tea and ugali, but the use of EPCs could not entirely replace LPG stoves, particularly for foods like chapati.
- The self-regulating property and speed of the EPC were identified as key factors influencing the adoption of new cooking technologies.
- Food vendors heavily rely on firewood and charcoal, indicating the need for targeted interventions to promote the adoption of cleaner cooking fuels among this group.
- Innovative solutions accommodating multiple cooking requirements are essential for facilitating the transition to cleaner cooking practices among food vendors in informal settlements.
- The lack of conventional electricity meters in informal settlements hinders accurate assessment of cooking costs from an electricity consumption perspective.
- Electricity as a stand-alone fuel requires less energy for heating compared to energy stacks including LPG, but the contribution of LPG significantly reduces overall household energy efficiency and increases energy consumption.

Recommendations:

- Focus on economic factors in promoting access to electric cooking, especially in lower-income households.
- Address the complex market ecosystem for household electricity access, emphasizing safety through proper wiring installation.

Market Scoping

The cooking solutions market in Mathare informal settlement is primarily driven by cooking fuel vendors, with a smaller number of businesses focusing on cook stoves and cooking appliances. From the analysis:

- The majority of businesses specialize in selling cooking fuels, particularly kerosene and LPG, which residents widely use.
- The prevalence of kerosene can be attributed to its affordability, availability, and familiarity, while LPG has gained popularity due to supportive policies and awareness campaigns. Charcoal also has a significant market share as a cooking fuel in the settlement.
- It is worth noting that a smaller portion of businesses cater to the comprehensive needs of customers by offering both cook stoves and cooking fuels. Access to a wider variety of cook stoves and appliances may require residents to venture outside the settlement. Lack of capital is identified as a significant obstacle for expansion, indicating the need for financial support and access to funding opportunities.
- Insecurity issues also emerge as a major concern, creating a challenging business environment that hampers potential growth. Addressing these obstacles and supporting capital investment and security measures can help stimulate the growth of cooking fuel and cook stove businesses in Mathare.
- Demand for cooking solutions is driven by affordability, influencing pricing for fuels and cook stoves.
- The sourcing of cooking solutions in the Mathare informal settlement involves a variety of channels, including direct sourcing from manufacturers or suppliers, wholesalers, distributors, other retailers within the settlement, and street vendors.
- The determinants of choice for sourcing include the reach or coverage of distribution channels, cost of distribution, delivery speed, channel reliability, customer preferences and convenience, and regulatory requirements.
- Improved access to electric cooking appliances is recommended, along with after-sales service enhancements.
- Emerging distribution channels and trends such as the potential of e-commerce platforms, mobile channels, direct-to-consumer models, and leveraging social media platforms for sales and marketing purposes have a potential for growth.
- Small retail stores and kiosks are the primary points of purchase for electric cooking appliances in informal settlements due to their convenience.
- Some households in informal settlements purchase electric cooking appliances from wholesale retail shops and supermarkets, requiring them to venture outside the settlement.

  Recommendations include establishing outlets within reach of residents and specialized stores for quality-conscious buyers.

- Small retail stores, or kiosks, emerged as the primary point of purchase, reflecting the prevalence of these establishments in informal settlements and their convenience for residents.
- A notable percentage of households purchased electric cooking appliances from wholesale retail shops and supermarkets, suggesting that some residents had to venture outside the settlement to access these outlets.
- The limited availability of supermarkets within the settlement may be attributed to land scarcity and related concerns.
- To improve access to efficient electric cooking appliances, it is recommended to establish outlets within the reach of the residents. Additionally, specialized stores and authorized dealers play a role for households that prioritize quality and specialized services.
- The market for electric cooking appliances within the settlement also includes second-hand appliances acquired from “orodhas”, which operate on unique business models. While affordability is a factor in choosing orodhas, there is a need to ensure the lifespan and after-sales support of these appliances.
- Security concerns surrounding the acquisition of appliances from black markets highlight the issue of theft and insecurity within the settlement
- Leveraging individuals using basic transportation like motorcycles (boda bodas) can overcome transportation challenges and ensure the availability and accessibility of electric cooking appliances.
- Women's and youth groups can aid in information dissemination and sales, contributing to economic security and entrepreneurial development.
- Enhancing after-sales services and capacity development for repairs and maintenance are crucial to promote self-sufficiency among users and ensure the longevity of appliances.
- Utilize personal networks, media, community forums, and social media platforms for awareness and information dissemination.
- Mobile phone-based marketing strategies, online marketplaces, and social media platforms are effective for online sales. Widespread internet access and mobile money systems in Kenya can boost e-commerce. Cash is the preferred financing option for both male and female household heads, followed by pay-as-you-go models.
- Rent-to-own programs are less popular but more favoured by female household heads.
- High interest rates associated with credit financing deter residents from considering this option. However, with incentives like appliance maintenance and extended warranties can increase interest in financing programs.
- Residents are willing to trade-in their current cooking appliances for electric cooking appliances, indicating their openness to adopting new technologies.
- Community-based eCooking financial resources pooling programs have support, highlighting residents' willingness to contribute collectively to access e-cooking solutions.

- Community workshops and door-to-door campaigns are effective for generating awareness.
- Performance arts and informational videos are less effective in promoting eCooking adoption in Mathare.

These insights can guide future efforts to promote eCooking adoption in Mathare, emphasizing the need for accessible financing options, incentives, and community engagement.

Recommendations

In relation to household income and skill development:

- Promote skill development and entrepreneurship in eCooking to boost household income, considering self-employment and casual work as primary income sources.

In relation to household access to electricity:

- Initiate efforts to make formal grid connections more affordable and accessible for lower-income households through subsidies, flexible payment options, and targeted support.
- Explore collaboration between local vendors and the utility company (KPLC) to eliminate informal electricity connections.
- Conduct awareness campaigns to educate households on the benefits of formal electricity connections and the risks associated with informal ones and the available financial assistance or incentives for accessing electricity.
- Awareness campaigns and educational programs should be conducted to promote proper electrical installations and discourage do-it-yourself (DIY) installations or the use of uncertified electricians. Access to qualified professionals for electrical installations should be facilitated.

In relation to household cooking practices:

- Encourage transition to eCooking by ensuring reliable electricity during meal preparation times, particularly for supper and breakfast.
- Promote energy-efficient appliances such as EPCs and Induction Stoves suitable for common supper and breakfast dishes.
- Raise awareness and encourage households to adopt Electric Pressure Cookers (EPCs), highlighting their ease of use and self-regulating properties.

For food vendors:

- Develop innovative solutions supporting multiple heating points for food vendors to transition away from polluting fuels.
- Provide larger pot sizes for EPCs to better accommodate their food vending needs.
- Developing appropriate cook stoves for food vendors, such as efficient electric stoves or other clean cooking solutions, can help transition away from the dominant use of firewood and charcoal.

By targeting food vendors, who play a significant role in the community's food preparation, these interventions can have a positive impact on reducing indoor air pollution and improving overall health in the informal settlements.

Based on the findings of the energy consumption analysis, several recommendations can be made:

- Promote the use of electricity as a stand-alone cooking fuel in households, as it demonstrated lower energy consumption compared to other fuel stacks. This can be achieved by promoting the use of efficient electric cooking appliances such as electric pressure cookers.
- Prioritize interventions aimed at reducing the use of polluting fuels such as kerosene, considering its high energy consumption compared to cleaner alternatives.

Based on the insights from the data, several recommendations can be made to improve the accessibility and availability of efficient electric cooking appliances for residents of informal settlements.

- Establish retail outlets, including supermarkets and specialized stores, within informal settlements to enhance convenience.
- Address the issue of black markets and insecurity within the settlement to maintain a safe and reliable marketplace.
- Adopt innovative distribution channels, such as last mile distributors utilizing motorcycles, to ensure the availability and accessibility of eCooking appliances within the informal settlement.
- Establishing distribution networks through existing women's and youth groups can facilitate information dissemination and sales, leveraging their social capital and entrepreneurial capacities.
- Enhance after-sales services by providing capacity development for appliance repairs and warranties, as well as enhancing the skills of local technicians to handle Electric Pressure Cooker (EPC) repairs.
- Leverage on personal networks, media/advertisements, community forums, and social media platforms to raise awareness and disseminate information about eCooking appliances to households within the settlement.

The data clearly shows that the perception of high interest rates associated with loans deter residents from considering loan financing. To address this, it is recommended to:

- Explore alternative financing options that are more appealing to Mathare residents for eCooking appliances such as financing models with incentives like appliance maintenance or extended warranties.
- Partner with savings and credit cooperative societies (SACCO) and savings groups for flexible payment options.

These strategies would align with the residents' financial preferences and make eCooking appliances more affordable and feasible for adoption.

For effective awareness campaigns:

- The focus should be community workshops and door-to-door campaigns in creating awareness about e-cooking.
- Use local community leaders and organizations as influencers.
- Allocate resources to preferred awareness approaches like community engagement.

It is recommended to:

- Capitalize on the potential of mobile phone-based marketing strategies and online platforms for the purchase of electric cooking appliances.
- Collaborate with leading online marketplaces and exploring partnerships with influencers or online communities can also enhance visibility and reach. Address challenges related to digital literacy and accessibility, ensuring that all residents can benefit from online purchasing options.
- Offer flexible financing mechanisms to accommodate the financial preferences of different households, including options for instalment payments and rent-to-own programs.

By aligning marketing strategies with financing options, businesses can effectively promote the adoption of eCooking appliances and cater to residents' diverse needs and preferences in the informal settlement.

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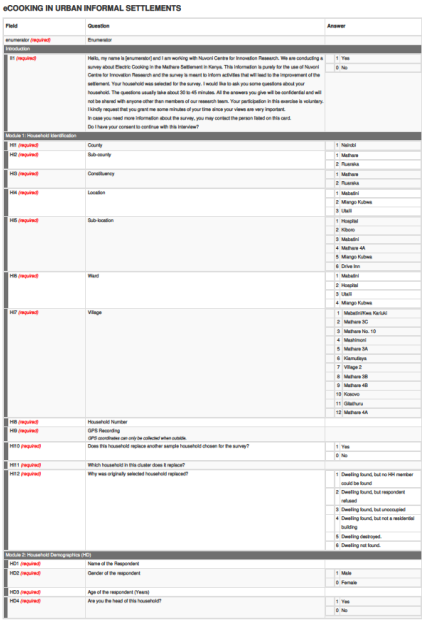
8. Annexes

8.1. Household questionnaire

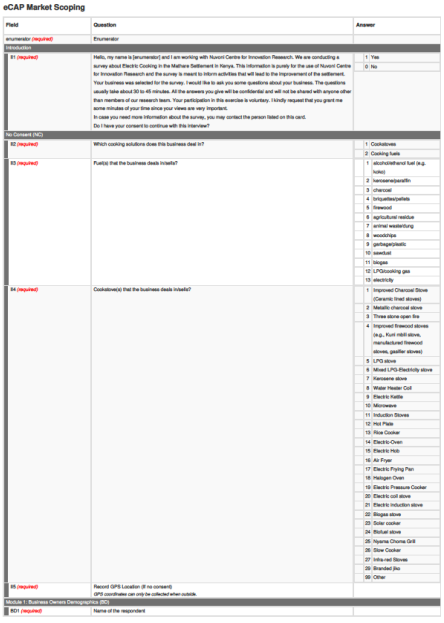
Double-click on the image below to access the document via Adobe Acrobat Viewer



eCOOKING IN URBAN INFORMAL SETTLEMENTS

Field	Question	Answer
enumerator (required)	Enumerator	
Introduction		
B1 (required)	Hello, my name is [enumerator] and I am working with Nuvoni Centre for Innovation Research. We are conducting a survey about Electric Cooking in the Mathare Settlement in Kenya. This information is purely for the use of Nuvoni Centre for Innovation Research and the survey is meant to inform activities that will lead to the improvement of the settlement. Your household was selected for the survey. I would like to ask you some questions about your household. The questions usually take about 30 to 45 minutes. All the answers you give will be confidential and will not be shared with anyone other than members of our research team. Your participation in this exercise is voluntary. I kindly request that you grant me some minutes of your time since your views are very important. In case you need more information about the survey, you may contact the person listed on this card. Do I have your consent to continue with this interview?	1 Yes 0 No
Module 1: Household Identification		
H1 (required)	County	1 Nairobi
H2 (required)	Sub-county	1 Mathare 2 Ruaraka
H3 (required)	Constituency	1 Mathare 2 Ruaraka
H4 (required)	Location	1 Mabatini 2 Mlango Kubwa 3 Utalii
H5 (required)	Sub-location	1 Hospital 2 Kiboro 3 Mabatini 4 Mathare 4A 5 Mlango Kubwa 6 Drive Inn
H6 (required)	Ward	1 Mabatini 2 Hospital 3 Utalii 4 Mlango Kubwa
H7 (required)	Village	1 Mabatini/Kwa Kariuki 2 Mathare 3C 3 Mathare No. 10 4 Mashimoni 5 Mathare 3A 6 Kiamutisya 7 Village 2 8 Mathare 3B 9 Mathare 4B 10 Kosovo 11 Gitathuru 12 Mathare 4A
H8 (required)	Household Number	
H9 (required)	GPS Recording GPS coordinates can only be collected when outside.	
H10 (required)	Does this household replace another sample household chosen for the survey?	1 Yes 0 No
H11 (required)	Which household in this cluster does it replace?	
H12 (required)	Why was originally selected household replaced?	1 Dwelling found, but no HH member could be found 2 Dwelling found, but respondent refused 3 Dwelling found, but unoccupied 4 Dwelling found, but not a residential building 5 Dwelling destroyed. 6 Dwelling not found.
Module 2: Household Demographics (HD)		
HD1 (required)	Name of the Respondent	
HD2 (required)	Gender of the respondent	1 Male 0 Female
HD3 (required)	Age of the respondent (Years)	
HD4 (required)	Are you the head of this household?	1 Yes 0 No

8.2. Market scoping questionnaire



eCAP Market Scoping

Field	Question	Answer
enumerator (required)	Enumerator	
Introduction		
B1 (required)	Hello, my name is [enumerator] and I am working with Nuvoni Centre for Innovation Research. We are conducting a survey about Electric Cooking in the Mathare Settlement in Kenya. This information is purely for the use of Nuvoni Centre for Innovation Research and the survey is meant to inform activities that will lead to the improvement of the settlement. Your business was selected for the survey. I would like to ask you some questions about your business. The questions usually take about 30 to 45 minutes. All the answers you give will be confidential and will not be shared with anyone other than members of our research team. Your participation in this exercise is voluntary. I kindly request that you grant me some minutes of your time since your views are very important. In case you need more information about the survey, you may contact the person listed on this card. Do I have your consent to continue with this interview?	1 Yes 0 No
No Consent (NC)		
B2 (required)	Which cooking solutions does this business deal in?	1 Cookstoves 2 Cooking fuels
B3 (required)	Fuel(s) that the business deals in/sells?	1 alcohol/ethanol fuel (e.g. koko) 2 kerosene/paraffin 3 charcoal 4 briquettes/pellets 5 firewood 6 agricultural residue 7 animal waste/dung 8 woodchips 9 garbage/plastic 10 sawdust 11 biogas 12 LPG/cooking gas 13 electricity
B4 (required)	Cookstove(s) that the business deals in/sells?	1 Improved Charcoal Stove (Ceramic lined stoves) 2 Metallic charcoal stove 3 Three stone open fire 4 Improved firewood stoves (e.g., Kuni mbili stove, manufactured firewood stoves, gasifier stoves) 5 LPG stove 6 Mixed LPG-Electricity stove 7 Kerosene stove 8 Water Heater Coil 9 Electric Kettle 10 Microwave 11 Induction Stoves 12 Hot Plate 13 Rice Cooker 14 Electric-Oven 15 Electric Hob 16 Air Fryer 17 Electric Frying Pan 18 Halogen Oven 19 Electric Pressure Cooker 20 Electric coil stove 21 Electric induction stove 22 Biogas stove 23 Solar cooker 24 Rocket stove 25 Nyama Choma Grill 26 Slow Cooker 27 Infra-red Stoves 28 Branded Jiko 99 Other
B5 (required)	Record GPS Location (If no consent) GPS coordinates can only be collected when outside.	
Module 1: Business Owners Demographics (BO)		
BO1 (required)	Name of the respondent	

8.3. Household Entry interview

Diary Form-Baseline (Households)

Field	Question	Answer
enumerator (required)	Please select the unique name for enumerator field. (Edit this label to meet your needs...)	
Household Identification (HI)		
HI0 (required)	Household Identifier	
HI1 (required)	Date	
HI2 (required)	What did you cook or heat for	1: Breakfast 2: Lunch 3: Supper 4: Snack 5: Food for baby 6: Water heating
HI3 (required)	Name of the cook	
HI4 (required)	Gender of the cook	1: Male 2: Female
HI5 (required)	Number of people served	
HI6 (required)	Number of adults served	
HI7 (required)	Number of children served	
HI7_1 (required)	What time did you start preparing [HI2_1]	
HI8 (required)	What time did you finish preparing [HI2_1]	
selected_crops1	Which dishes did you prepare for [HI2_1]?	1: Tea 2: Porridge 3: Pancakes 4: Eggs 5: Lunga (Mshori) 6: Mandazi 7: Samosa 8: Sweet potatoes 9: Nduma 10: Cassava 11: Githeri 12: Ugali 13: Rice 14: Pilau 15: Matoke 16: Chapati 17: Indomie 18: Pasta 19: Spaghetti 20: Fish 21: Omena 22: Chicken 23: Beef 24: Pork 25: Goat/mutton 26: Matumbo 27: Kienyeji vegetables 28: Cabbage 29: Sukuma wiki/ spinach 30: Chips 31: Beans 32: Dengu 33: Green maize 34: Peas 35: Mukimo 36: Chicken parts 37: Soup 38: Water heating: Drinking 39: Water heating: Tea/coffee/chocolate 40: Water heating: Bathing 41: Soasi Soya 42: Liver 43: Groundnuts (N'yugu) 44: Potatoes 99: Other

8.4. Business entry interview

Diary Form-Baseline (Businesses)

Field	Question	Answer
enumerator (required)	Please select the unique name for enumerator field. (Edit this label to meet your needs...)	
Household Identification (HI)		
HI0 (required)	Household Identifier	
HI1 (required)	Date	
HI2 (required)	What did you cook or heat for	1: Breakfast 2: Lunch 3: Supper 4: Snack 5: Food for baby 6: Water heating
HI3 (required)	Name of the cook	
HI4 (required)	Gender of the cook	1: Male 2: Female
HI5 (required)	Number of people served	
HI6 (required)	Number of adults served	
HI7 (required)	Number of children served	
HI7_1 (required)	What time did you start preparing [HI2_1]	
HI8 (required)	What time did you finish preparing [HI2_1]	
selected_crops1	Which dishes did you prepare for [HI2_1]?	1: Tea 2: Porridge 3: Pancakes 4: Eggs 5: Lunga (Mshori) 6: Mandazi 7: Samosa 8: Sweet potatoes 9: Nduma 10: Cassava 11: Githeri 12: Ugali 13: Rice 14: Pilau 15: Matoke 16: Chapati 17: Indomie 18: Pasta 19: Spaghetti 20: Fish 21: Omena 22: Chicken 23: Beef 24: Pork 25: Goat/mutton 26: Matumbo 27: Kienyeji vegetables 28: Cabbage 29: Sukuma wiki/ spinach 30: Chips 31: Beans 32: Dengu 33: Green maize 34: Peas 35: Mukimo 36: Chicken parts 37: Soup 38: Water heating: Drinking 39: Water heating: Tea/coffee/chocolate 40: Water heating: Bathing 41: Soasi Soya 42: Liver 43: Groundnuts (N'yugu) 44: Potatoes 99: Other

8.5. Household exit interview

8.6. Business exit interview

Exit Interview for EPC Testing (Businesses)

Field	Question	Answer
enumerator *(required)*	Please select the unique name for enumerator field. (Edit this label to meet your needs...)	
date *(required)*	Date of the Interview	
time *(required)*	Time of the Interview	
User Experience (UX)		
UX1 *(required)*	Who uses the electric cooking appliance?	1 Business Owner 2 Spouse 3 Child-Daughter 4 Child-Son 5 Grand Daughter 6 Grand Son 7 Niece 8 Nephew 9 Sister 10 Brother 11 Son-in-law 12 Daughter-in-law 13 Brother-in-law 14 Sister-in-law 15 Father-in-law 16 Mother-in-law 17 Grandfather 18 Grandmother 19 Uncle 20 Aunt 21 Cousin 22 Household help 23 Employee(s) 99 Other
UX1_99 *(required)*	Specify	
Cooking Experience (CE)		
CE1 *(required)*	Have you learned any new techniques of cooking since you started using the appliance?	1 Yes 0 No
CE2 *(required)*	Which new cooking techniques have you learnt?	1 Baking 2 Sautéing 3 Boiling 4 Stewing 5 Steaming 6 Deep frying 7 Roasting 8 Grilling 9 Barbecuing 10 Broiling 11 Frying 12 Stir-frying 13 Steaming 14 Poaching 15 Simmering 16 Blanching 99 Other
CE2_99 *(required)*	Specify	
CE3 *(required)*	Have you started cooking new dishes since you started using the electric appliance?	1 Yes 0 No

8.7. Cooking diary form

Household identifier: _____ Date DIARY FORM Please fill in one form every time you cook or heat water.

BEFORE COOKING	AFTER COOKING
Time: _____ Electricity: ___kWh LPG: _____kg Kerosene: __ ltr Other fuels (please state which): _____ kg. Charcoal: ____kg. Firewood: ____kg. How long did it take to light the fire: ____min	Time: _____ Electricity: _____kWh LPG: _____kg Kerosene: __ltr Other fuels (please state which): _____ kg. Charcoal: _____kg firewood: _____kg Did you save any charcoal/wood for later? Yes ☐ No ☐

Who cooked? Name of cook_____ Gender of cook: Male ☐ Female ☐

What did you cook or heat water for? Breakfast Lunch ☐ Super ☐ Snack ☐ Food for baby ☐ water heating ☐ other: _____

How many people did you cater for? Adults:_____ Children:_____

Did you serve any food that did not require cooking eg bread, fruits? No ☐ Yes ☐ If so, which one:_____

Which dishes did you prepare (Tick one from each row)	**Cooking devices Tick all that apply**	**Cooking utensil? Tick all that apply**	**Quantity (eg ½ chicken)**	**Did you put a lid on?**	**Fresh/re heated**	**Saving for later**	**Cooking process**	**Durati on**
Pancakes/chapati ☐ pilau ☐ matumbo ☐ Githeri/mokimo ☐ chips ☐ matoke ☐ Pasta/noodles ☐ Rice ☐ chicken ☐ Mandazi ☐ sausages ☐ leafy veg ☐ Eggs ☐ beans/peas/ndengu/kamande ☐ Meat ☐ potatoes/pumkin/nduma/muhogo ☐ Ugali ☐ porridge ☐ Other:_____ Fish ☐	Rice cooker ☐ pressure cooker ☐ Microwave ☐ electric hotplate ☐ Electric kettle ☐ kerosene stove ☐ Gas stove ☐ charcoal stove ☐ Firewood stove ☐ Other:____	Sufuria big ☐ kettle ☐ Sifuria med ☐ frying pan ☐ Sufuria small ☐ Pressure cooker ☐ Other:_____	____	Yes ☐ No ☐ Someti mes ☐	Fresh ☐ Reheate d ☐ Partially Cooked ☐	None ☐ Leftovers ☐ Precooking ☐ Preparig a meal in advanve ☐	Boil ☐ wetfry ☐ Dry fry ☐ deep fry ☐ Grill ☐ steam ☐ Bake ☐ Microwave ☐ Pressure cook ☐ Other:_____	Hrs ___ Min ___
Pancakes/chapati ☐ pilau ☐ matumbo ☐ Githeri/mokimo ☐ chips ☐ matoke ☐ Pasta/noodles ☐ Rice ☐ chicken ☐ Mandazi ☐ sausages ☐ leafy veg ☐ Eggs ☐ beans/peas/ndengu/kamande ☐ Meat ☐ potatoes/pumkin/nduma/muhogo ☐ Ugali ☐ porridge ☐ Other:_____ Fish ☐	Rice cooker ☐ pressure cooker ☐ Microwave ☐ electric hotplate ☐ Electric kettle ☐ kerosene stove ☐ Gas stove ☐ charcoal stove ☐ Firewood stove ☐ Other:____	Sufuria big ☐ kettle ☐ Sifuria med ☐ frying pan ☐ Sufuria small ☐ Pressure cooker ☐ Other:_____	____	Yes ☐ No ☐ Someti mes ☐	Fresh ☐ Reheate d ☐ Partially Cooked ☐	None ☐ Leftovers ☐ Precooking ☐ Preparig a meal in advanve ☐	Boil ☐ wetfry ☐ Dry fry ☐ deep fry ☐ Grill ☐ steam ☐ Bake ☐ Microwave ☐ Pressure cook ☐ Other:_____	Hrs ___ Min ___

Pancakes/chapati ☐ pilau ☐ matumbo ☐ Githeri/mokimo ☐ chips ☐ matoke ☐ Pasta/noodles ☐ Rice ☐ chicken ☐ Mandazi ☐ sausages ☐ leafy veg ☐ Eggs ☐ beans/peas/ndengu/kamande ☐ Meat ☐ potatoes/pumkin/nduma/muhogo ☐ Ugali ☐ porridge ☐ Other:_____ Fish ☐	Rice cooker ☐ pressure cooker ☐ Microwave ☐ electric hotplate ☐ Electric kettle ☐ kerosene stove ☐ Gas stove ☐ charcoal stove ☐ Firewood stove ☐ Other:____	Sufuria ☐ kettle ☐ Sifuria med ☐ frying pan ☐ Sufuria small ☐ Pressure cooker ☐ Other:_____	____	Yes ☐ No ☐ Sometimes ☐	Fresh ☐ Reheated ☐ Partially Cooked ☐	None ☐ Leftovers ☐ Precooking ☐ Preparig a meal in advanve ☐	Boil ☐ wetfry ☐ Dry fry ☐ deep fry ☐ Grill ☐ steam ☐ Bake ☐ Microwave ☐ Pressure cook ☐ Other:_____	Hrs ___ Min ___
Drinking/purifying ☐ Bathing ☐ Tea/coffee/chocolate ☐ Other:_____	Rice cooker ☐ pressure cooker ☐ Microwave ☐ electric hotplate ☐ Electric kettle ☐ kerosene stove ☐ Gas stove ☐ charcoal stove ☐ Firewood stove ☐ Other:____	Sufuria ☐ kettle ☐ Sifuria med ☐ frying pan ☐ Sufuria small ☐ Pressure cooker ☐ Other:_____	How full? ¼ ☐ Full ☐ ½ ☐ 2X ☐ ¾ ☐ 4X ☐	Yes ☐ No ☐ Sometimes ☐	Fresh ☐ Reheated ☐	Saving water in thermos None ☐ All ☐ Some ☐		
Drinking/purifying ☐ Bathing ☐ Tea/coffee/chocolate ☐ Other:_____	Rice cooker ☐ pressure cooker ☐ Microwave ☐ electric hotplate ☐ Electric kettle ☐ kerosene stove ☐ Gas stove ☐ charcoal stove ☐ Firewood stove ☐ Other:____	Sufuria ☐ kettle ☐ Sifuria med ☐ frying pan ☐ Sufuria small ☐ Pressure cooker ☐ Other:_____		Yes ☐ No ☐ Sometimes ☐	Fresh ☐ Reheated ☐	Saving water in thermos None ☐ All ☐ Some ☐		

8.8. *eCAP Focus Group Discussion Guide*

Community name: _____
Sub-county: _____
County: _____
Date: (DD/MM/YYYY) ____ / ____ / _____
NCIR Facilitators: _____
# of male participants: _____ # of female participants: _____
Ages represented in the group: _____
Were vulnerable groups present (elderly, disabled etc.)? _____

Introduction and consent
General introduction:
Good morning/afternoon, my name is_____. I /We work for Nuvoni Centre for Innovation Research (NCIR). We thank you for taking your time off your busy schedules to be here. We as Nuvoni are currently conducting a study on electricity access and electric cooking in Kenya. The study is meant to develop policy options/pathways for the scaling-up and transition to electric cooking by 2028. It is for this reason that we are collecting views and ideas from Kenyans in different parts of the country so that they are incorporated in the development of these pathways and that no one is left behind. I therefore request for your honest views and opinions on the issues that we will discuss.

Consent seeking
I request to record this conversation for the purposes of analysis and note taking. We guarantee confidentiality therefore be free to give your opinions.
No personal data will be shared with others and the information provided will be analysed anonymously and used confidentially.
Your views are valuable and important and will contribute to the knowledge gained on electric cooking.
At the end of the discussion, we will try to answer your own questions about electric cooking as much as we can.

Do you have _____ minutes to respond to participate in this discussion?
Our group discussion will last around 90 minutes. (1.5 hrs)
Do you have any questions? Are you willing to participate in the group?

Consent:
Do you provide consent to document, use, and store and share the information provided for reporting and communication purposes?

General questions on fuel availability

1. Kindly give an account of the fuels which are commonly used in this region.
2. Would you please narrate how the availability of these fuels has changed over time?
3. In your opinion, what has caused the change.
4. What are the impacts of such changes in fuel availability?

Electricity access in the informal settlement

5. What is the level of electricity access in this area?
    a. *Probe if all households are connected to electricity? If not, why? What are the hinderances? Any plans to have connection?*

6. Kindly give a historical account of electricity access in the area. (*Probe when the electricity got there, how, who influenced/whose idea e.g., community, NGO/CBO, influential persons, challenges faced by households to get connections, how were the challenges handled? Probe if they are beneficiaries of the last mile project.*
7. What process does one have to follow to have electricity connected to their home? *(Probe for any challenges and how they were solved if any*).
8. What is the duration between application for electricity connection and actual connection
9. Were there any payments made or required? How much? What was the mode of payment?
10. How did they finance these connection cost (Where there are costs) (*Probe for financing institutions, which ones if they can be named, type of agreements with the institutions e.g., length of payment, deposits made etc*).
11. How do they access services on:
    a. Outages: are planned outages communicated? How? How long do outages last?
    b. Customer care?

Electric cooking

12. Generally, how do people in this community use electricity?
13. Have you considered that electricity can be used for cooking in your homes? (*Probe for reasons why they have not considered it.*
14. For those who have considered it, probe if they have started using it for cooking. If they have started using it, which appliances are they using, what has been their experience-costs *e.g., units of tokens/Ksh. to prepare a particular meal, time, meals that they often cook with it?*
15. What are some of the factors you consider when acquiring an electric cooking appliance?
16. In your view, how can the adoption and use of electric cooking appliance be improved in the settlement?
17. What incentives can facilitate rapid adoption of electric cooking appliances in urban informal settlements?
18. What is the potential for the improved adoption of electric cooking appliances in the urban informal settlements?

Mapping the marketing channels for electric cooking appliances in informal settlements

19. Appliances
    a. Describe the range of appliances commonly used in the urban informal settlements/preferred by residents of these settlements *Explore cost, affordability, user friendliness, awareness, power rating, brands/models, capacities (size)*
20. Distribution systems*: Probe on:*
    a. *Where did they purchase the appliances,*
    b. *what was the cost, ease of access to suppliers /Ease of access to the appliances e.g., are they available in local stores?*
    c. *after sales services like repairs, warranties, e.g. What challenges have they faced with the appliances? In case of a break down, how did you address the problem? Was it repaired? By whom? At whose cost? At what cost? How easy/difficult is it to get assistance with your appliances?* (*e.g., are they within the nearest shopping centre/town*)

21. In your opinion, which marketing strategies would be applied in introducing/accelerating the use of the electric cooking appliances in the settlements?
22. Appliance financing*:*
    a. *any financing scheme available to them,*
    b. *if there was a financing scheme, how was it structured to provide the finances or the appliances?* (*One off payment/loans/part-payment/lipa pole pole etc)*
    c. *If loans, from which bodies? Banks, Chamas, micro-finance etc.*
23. Which financial institutions are accessible to the residents of informal settlements?
    a. How is engagement with them structured? (individuals/groups)
    b. What are the loan limits?

8.9. eCap Interview Guide-KPLC/Researchers/NGOs/CBOs

General questions

A. General Questions

a. Name of the respondent
b. Name of organisation
c. Designation and role of respondent in the organisation
d. No of years worked in the energy sector; e-cooking subsector

B. About the organisation

1. Describe the scope of work done by [the organisation] in the country in electricity access and ecooking? What are the focus areas of the organisation?
2. Which departments are involved in projects or initiatives in the e-cooking sector? How large are those departments?
3. List and describe the organisation's programmes or projects on e-cooking (chronologically):
    - Which partners does the organisation work with in these projects?
    - What were the achievements of the project? Successes and failures in the interaction?
    - What were the lessons learned?
    - What are the next steps?

Electricity access in urban informal settlements/ usage and costs

Electricity supply

i. What is the level of electricity access in Mathare/Kibra/Mukuru?
    a. Explore estimated number of households connected to electricity
    b. Explore the percentage of residents/households connected to electricity
ii. Which projects have targeted acceleration of electricity supply in the informal settlements
iii. What is the severity of fluctuations in the electricity supply (blackouts and voltage instability) in the settlement
    a. Explore frequency of blackouts, surges, duration of fluctuations and black outs, scheduled/unscheduled outages etc.
iv. What are some of the mitigation measures that can be put in place to deal with voltage drops and fluctuations in informal settlements?
v. Describe the challenges in the electricity supply in the urban informal settlements
vi. In your opinion, what strategies can be applied to reduce/eliminate the said challenges

Electric cooking in urban informal settlements

i. In your evaluation, what is the level of adoption of electric cooking in the urban informal settlements?
ii. Appliances
    a. Describe the range of appliances commonly used in the urban informal settlements/preferred by residents of these settlements *Explore cost, affordability, user friendliness, awareness, power rating, brands/models, capacities (size)*

iii. In your view, what are the reasons for non-utilisation/low utilisation of electric cooking appliances in the informal settlements?
iv. In your view, how can the adoption and use of electric cooking appliance be improved in the settlement?
v. What incentives can facilitate rapid adoption of electric cooking appliances in urban informal settlements?
vi. What is the potential for the improved adoption of electric cooking appliances in the urban informal settlements?

Mapping marketing channels for electric cooking in informal settlements

i. In your opinion, are the electric cooking appliances available within the informal settlements?
ii. What is the level of awareness on electric cooking devices within the settlements?
iii. Do the residents of the informal settlements have ease of access to electric cooking appliances?
iv. Would you consider the electric cooking appliances affordable for residents of the informal settlements?
v. Are these electric cooking appliances acceptable by residents of urban informal settlements?
vi. What strategies can be applied to improve access to electric cooking appliances for residents in the settlement?
vii. Which distribution channels/markets in your opinion currently serve the residents on these settlements? (*eg markets for other electronic products can be used as a proxy)*
viii. How effective are they?
ix. In your opinion, which marketing strategies would be applied in introducing/accelerating the use of the electric cooking appliances in the settlements?
x. What mechanisms can be used to incentivise market development of electric cooking appliances in the urban informal settlements?
    a. Explore market development activities such as subsidies, new tax regimes etc

Mapping financial mechanisms in informal settlements

i. Upfront costs of electric cooking appliance have been a hindrance to the adoption of electric cooking and appliance ownership. In your opinion, which financing mechanisms do you propose to facilitate the use/purchase/acquisition of electric cooking appliances
ii. Which financing options are available to enhance the supply of electric cooking appliances to the residents of Mathare/Mukuru/Kibera
iii. Which new financing options could we explore to facilitate rapid penetration of electric cooking appliances in these informal settlements?
iv. In your opinion/experience which financing options have been successful?

For retailers/distributors

i. In your experience/ line of duty, have you interacted in any way with distributors/outlets of electric cooking appliance who serve the informal settlements?
ii. What kind of agreements do you have with the distributors/outlet?
iii. Any plan to enter the urban informal settlement market?
iv. What is the potential for the development of a distribution chain that targets the informal settlements?

v. What specific incentives can be applied to encourage the expansion of distributors into the informal settlements
vi. In your opinion, what challenges are experienced by distributors in urban informal settlements?
vii. What has been the reason for not growing the distribution chain into the urban informal settlement?
viii. What kind of support is needed (government/development partner/other stakeholders etc.) for expansion of the distribution chain into the informal settlements in Nairobi

8.10. eCAP Interview Guide-Households /Food Business

Name of entrepreneur
Age
Name of business
How long have you had the business?
What prompted you to engage in food business?
What are your operating hours? Daily?
No. of employees?

Cooking practices
Which foods do you cook?
Which cooking methods do you use to prepare the different foods?
Which of these foods are prepared purposely for breakfast, lunch, and super/dinner?
Do you have a schedule of foods you cook on a daily basis?
How do you prepare your meals? On site/ at home and carry to the venue?

Fuel and cook-stove details
Which fuels do you commonly/mostly use for cooking in this establishment?
Reason for using these energy sources?
What is your source of the fuels used?
How much do you spend on the fuels used per month?
Which cookstove(s) are you using to cook?
How much did it (they) cost?
What challenges do you face with the current fuel you are using? *Explore availability, accessibility, costs, ease of use, firepower etc.*

Access to electricity
Is the business premise connected to electricity?
If yes, how do you use the electricity?
Have you explore the option of using electricity for cooking?
What has hindered you from using the electricity for cooking?

Appliance financing?
How did you finance the current cook-stoves you are using?
Other options available for financing kitchen appliances?
Which is the most common method of financing appliances/assets used by residents of the informal settlements
What financing options would be useful for the adoption of electric cooking by food enterprises?

Marketing systems
How do you access the fuels you use? (*Explore availability in immediate local markets, neighbouring areas, etc.*)
What are some of the challenges experienced in accessing these markets?

In your view which marketing strategies would help upscale electric cooking in the informal settlements?
Which market channels do you think are best suited for the urban informal settlements? Reason?
In what ways can these market challenges be reduced or eliminated?

Distribution chains

In your experience, which distribution systems e.g. for electronic appliances are used or would be effective for in the informal settlements
Which ones are effective in ensuring delivery of the products?
Which distribution channels are not yet used in the informal settlements yet in your opinion can have the potential to ensure that residents of the informal settlements have access to electric cooking appliances?

Perceptions

What beliefs do you, or other people have about electric cooking?
What are the perceived benefits of electric cooking to your food enterprise?

Willingness to switch to electric cooking

In your view, would you be willing to shift to electric cooking?
Why would you be willing to switch?
What strategies need to be put in place so that more people are willing to switch to electric cooking in these settlements?

Income

How much is your income? (Income from the food business)