BASELINE ASSESSMENT ON E- COOKING FOR HOUSEHOLDS IN THREE UGANDAN REGIONS

GIZ ENERGISING DEVELOPMENT (EnDev) UGANDA INNOVATION WINDOW
E-COOKING PILOT PROJECT

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EXECUTIVE SUMMARY

Despite the amount of electricity produced by the country, 96% of Ugandans continuously rely on wood fuel for their household cooking needs (UBOS, 2021). In this baseline study, GIZ Energising Development (EnDev) Uganda in cooperation with Modern Energy Cooking Services (MECS) Program sought to build on the experiences and recommendations of existing studies: to clearly understand domestic cooking energy usage and compatibility of energy-efficient electric cooking appliances, specifically Electric Pressure Cookers (EPCs). The e-cooking baseline assessment aimed at expanding knowledge on how households in the three regions use the EPCs, what their electricity needs are, examine if EPCs meet their cooking needs, the market potential for EPCs, and adoptability. The study was conducted over a 4-week period and focused on everyday cooking practices of Ugandan households across three regions in given districts, i.e., East Central (Seeta /Mukono/Mbale), Western (Mbarara), North (Gulu). A total of 80 households, 20 per region, were involved in the study. While 10 households in each district were involved to understand EPCs market potential/ Uptake, the other 10 in each of the districts were engaged in a cooking diaries research approach[1], to assess cooking practices and fitness of EPCs in meeting the cooking practices.

The study based its comparison on the efficiency and effectiveness on EPCs vs. charcoal stoves for cooking. It was discovered that the households cooked more while using EPCs as compared to cooking with charcoal in charcoal stoves. There was also a 63% drop in the amount of charcoal used when EPCs were introduced the respective households. This mainly attributed to the energy mix (use of both charcoal and EPC for daily use) that was adopted by majority households. There was no significant change in the type of food prepared during the two legs. Meaning that the EPC is suited to cooking at least 80% of the food commonly cooked in the three regions.

The study revealed a significant saving on energy and time for cooking when using an EPC; especially for long-cooking foods (like beans, peas, and beef). Time saving for the most cooked food ranged from 5% to 54%. Relatedly, saving in terms of cooking expenditures is at least 12.4%; when using an EPC to cook at least one dish per meal; for 3 meals a day. Overall, all 80 households (100%) stated that they would willingly buy the EPC, given the benefits they observed when using it which included the ability to cook very fast, cleaner than charcoal, easy to control heat, allows for multi-tasking, and the ability to cook inside the house.

[1] The cooking diaries research approach combines qualitative and qualitative research techniques and involves participants writing down details about meals cooked, frequency of cooking those meals, time taken to prepare the meals, energy used, and any other details relating to the study, In this approach, enumerators observe participants and take note of outstanding cooking practices and any other information relating to the study objectives.

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LIST OF ABBREVIATIONS AND ACRONYMS

CREEC - Centre for Research in Energy and Energy Conservation
LPG – Liquified Petroleum Gas
MEMD – Ministry of Energy and Mineral Development
WHO - World Health Organization
MECS – Modern Energy Cooking Services
EPCs – Electric Pressure Cooker(s)
EnDev – Energising Development
LPO - Local Purchase Order
SPSS - Statistical Package for Social Sciences software

1 INTRODUCTION

1.1 Background

The Discrete Choice Modelling study that was conducted by Center for Research in Energy and Energy Conservation (CREEC) and Gamos Limited among 345 dwellers in Kampala, revealed that 88% of the households use charcoal as their primary cooking fuel, with Liquified Petroleum Gas (LPG) and electricity accounting for 8% and 1% of the time respectively (Scott et al., 2019). Despite more than three decades of interventions in the renewable energy sector, "there is less than 5% uptake of clean cooking technologies and fuels in Uganda" (Energy Policy for Uganda, 2023). Poor access to clean and modern cooking energy solutions has national consequences at the macro and micro level. At the macro level, deforestation is a major concern: firewood use is the second driver of the loss of Uganda's forests, annually (Balder, 2019). According to the Biomass Energy Strategy (2014), there is a 26 million tone annual supply but a 44 million tone annual demand for firewood. At micro level, traditional cookstoves and fuels still pose a threat to human health. According to WHO (2022) fact sheet, household air pollution was responsible for an estimated 3.2 million deaths per year in 2020, including over 237,000 deaths of children under the age of 5. Stoves that are ineffective and improperly vented produce a hazardous indoor environment, contributing to the early mortality rate.

Burning biomass for cooking was shown to be more closely related to morbidity than any other physical home attribute during an investigation on the relationship between housing quality and occupant health in Uganda (Herrin et al., 2013). These findings are supported by WHO (2019) report that discovered the use of solid fuels is responsible for 4.2% of the country's disease burden, and that by 2019, approximately 4,200 deaths in children under 5 years of age were caused by pneumonia, mainly brought on by home air pollution. For the most part, concerns with accessibility and affordability (high initial cost and expensive fuel) prevent widespread access to contemporary energy fuels like LPG and electricity (National Charcoal Survey, 2016). In Kampala, while 70% of the population has access to electricity, 80% of that population identify charcoal as their primary cooking fuel (Scott et al., 2019). This implies that although the population in Kampala has considerable access to electricity; with more grid connections relative to other parts of the country, it is also one of the largest markets for charcoal (Nabukalu and Giere, 2019). K4D asserts in their report on "'Clean' Cooking Energy in Uganda– technologies, impacts, and key barriers and enablers to market acceleration" that access to modern and clean fuels are limited due to relatively high prices and low demand. Accordingly, while the benefits of modern energy for clean cooking remain, accessibility and awareness are essential for its promotion.

Against the above concerns, it's continuously becoming relevant to adapt and promote clean cooking solutions. EnDev, in collaboration with MECS have, through this baseline study on e-cooking, examined the cooking needs of households in urban and peri urban centres in Gulu, Mbale, Mukono and Mbarara districts to understand whether Electric Pressure Cookers (EPCs) meet the cooking needs of households. The study in particular explored user perceptions on

cooking with electricity, the fitness and compatibility of EPCs for cooking different cuisines in Uganda, and users' willingness to buy an EPC.

1.2 Objectives of the Study

The main objective of the baseline assessment was to expand market intelligence on e-cooking usage and consumption data among grid connected households in four urban and peri urban centres of Mbarara, Gulu, Mbale, and Mukono.

1.3 Specific Objectives

The specific objectives of the study were:

1. To understand the electricity needs of the households in these urban centres.
2. To examine if the different EPCs meet the households' cooking needs.
3. To garner insights on the market potential for EPCs; in terms of adoptability, product-fit, and willingness to pay.

2. METHODOLOGY

2.1. Inception and Onboarding

At project commencement, an inception meeting was held between Belli Advisory project consultants, EnDev project team and MECS during which the expectations of this assignment were aligned. The study approach was agreed upon including conclusion on the study districts, number of households, the methodology, requirements for a successful study. In line with the assignment terms of reference and drawing from the inception meeting, Belli Advisory project team developed data collection tools (online and offline questionnaires, kitchen diary forms, etc.), the broad evaluation questions as per the study objectives. Furthermore, an inception report was prepared which detailed the entire approach that would be adopted during the execution of the assignment.

2.2. Selection of Participating Households

The households that participated in the study were selected based on a pre-determined criterion that was aligned with EnDev and MECS.[2] The study involved households that were firstly and most importantly connected to the national electricity grid, whose members are literate or at least had a literate cook who would support in the data collection according to the daily meals and preparation methods explored. The households were in grid connected urban and peri urban canters which are assumed to experience lower power outages. A household size of between 3-7 members was considered which is believed to guarantee that cooking happens at least once per day. The study also considered households with alternative cooking energy sources to electricity, with major focus on charcoal. An even number of 20 households per region/ district for all the 4 districts was considered. In addition, ***30% of the households that were engaged in the study were female-led households.*** Table 1 shows the specific locations (villages) of the respective households per district.

[2] *All the households involved, including those that didn't actively participate in the cooking diaries, expressed their willingness to participate in the study; by signing a form consenting to the same.*

Table 1:Villages (Locations) of the household Per District.

Mbarara	Mbale	Gulu	Mukono / Seeta
Kiyanja	Kasanvu	Acoli lane	Nantabulililwa
Kateete	Muyembe Cell	Phillip Adonga Road	Koolo
Nsikye	Indian Quarters	Oyaka Road	Nakiyanja Road
Booma	Primary cell	Pece Vanguard	Nsanziro Road
			Bukerere Road
			Kob Road

2.3. EPC Selection and Procurement

The EPC type considered for this study was Digiwave (DW) Model No: DWPC-1703; 7 litres. The selection of the EPC used was mainly based on efficiency, availability on the market: at the time, capacity / pot size, and price. According to Leary *et al. (*2018), energy efficiency is determined by insulation of the lid or the lack thereof and power rating. The authors also assert that insulated lids can reduce energy consumption by half, with more impact on longer cooking dishes (Leary *et al.,* 2018). Other factors such power rating of (AC ranging from 700W to 1200W is advised) should be considered when choosing an EPC. Table 2 details the specification of the different EPC brands which were compared during the selection processes.

Table 2: Specifications of the Available EPC Brands that were Compared.

Specifications					
Parameters		**Majestic**	**DW**	**ElectroMaster**	**Sonifier**
Power consumption	900 – 1200W	900W	1200W	1800W	1000W
Operating voltage	220 -240V	Yes	Yes	Yes	Yes
Capacity	7litres	6litres	7litres	7litres	6litres
Operating mechanism	Knob or Touch	Touch	Touch	Knob	Knob
Pot material	Non-sticky aluminium	Yes	Yes	No	No
Housing	Plastic + Stainless steel	Yes	Yes	Yes	Yes
Price (UGX)		510,000	270,000	350,000	416,000
Availability		✗	✓	✗	✓

EPC brands other than the ones compared, above, were not considered because the available quantities were not sufficient for the study. Some of these included Sayona, Geepas, and Miralux. To procure the EPCs, the procedure followed a request for quotation from suppliers recommended by the EnDev project team; appended on page 32. The procedure followed.

1. Ascertaining quantities of the desired EPC brands. The considered brands were Electro Master, Majestic, Digiwave (DW), and Sonifer
2. From the recommended list of suppliers[3], Identifying those who can supply the quantities at a fair price.
3. Price negotiations and issuance of an LPO.
4. Delivery and receipt of the EPC at Belli Advisory office premises.
5. Final payments according to the quantities delivered.
6. Household trainings on the EPC usage, and distribution of the selected EPCs to the 80 households

There were some constraints and gaps witnessed during the procurement of the EPCs. Following a market assessment, the consulting team noticed a few volumes of the existing brands which hindered the baseline assessment timelines and assessments. Most of the EPC brands sold had small pot sizes (5 litres and 6 litres) – which are usually not sufficient to feed a typical Ugandan household. Lastly, it is not easy to tell which brand is better than the others because of limited research are additionally low sales volumes don't leave enough room for feedback from the retailers and suppliers.

2.4. Study Approach

The study employed a cooking diaries approach that involved the 80 households (20 per district) writing down details about meals cooked, frequency of cooking those meals, time taken to prepare the meals, energy used, and any other details relating to the study. The approach was structured into two phases; Charcoal Diaries: to understand how the households normally cook with charcoal, followed by EPC Diaries. Data collection spanned over a period of 4 weeks with two weeks of each; Charcoal and EPC diaries.

2.4.1. Entry survey

An entry survey was collected to ascertain the baseline cooking partners and the most prevalent fuels used by the selected participants. It was also used to understand their level of awareness about electric cooking in general. (Appendix VI)

2.4.2. Training of Participants

To ensure consistency and reliability of the data, all the participants were trained before any actual data collection processes for both the charcoal and Electric Cooking Diaries. The training employed two different training modes. That is classrooms learning which involved the general theory and practices for related to using the electric pressure cookers; how to collect and

[3] *From the supply, only REAL Energy and MEPe Engeering were the only companies capable of supplying the EPC quantities required. Most retailers and suppliers within the country were not able to make up the desired quantities or could make the desired quantities but with different brands.*

document data in the different data forms and practical sessions especially on how to use the electric pressure cooker to cook and how to read and record data from the smart meter. The households were also onboarded and provided technical guidelines for using the electric pressure.

Figure 2: Photo taken during the charcoal diaries practical training.

Figure 1: Photo taken during the EPC diaries practical training.

cookers. Issues such as safety and use of the pre-set menu were elaborated. These training were specifically designed by for both the enumerators and the households. Figures 1 and 2 shows the some of the onboarding that were conducted in preparation for the data collection. The Enumerators were further subjected to additional training on the processes of conducting primary data cleaning during the household visits and were also assigned task of further supporting the households with the relevant technical support relating to using the EPC and collecting related information. Because of the limited time duration for the assignment; emphasis was made on collecting good data. The key areas that were emphasized were.

1. The difference between a dish and a meal
2. How to read off measurements (kgs and kWh)
3. Missing data or gaps in the data recorded.
4. Consistency in the way certain dishes is recorded, e.g., Katogo Vs. Matooke, Tea Vs. Water, etc.
5. The need to record decimal points.

6. Forging data.

Figure 3:One of the participants recording the amount of charcoal to be used at the beginning of the day.

2.4.3. Charcoal Diaries

This focused on capturing data on cooking with charcoal. The participating households were encouraged exhibit their normal cooking partners and behaviors while using charcoal while documenting records of their daily menus. In each of the days in which data collection was taking place, enumerators would interview the participants and support the coos with recording data on the quantity of fuel (charcoal used) ; food preparation time; most preferred cooking methods and other cooking related information based on discussions with the participating households. Using a portable weighing scale, fuel (quantity of charcoall in kgs) was measured at the beginning and at the end of day; after cooking, activities had been completed. Information collected during this period were then used as baseline data and it was later used to compare with data collected when the EPCS were introduced to the respective households. Figure 3 shows one of the participants recording the quantity of charcoal before use.

2.4.4. Eelectric Pressure Cooking (EPC) Diaries:

The same participating households were trained on how to cook with EPCs. Furthermore, they were also trained in how to record power consumption from cooking with electricity using energy meters. Figure 4 and Figure 5 show some of the participants who participated in the collection of the data during the EPC diary.

Figure 4:One of the participants from Gulu district waiting to fill a cooking diaries form.

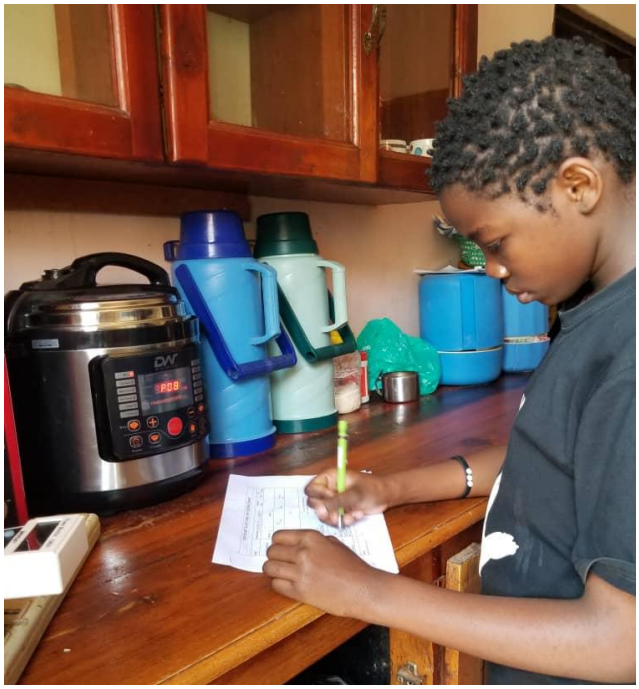

Figure 5: One of the participants filling in a cooking diaries form during meal preparation using an EPC

2.4.5. Exit Survey

To finalize the data collection process, the exit survey was administered to ascertain any changes relating to perception about electric cooking whilst comparing experiences before and after the introduction of electric pressure cookers. (Appendix VII).

2.5. Data Collection

Figure 6: Smart Metering Device used for Collecting Electric Power Usage

To collect data participants were given pre-printed data collection forms to record data on each dish cooked in the day, including: the start and end time of the dish, amount of fuel (charcoal) at the beginning and at the end of the day, and/or energy meter reading (at the beginning and end of the dish). Data from the field was collected by the enumerators and sent to the analysis team in real-time using Kobo Toolbox. Enumerators were also tasked to inform the analysis team of any other observations that they deemed necessary to the study, such as cooking methods, how participants used the EPCs, attitudes during the use of the EPCs, additional comments that may not have necessarily been captured using the participant form. (Appendix II and III).

Primary data clean-up was done by the enumerators and secondary clean up by the analysis team. Clean data sets retrieved from Kobo Toolbox were coded and analysed by subjecting them to excel functions and SPSS software[4]. Statistical data was summarized and presented using frequency and percentage distribution tables, graphs, and charts.

[4] *SPSS Statistics is a statistical software suite developed by IBM for data management, advanced analytics, multivariate analysis, and business intelligence.*

RESULTS AND DISCUSSIONS

3.1. Demographics

73% of the participants were females. The respondents were between the ages of 20 to 45 years. The top three occupations of the respondents were self-employed / business, school administrators, and students. All respondents at least attained basic education; primary (9.9%), secondary (37.1%), tertiary education (29.6%), and university degree (23.4%). Majority 72(90%) - of participants attained the mid-level of education (tertiary, and secondary) with 47.5% of those being females. Participants in the eastern region were more informed about energy trends. This could be attributed to them being more highly educated than the participants in the rest of the three regions. Overall Mbale had majority households that attained university education (52.6%), tertiary (25%), secondary (13.3%). The table below makes a better comparison of the participants' levels of education according to their regions.

Table 3: Summary of the Participants' level of Education Per District

District	Education Level				Total
	Primary	Secondary	University	Tertiary	
Gulu	12.5%	23.3%	26.3%	29.2%	24.7%
Mbale	0.0%	13.3%	52.6%	25.0%	24.7%
Mbarara	75.0%	20.0%	5.3%	29.2%	24.7%
Mukono	12.5%	43.3%	15.8%	16.7%	25.9%
Count	8	30	18	24	80

3.2. Cooking Practices and Food Preferences

3.2.1. Cooking fuels

All the households used charcoal as their primary cooking fuel. Before the introduction of EPCS, 80% of the households fully relied on charcoal, 20% (of which16% used charcoal and LPG, 4% use charcoal, LPG, and electricity) were stacking fuels. Electricity was used for boilin water (for tea) in as much as *71.25% of those that used owned electric cooking appliances (kettles, microwaves, hot plate, toaster)*[5]. The households that used a combination of charcoal and LPG used LPG to prepare quick foods/dishes and charcoal for preparing dishes that take long to cook e.g., beans and peas. For households that use both LPG and charcoal, breakfast meals are prepared using LPG while lunch and dinner are prepared using charcoal (Table 4).

[5] *Despite the fact that majority of the households (71.25%) owned electric cooking appliances (kettles, microwaves, hot plate, toasters, etc.), very few of them often used them to cook.*

Table 4: Comparison between fuels during the charcoal diaries.

Meals / Fuel	Breakfast	Lunch	Supper	Midmorning snack	Evening snack
Charcoal	21%	52%	25%	0%	2%
LPG	53%	24%	24%	0%	0%

Before EPCs were introduced, there were no households that stacked charcoal with electricity only. Upon the introduction of EPC during the cooking diaries, at least **64% of the households begun cooking with electricity** (given the option of charcoal) with preference being in preparing longer cooking dishes (beans, peas, matooke) with EPCs which are often eaten during lunch and supper.

Table 5: Comparison between fuels during the EPC diaries

Meals / Fuel	Breakfast	Lunch	Supper	Midmorning snack	Evening snack
Charcoal	9%	57%	26%	1%	6%
Electricity	8%	64%	28%	0%	0%
LPG	29%	71%	0%	0%	0%

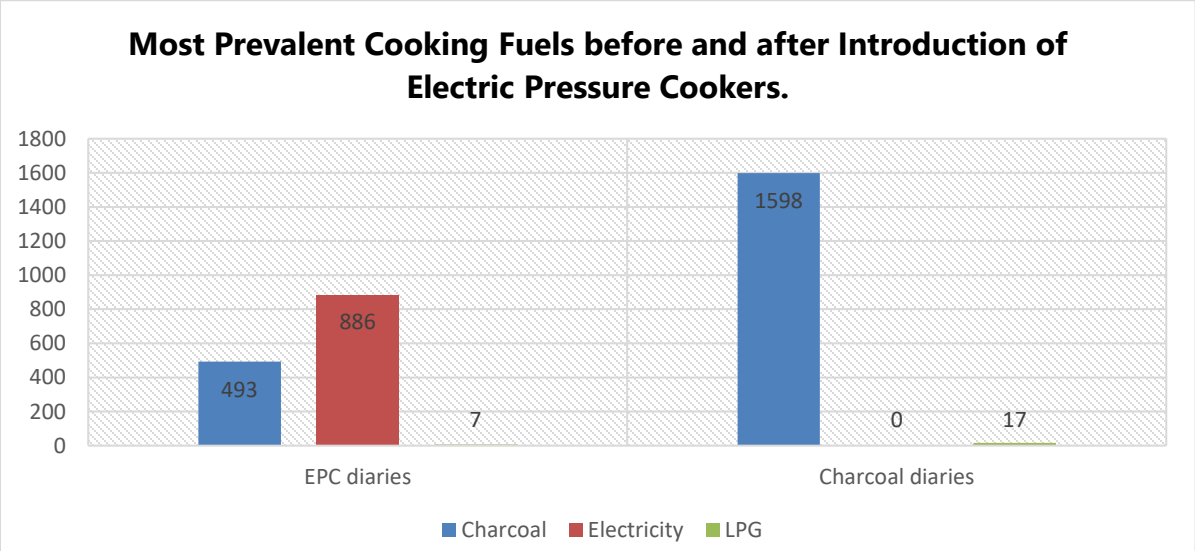

Figure 7: Overall comparison between fuels during the two diaries (charcoal and EPC).

3.2.2. Frequency of Cooking

The households cooked 58% of the study time, during the charcoal diaries. This percentage can be explained by the festive season during which households visited or hosted their extended families; causing a slight reduction or increase in the amounts and number of times they cooked.[6] There was a 35% increase in the number of cooking times when the EPCs were introduced. diaries compared to charcoal diaries.

3.2.3. Food Preferences

There was no significant change in the dishes / food cooked during the EPC cooking diaries from the charcoal cooking diaries. Majority of the food remained the same across all the four regions, with exceptions of a few staple foods such as Boo (pasted black eyed pea leaves), Kwon Kal (Millet bread), Dek Ngo (split pigeon peas sauce), and Malakwang (pasted hibiscus species leaves) for northern households, and Malewa (smocked bamboo shoot), Lapena (pigeon peas soup), Lakotokoto (ground unroasted sesame seeds) for eastern households.

The main difference to note was the type of food, preferred for individual meals - Breakfast, Lunch, and Dinner. Figure 5 compares the most cooked food per mealtime (breakfast, lunch, supper) before and after the introduction of electric pressure cookers. During break, milk tea and porridge were the most prevalent foods prepared in both electric pressure cookers and charcoal stove. During break, milk tea and porridge are the most prepared foods, while lunch and supper time meals are dominated by posho, beans, rice and matoke. Overall, lunch is the most prepared meal. The most preferred dishes to cook using the EPC were Beef, Chicken, Cassava, Irish potatoes, and boiling drinking water.

[6] *If there is any left-over food, it is re-heated as a supplement to a main meal or eaten as a subsequent meal, depending on the food type and the quantities.*

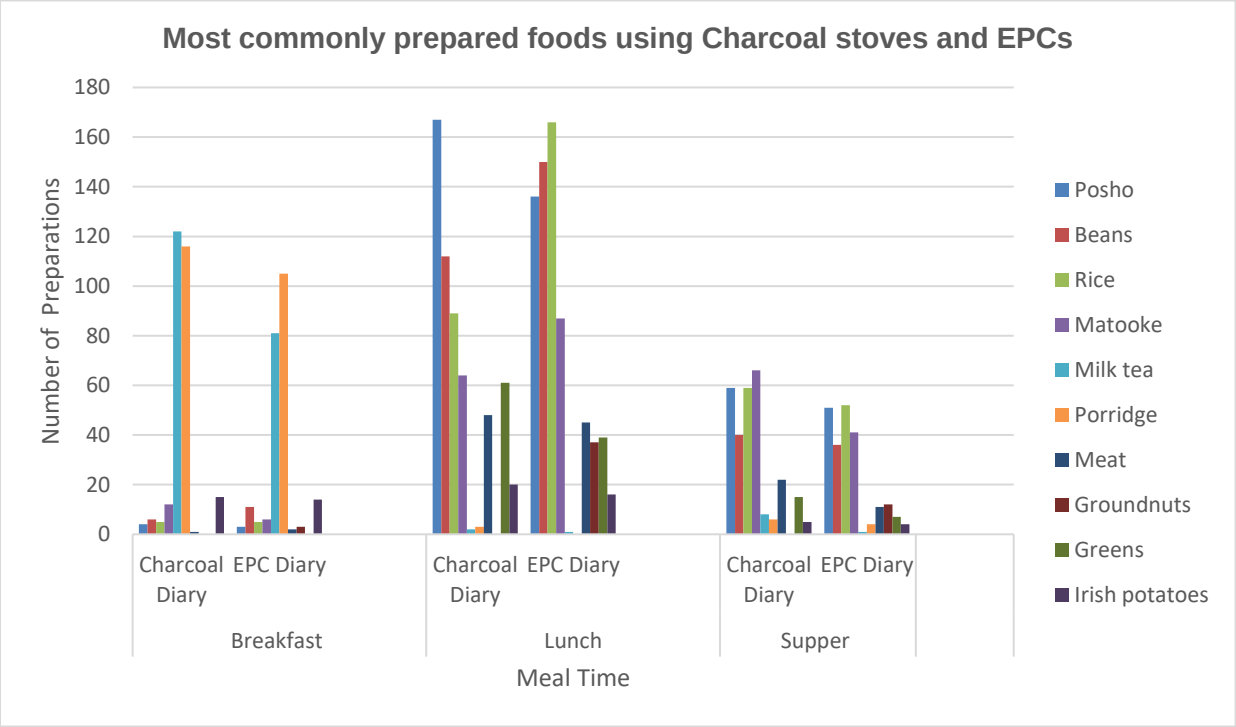

Figure 8: Commonly prepared foods before and after introduction of Electric Pressure Cookers

3.3. Understanding the Electricity Needs of the Households

3.3.1. Amount of Energy and Cooking Time

i. Amount of Energy:

The cooking with electricity increased while the use of charcoal for cooking reduced by 36% after the introduction of Electric Pressure Cookers. Hence, the general electricity consumption among the households increased. Findings also revealed that the daily charcoal requirement for cooking at least three meals for about 4-7 people was an average of 3.3kgs which translates to UGX 3,850 ($1.03) in charcoal fuel cost per day.This estimate is derived from an expenditure of UGX 70,000 on a sack of charcoal – weighing 60kgs; lasting 3 weeks or approximately 21 days. (Daily Monitor, 2022) [7]. Moreover, the ability of the charcoal to last three weeks is dependent on its quality and the quality of the stove used for cooking. 'Hard charcoal' (charcoal produced from wood with high density that burns slowly)– which is regarded as better quality is estimated to last at least 3 weeks, while 'soft charcoal' (charcoal produced from wood with low wood density and burns faster) is of poor quality and will not last longer than 2.5 weeks for an average sized household (i.e., 5 people).

[7] Mode amount spent on a sack of charcoal is UGX 70,000. Average amount is UGX 55,000.

The data gathered during the EPC diaries showed that stacking charcoal with electricity saves a household of 4-7 people, cooking three meals a day (each meal comprising of 2 dishes) at least 12.4% if they cooked at least one of the dishes of each meal using an EPC. Furthermore, the energy intensity is higher for dishes that require frying or rather do not use pressure to cook, compared to those that require pressure. Meaning that a household will save more when using an EPC to cook such dishes (especially dishes that take long to cook, e.g., beans, peas, etc.). Figure 6 shows the average amount of energy spent on the topmost cooked foods in the assessed regions, during the EPC diaries.

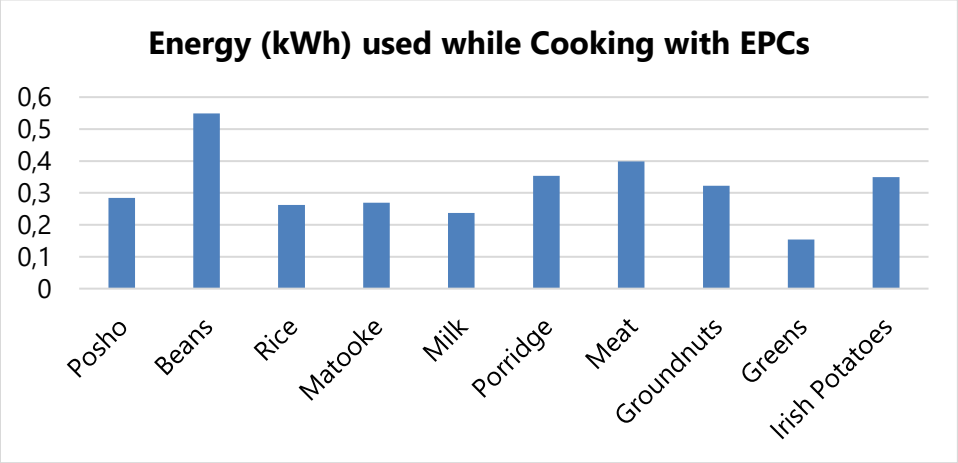

Figure 9: Average amount of energy per food.

ii. Cooking Time:

Cooking with EPCs significantly shortened cooking time. Time saving is more significant for dishes that cook with pressure (especially steaming dishes that are ordinarily known to take longer to cook, e.g., beans, peas, matooke, beef, etc.). Dishes that require frying or cooking without pressure were seen to take approximately the same amount of time. Overall, there was a 20% saving by the EPC when used to cook posho, 54% for beans, rice (30%), matooke (50%), milk (5%), porridge (32%), meat (38%), groundnuts (49%), greens (8%), and Irish potatoes (38%). Table 6 illustrates the difference in cooking time for the common dishes[8].

[8] *In determining the time taken to cook a dish, during the charcoal diaries, the time taken to light the charcoal stove was included as part of cooking time. The average time it takes to light charcoal stove is 11 mins.*

Table 6: Average cooking time of the Common Foods Prepared

Food	Charcoal Time (mins)	EPC Time (mins)
Posho	49	38
Beans	169	72
Rice	47	32
Matooke	163	52
Milk	22	20
Porridge	41	28
Meat	153	47
Groundnuts	132	37
Greens	26	24
Irish Potatoes	56	35

There was a noticeable change in the time taken to prepare meals during the two diaries. While cooking with charcoal, households used an average of 31 minutes to prepare their breakfast dishes, and an average of 42 minutes to prepare lunch and supper dishes. Contrary to the charcoal diaries, there was a 24% reduction in preparation time for breakfast meals during the EPC diaries, and a 45%-time reduction for lunch and supper dishes. Figure 10 shows the time variation for some specific commonly cooked while using EPCs and charcoal stoves.

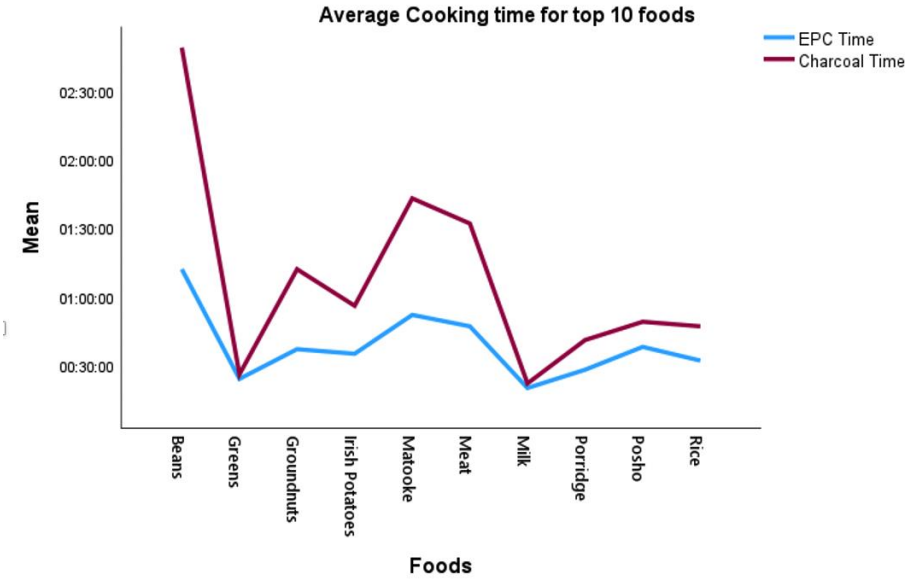

Figure 10: Graphical representation of cooking time per dish (EPC vs Charcoal)

3.3.2. Power Stability

There were very few incidents of power outages that resulted into households not being able to cook/prepare a meal. Overall power was not available 7% of the time[9] in Gulu, Mbale (2%), Mukono (14%), and Mbarara (16%). During the time power was unavailable, the households would resort to cooking with the traditional fuels, i.e., charcoal or LPG.

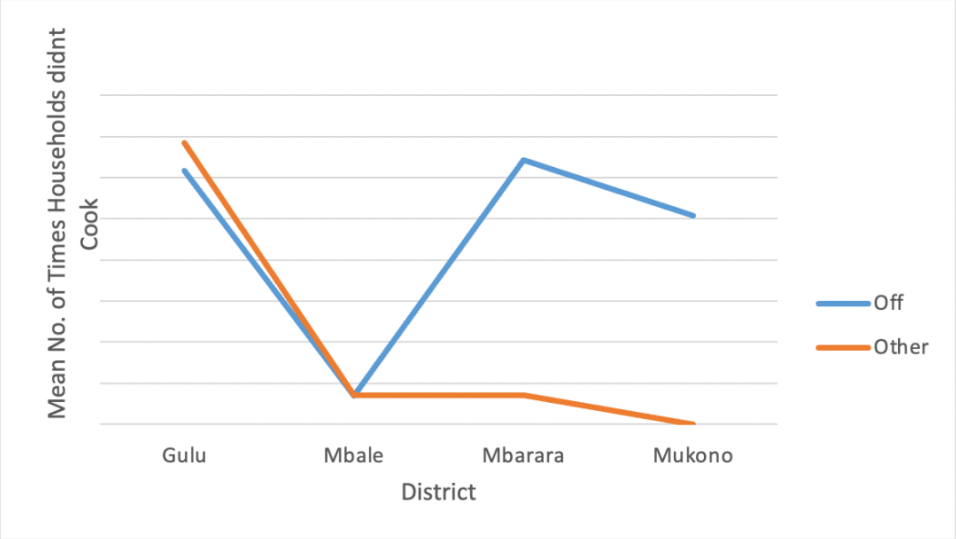

Figure 11: Shows power outages vs. other reasons households didn't cook.

3.3.3. Load Capacity

71.25% of the participants own electric cooking appliances. At least 25% of households owned more than 1 electric cooking appliance. The most common cooking appliances were electric kettle (73.7%), microwave (11%), electric oven (7%), toaster (6%), hotplate (4%), and rice cooker (2%), The common brands were Scarlett, Saachi, Phillips, Nikai, Logik, DW, LG, and Kenwood. The load capacity of the households ranges from 1,000 to 6,500 watts. The average load capacity of a household is 2,033 watts. Table 10 shows the load capacity range for participating households, per district.

Table 7: Average load capacity of the households in each district

	Mean (watts)	Median (watts)	Minimum (watts)	Maximum (watts)
Gulu	1458.1	1000	1000	3665
Mbale	2866.7	2000	1200	6500

[9]*Total cooking incidents were 560, which is 14 days / two weeks per household for each of the 4 regions.*

Mbarara	1600.0	1600	1200	2000
Seeta	1794.7	2000	1300	2200

3.4. Extent To Which the EPCs Meet the Household's Cooking Needs

3.4.1. Perceptions on Taste

Households disagreed with the notion that 'food tastes differently when cooked using an EPC, as compared to charcoal'. 32 out of 81 participants stated that the food tastes differently when cooked with an EPC while 49 disagreed. When asked about variations in taste of the food, a few households stated that: cassava and sweet potatoes taste very dry, matooke loses its taste, while beef, chicken, and fish are very tender.

3.4.2. Suitability / Product Fittness

To assess EPC suitability in cooking different cuisines, selected variables including, functionality, and usability features, ease to clean pot size/volume, safety, design specifications and number of cooking pots. All the participants agreed that it was easy to control heat while cooking with the EPC, the EPC could cook fast enough, long cooking dishes cooked much faster with the EPC, and that the EPC didn't take up a lot of space in their kitchens. 89.7% strongly agreed that they were able to multitask while cooking with the EPC. 97.4% stated that the EPC produced sufficient heat to fry foods. The EPC pot was big enough (79.2%), the EPC was easy to clean (96.2%), it was easy to learn to use the EPC (97.5%) and that it was safe to use (30%) (Figure 12).

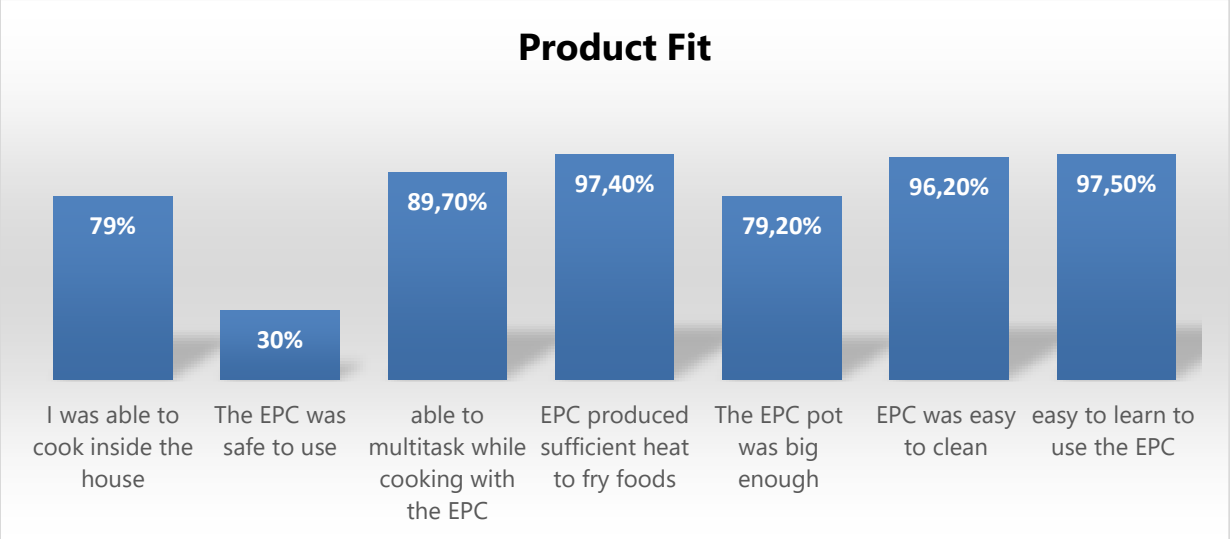

Figure 12:The extent to which the EPC design meets household needs.

When asked what the households would desire to change on the EPC's design, the household's responses were synonymous with the responses on suitability. The suggested designs consideration is presented in Figure 13.

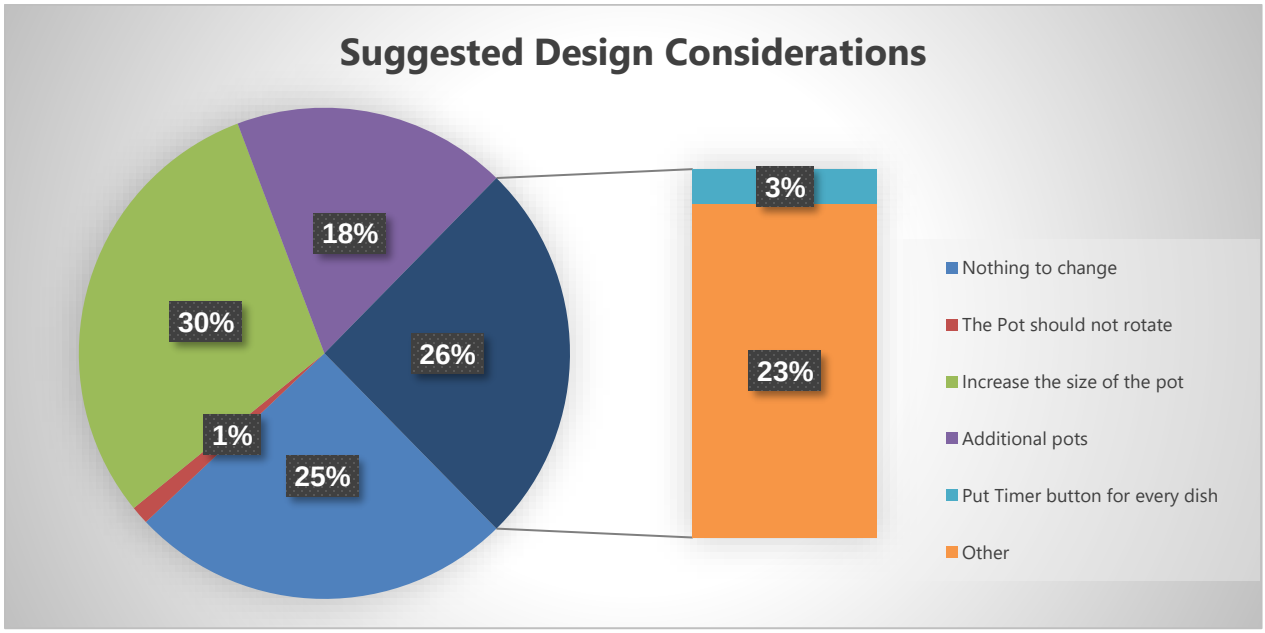

Figure 13: Suggested EPC design changes

Other design changes include: -

1. EPC should come with additional cooking pots.
2. Have an in-built rechargeable battery to save energy for when the power goes off.
3. Make pprovision for warming matooke without it being immersed in water.
4. Develop aaccurate pre-set time for cooking each type of food.

EPC Pot Capacity

The EPC pot size used for the study was 7 litres. 79% of the households were satisfied with the pot volume and only, 21% preferred to have bigger size. This was more common among households with larger number of people especially those that with more children. On average each household feeds between 4-6 people each day with (3/4) 75% being children. This observation was similar throughout the study period.

Safety

Despite continuous training done on safety, during the EPC diaries by the field enumerators, 56 out of 80 participants still regarded the EPC unsafe. Figure 14 summarises the safety concerns raised about use of the EPC which is unique to individual users and personal perceptions.

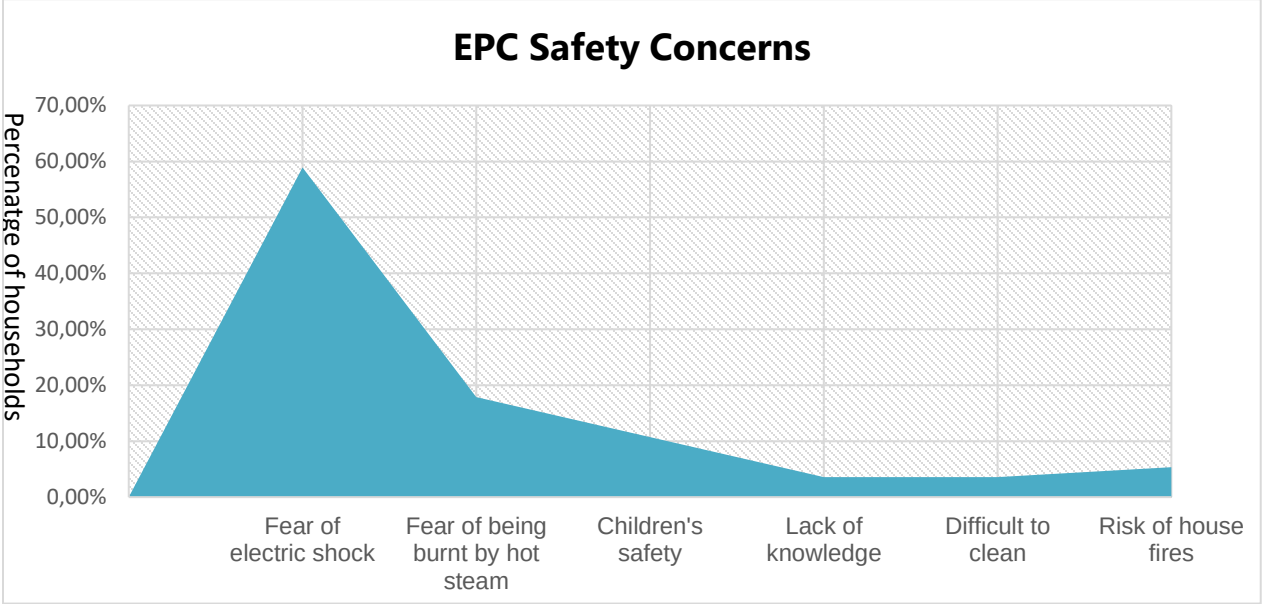

Figure 14: Summary of the household's concerns regarding using the EPC to cook.

3.5. Market Potential

3.5.1. Adaptability

The participants were asked about the best and the worst things they discovered about cooking with an EPC. Responses to the worst things correlated to the things they like the most about cooking with charcoal. These worst things about cooking with the EPC included the following.

1. It is dependent on availability of electricity (21%).
2. Limited number of pots (16%).
3. Limited pot size (2.5%).
4. Requires a certain skill/ level of education (4.9%).
5. Time and water measurements are difficult to estimate (2.5%).

The best things about cooking with the charcoal included the following.

1. It is safe (27.2%).
2. It is easy to use (2.5%).
3. It is cheap and readily available (29.6%).
4. It doesn't depend on availability of electricity (12.3%).
5. It doesn't require a certain skill / level of education (7.4%).

To better understand the participant's willingness to adopt EPCs in the cooking mix, the study examined how often the participants cooked with the EPC after its introduction to the households. Out of the 80 participating households 64% cooked more often using the Electric pressure cooker. Except for Charcoal and Porridge which are mostly prepared using charcoal, most foods were prepared using Electricity (EPC) (Figure 15).

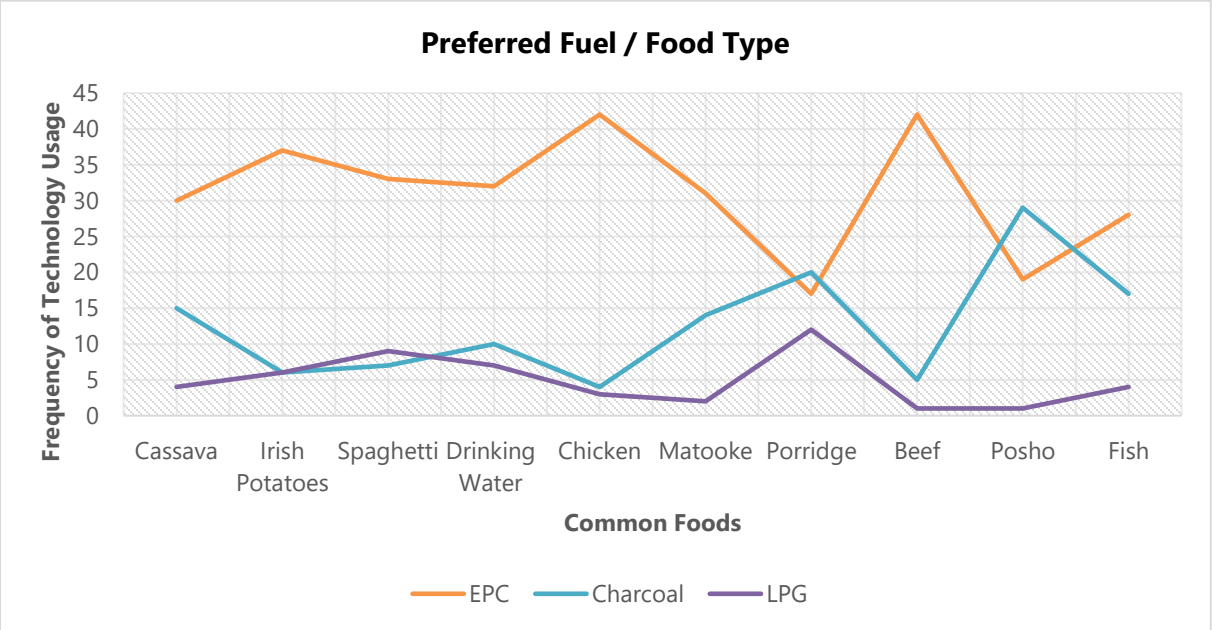

Figure 15: Comparison of the Most Preferred cooking technology for the different food types.

3.5.2. Affordability

Sixty six percent (66%) of the participants asserted that cooking with electricity is cheaper than cooking with charcoal. To ascertain affordability, the following variables were considered; - the respondents' level of education, the respondents' occupations, their perceptions on cooking with electricity, what other electric cooking appliances they own, and if the house they stayed in was rented or owned.

The assumption was that a participant who has attained at least a basic level of education, is likely to have a job that pays enough to afford an EPC. 67.5% of the participants were in the 75th percentile of education, meaning majority of them attained tertiary and secondary education. From the findings, there is a weak positive correlation between education and the participants' ability to afford an EPC (co-efficient of correlation, R = 0.043), meaning there is no correlation between education and affordability. Considering the variables of owning electric appliances; 71% of the participants own other cooking electric appliances. There is a positive but weak correlation (0.124) between owning other electric cooking appliances and affordability of an EPC. Fifty-four (54%) of the participants own the house they live in while 46% rent. Despite the assumption that participants who own their houses are better positioned to afford the EPC, there is a weak positive correlation between owning a house and affordability of the EPC (co-efficient of correlation R, 0.151). Seventy-two percent (72.1%) stay in a detached house, while the rest stay in a semi-attached home. 89.7% cook from a decently constructed kitchen, while 10.3% cook from their verandas and compound. The most common occupations were business / self-employment (67.5%), school administrator (16.3%), student (6.3%), midwife (1.3%), laboratory technician (1.3%), social worker (1.3%), civil servant (2.5%), and farmers (2.5%). 15% of female respondents were housewives. While there is a positive relation between the participants' occupation and affordability, the significance level is very low (co-efficient of correlation R, 0.0302). We can thus conclude that the participants' occupations do not necessarily affect their ability to afford an EPC.

3.5.3. Willingness to Pay

All the participants (100%) agreed that they would buy the EPC, if money wasn't a limitation. We correlated the decision to buy the EPC with the household head. The decision to buy electrical appliances may be influenced / made by the household head but not significantly (co-efficient of correlation R, 0.086). The average amount of cash the participants would be willing to spend is UGX 148,000. The modal amount in UGX is 100,000. This is almost 63% less than the actual market price of the EPC, which is UGX 270,000. The preferred payment modes are cash (46.3%), loan (52.5%), pay-go (1.3%). Table 8 shows the average amount, participants are willing to spend on an EPC, per district.

Table 8: Average amount of money (UGX) participants are willing to spend on an EPC.

District	Av. Amount (UGX)
Gulu	129,750
Mbale	155,263
Mbarara	217,500
Mukono /Seeta	91,500

Figure 16 shows that the willness is more squeezed towards the lower side of the mean value of the of Uganda shilling 270,000 with more than 30 of the respondents willing to pay at a price that is slightly higher than Uganda shillings 100,000.

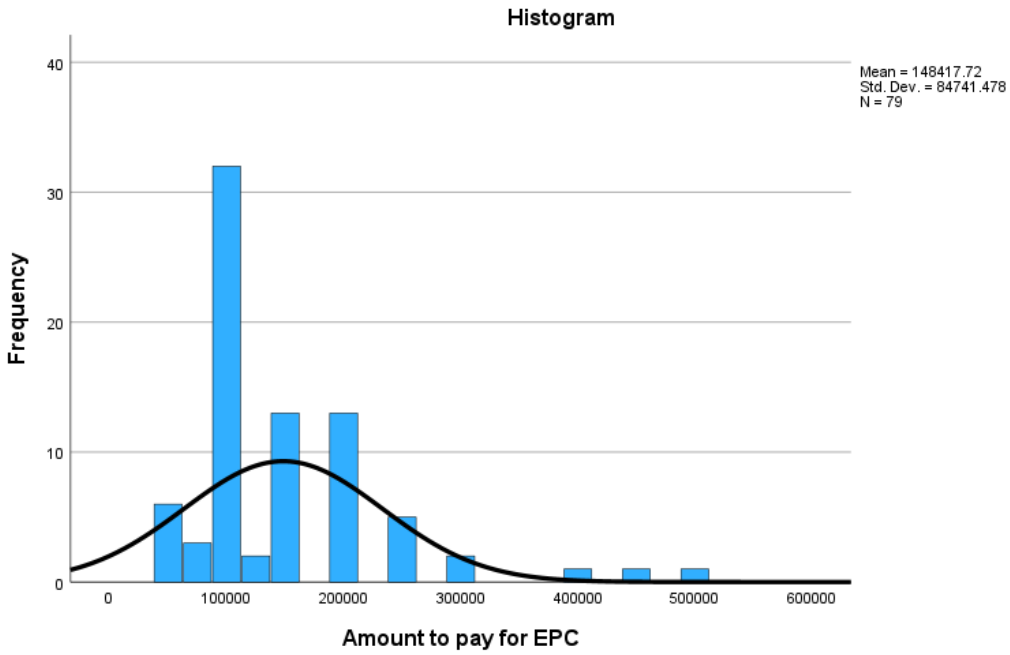

Figure 16: Average amount of money (UGX) participants are willing to spend on an EPC.

4.0. Conclusion

From the observations of this study, it can be resolved that EPCs are a more energy-efficient cooking technology compared to the traditional option of charcoal. EPCs provide households with a cost and time efficient alternative to charcoal. Households can make a saving of UGX 64,000 on average each month when using the EPC to cook. Additionally, the cooking time is reduced by at least 30 minutes on average when cooking with an EPC. Overall, the households agreed that EPCs are not only able to cook most of Ugandan food but also that the food taste is maintained. Implying that the EPC is a good replacement for traditional fuels. Additionally, the EPC can work within the households' load capacity. The maximum load capacity for the EPC (Digiwave Model No: DWPC-1703) is 1300W which fits well within the range for the households, i.e., 1000W to 2200W.

However, despite its advantages, households were still reluctant to completely rely on the EPC as their main cooking fuel. Some of these concerns emanated from power outages and instabilities (particularly in Gulu and Mbarara districts). Safety is also another issue that could hinder adoptability. At least 70% of the households regarded the EPC unsafe. 27% of Households, because of safety concerns, would rather use charcoal as their primary cooking fuel. Lastly, despite the EPC's high market potential, affordability remains a key issue. Households can only afford to pay an average amount of UGX 150,000 for the EPC. The households are, however, open to favourable payment models which can enable them to own the EPC over a longer period. Overall, the study demonstrated that there is great potential for households to adopt cooking with the EPC. This was proven by the household's adoptability level (64%); given the option of cooking with other traditional fuels (charcoal and LPG). Results from the study show that with a well-developed market system and favourable payment models, Uganda households can easily take up EPCs to replace charcoal.

4.1. Recommendations

Our recommendations mainly draw from observations made from the study, and they are listed below.

1. **Market Potential:** There is an underdeveloped market system, few renowned brands and very few distributors of these brands. Local retailers are either not aware or do not no consider the products profitable which makes reach to households difficult and more expensive. There is therefore a need to invest in market development to increase product reach and consequently reduce the purchase cost.
2. **EPC Perception:** Households are still very sceptical about using an EPC despite its advantages, due to safety 'fears' brought on by the traditional pressure cookers. There is a need to intensely educate the public on the safety measures embedded by the EPC manufactures: to settle these safety uncertainties.

3. **Affordability:** While the households regard the EPC a better alternative to charcoal, they find its purchase price high and quite expensive. Consideration and development of payment models that would advantage the buyers and yet guarantee profit to retailers is important for successful market development.
4. **Product Type:** Development of an EPC type with a more accurate pre-set menu (in terms of cooking time) customized to Ugandan food will accelerate the uptake and adoptability of EPCs by the households.
5. **Product Fitness:** one of the reasons as to why households continued to use charcoal even after the EPCs were introduced, is because they were limited to cooking with one pot when using the EPC. EPC manufacturers should highly consider the option of an additional pot to leave room for preparing more than one dish using the EPC.

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APPENDICES

1. Fuel usage preference per food type for most commonly prepared foods.

Food	EPC		Charcoal		LPG	
	Count	%	Count	%	Count	%
Cassava	30	61.20%	15	30.60%	4	8.20%
Irish Potatoes	37	75.50%	6	12.20%	6	12.20%
Spaghetti	33	67.30%	7	14.30%	9	18.40%
Drinking Water	32	65.30%	10	20.40%	7	14.30%
Chicken	42	85.70%	4	8.20%	3	6.10%
Matooke	31	63.30%	14	28.60%	2	4.10%
Porridge	17	34.70%	20	40.80%	12	24.50%
Beef	42	85.70%	5	10.20%	1	2.00%
Posho	19	38.80%	29	59.20%	1	2.00%
Fish	28	57.10%	17	34.70%	4	8.20%

2. Household Composition Per District

District	Av. No. of children	Av. No. of Adults
Gulu	2	3
Mbarara	3	2
Mbale	2	4
Mukono / Seeta	2	3

3. Discoveries by the Households About the EPC

Overall, there were a few discoveries by the households, while they used the EPC. Some of these are listed below.

I. Cooking with charcoal is more expensive than cooking with electricity; particularly when using an EPC.
II. Cooking time was reduced to almost quarter the usual cooking time when using charcoal.
III. It is important to pay attention to cooking time and water quantities when cooking a dish using an EPC for the first time. The discoveries (time and water) usually set a standard for cooking that dish.
IV. It is important to have excellent electrical wiring for the house to avoid safety issues when using the EPC.
V. The EPC can cook majority of the food prepared by the household.

VI. It is possible to measure the amount of energy when using other electric appliances, i.e., using an energy meter.

4. Frequently Asked Questions (FAQs) on EPC Usage

During the training and throughout the data collection period, a number of questions were fronted by the participants. Some of these with their corresponding responses are listed below.

I. Wouldn't the first dish be cold by the time we are through with cooking the second dish since the EPC has only one cooking pot?
II. What are the maximum number of dishes that a person can cook in a day using an EPC?
III. How long does the pressure take if power goes off?
IV. Is there a specific amount of water needed to cook each dish?
V. Do all EPC brands work the same?
VI. What is the best socket to use for the EPC?
VII. Can it be used on a combined electricity meter?
VIII. How many people can the EPC feed?
IX. How many power units does the EPC take?

5. Recommended List of EPC Suppliers

	COMPANY NAME	CONTACT PERSON
1	Ecoca-East Africa	**Ruth Komuntale** Email:r.komuntale@pesitho.com Mobile: +256703524000
2	Power Up	Mr. Kato Sekubunga Kibuka Email: kato@powerup.works Mobile: +256775948600
3	Ener grow	**Mr. Edwin Kwesiga** Email: edwin@ener-grow.com Mobile: 0775 212629
4	Up Energy	Mr. **Moses Amone/ Denis Bull** Mobile: +256774198895/ 256702300532 Email: moses@upenergygroup.com
5	REAL Energy	**Mr. Agaba Jimmy** **Email:** jagaba@creec.or.ug **Mobile:** +256785441332
6	Mapei Engeering	**Mr. Innocent Opio** **Email:** engineeringmpepe@gmail.com **Mobile:** +256774008057

6. <u>The number of times the top 10 foods were cooked per meal; breakfast, lunch, supper; during the Charcoal diaries.</u>

Gulu		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	3	68	22	93
	Beans	4	48	7	59
	Rice	4	19	3	26
	Matooke	6	1	1	8
	Milk tea	9	1	0	10
	Porridge	10	1	3	14
	Meat	1	15	2	18
	Ground nuts	0	0	0	0
	Greens	0	17	6	23
	Irish potatoes	0	3	0	3
Mbale		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	1	48	2	51
	Beans	0	24	4	28
	Rice	1	30	15	46
	Matooke	1	13	16	30
	Milk tea	31	0	0	31
	Porridge	32	0	0	32
	Meat	0	14	4	18
	Ground nuts	0	0	0	0
	Greens	0	25	1	26
	Irish potatoes	5	7	0	12
Mukono		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	0	26	10	36
	Beans	1	17	14	32
	Rice	0	17	24	41
	Matooke	1	9	10	20

	Milk tea tea	35	0	6	41
	Porridge	23	1	2	26
	Meat	0	2	4	6
	Ground nuts	0	0	0	0
	Greens	0	8	4	12
	Irish potatoes	9	8	2	19
Mbarara		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	0	25	25	50
	Beans	1	23	15	39
	Rice	0	23	17	40
	Matooke	4	41	39	84
	Milk tea tea	47	1	2	50
	Porridge	51	1	1	53
	Meat	0	17	12	29
	Ground nuts	0	0	0	0
	Greens	0	11	4	15
	Irish potatoes	1	2	3	6

7. <u>The number of times the top 10 foods were cooked per meal; breakfast, lunch, supper; during the EPC diaries.</u>

Gulu		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	3	56	18	77
	Beans	10	42	10	62
	Rice	3	17	4	24
	Matooke	1	0	0	1
	Milk tea tea	0	0	0	0
	Porridge	12	0	1	13
	Meat	1	8	1	10
	Ground nuts	1	3	1	5
	Greens	0	3	0	3
	Irish potatoes	1	0	0	1

Mbale		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	0	21	1	22
	Beans	1	37	8	46
	Rice	1	58	22	81
	Matooke	2	18	12	32
	Milk tea	6	0	0	6
	Porridge	11	0	0	11
	Meat	1	15	4	20
	Ground nuts	1	4	2	7
	Greens	0	23	3	26
	Irish potatoes	4	6	1	11
Mukono		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	0	29	10	39
	Beans	0	33	10	43
	Rice	1	54	15	70
	Matooke	2	35	5	42
	Milk tea	31	0	0	31
	Porridge	35	0	1	36
	Meat	0	0	0	0
	Ground nuts	1	17	3	21
	Greens	0	8	3	11
	Irish potatoes	7	7	1	15
Mbarara		**Breakfast**	**Lunch**	**Supper**	**Total Frequency**
	Posho	0	30	22	52
	Beans	0	38	8	46
	Rice	0	37	11	48
	Matooke	1	34	24	59
	Milk tea	44	1	1	46
	Porridge	47	0	2	49
	Meat	0	22	6	28
	Ground nuts	0	13	6	19
	Greens	0	5	1	6

	Irish potatoes	2	3	2	7

8. Average cost incurred by each household when cooking with charcoal only: for three meals per day.

District	Household identifier	Av. Number of People per household	Average amount of Charcoal (Kgs.)	Cost of Charcoal Per day (UGX)
Gulu	HG01	6	6.3	7,355
	HG02	7	6.8	7,912
	HG03	3	2.8	3,319
	HG04	4	3.7	4,305
	HG05	3	3.2	3,677
	HG06	3	3.4	3,998
	HG07	8	7.6	8,880
	HG08	5	5.0	5,830
	HG09	3	3.0	3,498
	HG10	10	10.2	11,929
Mbale	HM01	6	1.8	2,118
	HM02	9	2.8	3,307
	HM03	5	1.1	1,328
	HM04	7	1.4	1,612
	HM05	8	4.0	4,675
	HM06	8	1.9	2,161
	HM07	4	1.4	1,678
	HM08	8	1.6	1,908
	HM09	5	1.4	1,675
	HM10	7	1.1	1,320
Mbarara	HMBR 1	3	3.3	3,816
	HMBR2	3	3.3	3,857
	HMBR3	3	3.2	3,677
	HMBR4	4	3.8	4,395
	HMBR5	3	3.0	3,498
	HMBR 6	5	5.0	5,830
	HMBR 7	7	7.4	8,610
	HMBR 8	4	3.6	4,216
	HMBR 9	5	4.9	5,733
	HMBR 10	5	4.5	5,247
Seeta	HS01	4	2.9	3,392

	HS2	5	2.5	2,925
	HS03	3	1.1	1,270
	HS04	10	10.8	12,549
	HS05	3	0.9	1,091
	HS06	6	2.4	2,778
	HS07	5	1.1	1,245
	HS08	5	1.1	1,298
	HS09	6	2.4	2,846
	HS10	5	1.5	1,705

9. Average cost incurred by each household when cooking with charcoal and electricity; for three meals per day: with at least one dish per meal being cooked with the EPC.

District	**Household identifier**	**Av. Number of People per household**	**Average Energy (kWh)**	**Cost of energy per day (UGX)**
Gulu	HG1	6	0.32	81
	HG2	7	0.47	117
	HG3	4	0.37	92
	HG4	4	0.14	34
	HG5	5	0.35	87
	HG6	3	0.32	79
	HG7	5	0.23	57
	HG8	6	0.41	104
	HG9	4	0.23	57
	HG10	6	0.42	105
Mbale	HM1	7	0.37	94
	EM2	4	0.39	98
	HM3	4	0.48	120
	HM4	7	0.16	41
	HM5	6	0.22	56
	HM6	7	0.25	63
	HM7	4	0.20	49
	HM8	6	0.20	50
	HM9	7	0.20	51
	HM10	5	0.18	45
Mbarara	HMBR1	4	0.65	163
	HMBR2	7	0.35	87
	HMBR3	3	0.29	72
	HMBR4	5	0.30	76

	HMBR5	3	0.27	67
	HMBR 6	5	0.38	95
	HMBR 7	5	0.28	70
	HMBR 8	4	0.33	81
	HMBR 9	7	0.29	72
	HMBR 10	7	0.32	79
Seeta	HS1	9	0.52	130
	HS2	4	0.19	48
	HS3	8	0.40	100
	HS4	2	0.63	156
	HS5	7	0.34	86
	Hs6	5	0.37	94
	Hs7	3	0.31	78
	HS8	6	0.28	70
	Hs9	3	0.27	68
	Hs10	6	0.29	74

10. Other Annexures

I. Training Material
II. Charcoal Diaries Participant Form
III. EPC Diaries Participant Form
IV. Charcoal Diaries Data Collection Survey
V. EPC Diaries Data Collection Survey
VI. Entry Survey
VII. Exit Survey