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# The Desirability of Clean Cooking in Off-Grid Households


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# Foreword - A2EI and Cooking

Sometime in November 2018, four people sat around a table at the Access to Energy Institute (A2EI) office in Berlin to discuss the prospects of developing solar-powered cooking appliances. It was one of A2EI's first team meetings as a registered organization, back when we did not actually own the chairs we were sitting in and half the team did not have contracts. Someone proposed the idea of making an electric pressure cooker for off-grid households, and we mused about how much money the solar system would cost and whether you could convince people to change their behavior on a topic as deeply culturally ingrained as cooking.

Some were skeptical, others more optimistic, but everyone agreed: it is a topic that deserves attention.

As A2EI began to test the waters of clean cooking, the drum for clean cooking technologies was beating louder and louder around the world. As an organization, we had to decide where we would fit in the bigger picture.

We chose to start small. In March 2019, in our office in Arusha, Tanzania, the Access to Energy Lab team bought a pressure cooker and ate lunch out of it every day for a week. From there, we began to formulate the questions and ideas that would guide our research for the coming months.

As the world's first non-profit, collaborative R&D institute for the off-grid sector, we aim to improve industry-wide understanding on important topics such as clean cooking. Our work is motivated by the desire to answer questions like those we had in Berlin and Arusha, and we hope the answers will be insightful and beneficial to others.

With two thumbs up,
The A2EI Team

# Executive Summary

## Background, Purpose, and Objectives

Research was conducted to understand the desirability of electric cook stoves and whether off-grid households in countries like Tanzania would be willing to switch to clean cooking technologies.

## Methodology

The desirability of biomass cooking methods and clean cooking methods were compared by evaluating three metrics: time, ease of use, and cost.

Nine off-grid households were provided solar systems and electric pressure cookers for periods of 7-10 days and were asked to cook with it. The users were surveyed before and after the testing period and kept food journals, where they recorded the meals they cooked in the pressure cooker and the time it took them.

The survey and journal data was analyzed to determine the required cooking time and ease of use of biomass cooking methods and electric pressure cooking technologies. The cost of biomass cooking was also determined so as to set a benchmark for future cook stove development.

## Results and Conclusions

The results of the data collection are summarized in the tables below.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Wood Cooker | 132 minutes/day | 2 – very difficult | $0.00 |
| Electric Pressure Cooker | 53 minutes/day | 7 – easy | - |

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Charcoal Cooker | 124 minutes/day | 7 – easy | $14.10/month |
| Electric Pressure Cooker | 47 minutes/day | 8 – easy | - |

From the tables above, we conclude that electric pressure cookers are generally desirable as they are perceived as time-saving and easy to use in comparison with biomass cooking. We would expect charcoal users to make the switch if the cost was below roughly $14.10 per month in costs, however more research is needed to understand the tipping point for firewood users.

However, users chose to use the electric pressure cooker only for certain meals during the testing, such as beans and rice, and we believe this contributed to the high ease of use score.

Consequently, we expect that at the current time of writing, off-grid users would use an electric pressure cooker but only in combination with other cooking methods. To encourage a complete switch away from biomass cooking and toward clean cooking technologies, additional steps must be taken.

# Research Scope

## Background

Charcoal and wood burning cooking methods are widely used in rural parts of African countries such as Tanzania, but are time-intensive and have strong negative health and environmental impacts (World Health Organization). Many of the harmful effects of cooking affect women, who are tasked with the labor of preparing meals as well as collecting fuel (World Health Organization).

Electric and clean cooking methods promise a brighter future, one where women spend fewer hours cutting down trees for firewood, where families do not suffer from indoor air pollution, and where households can actually save money as they save time. The potential benefits of clean cooking are plentiful, and recent initiatives such as the Modern Energy Cooking Services (MECS) have been founded to accelerate the adoption of clean cooking technologies.

While the positive impacts of clean cooking technology becomes better understood at a policy level, the fate of the technology ultimately rests in the hands of millions of families that practice traditional cooking methods as with biomass. Do these users see the benefit in switching to electric cookstoves? Can the benefits of clean cooking overcome long-standing cultural traditions that households have around food?

A2EI's research focused on the following question: do off-grid households want to switch to electric cooking?

Our research complements and builds off of other research conducted in the field such as the eCook Tanzania Country Report, which uses cooking diaries to study on-grid cooking behavior (Batchelor). This is the first of two reports we will publish on the topic of cooking in 2019. The second report will quantify the time, energy, and cost requirements for improved electric cooking appliances.

## Purpose and Objectives

The purpose of this research is to understand the desirability of electric cooking methods in relation to biomass cooking methods. We believe that if an electric cooking methods are more desirable than conventional biomass cooking methods, then users will freely adopt them. However, if they are less desirable, the design of the technology must be improved before its benefits can be realized.

The primary goal of this research is to determine if off-grid households want to switch to electric cooking methods. Therefore, our research objectives were to:

- Understand the time, ease of use, and cost implications of conventional cooking behaviors (wood and charcoal)
- Understand the time and ease of use of electric cooking methods

"A2EI's research focused on the following question: do off-grid households want to switch to electric cooking?"

# Methodology

## Overview of Methodology

Our research focused on the desirability of electric cooking, categorized under three key categories: time, ease of use, and cost.

We propose that electric cooking would be definitively more desirable than biomass cooking if:

1. It uses less time
2. It is easier to use
3. It is costly to use

In order to make these comparisons, we collected data to quantify the time, ease of use, and cost of both biomass cooking and electric cooking.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Biomass Cooker | Food Diaries + Interviews | Interviews | Interviews |
| Electric Pressure Cooker | Food Diaries | Interviews | - |

**Table 1:** The expected results table showing how each cell would be derived. By comparing the cooking methods across the three metrics, we could compare the desirability of each method. Explanations on how each data point was calculated is given in the Analyzing Data section.

### Experimental Design

We installed pressure cookers and solar systems at nine off-grid households in the Arusha region of Tanzania. At the time of installation, households were interviewed about the cooking times, cooking expenditures, and their perceptions on the ease of cooking with wood and charcoal. Each household was then trained to use the pressure cooker and given a food diary, which was used to record the meals and cooking time during the test period. A follow-up interview was conducted with each user at the end of the test period to record their perceptions on the ease of use of the pressure cooker.

### Use of Electric Pressure Cookers

To better understand the desirability of electric cooking technologies, we conducted user testing with electric pressure cookers. Although less versatile than electric hotplates and stovetops, electric pressure cookers are well suited to cooking staple meals in Tanzania such as beans and rice. Additionally, electric pressure cookers are energy efficient in comparison with other electric cooking technologies, meaning they face the lowest barrier to adoption in terms of cost.

# Analyzing Data

## Calculating Cooking Time

Food diaries were used to calculate the time used to cook by each user. To determine electric pressure cooking time, we used the times recorded in the food diaries to calculate each household's average daily total cooking time.

To determine the biomass cooking time, we used survey answers to calculate an average time to cook each dish, and then applied these times to the meal schedule of each user. Conventional cook times were estimated for both wood and charcoal, depending on what method or methods the user used. The final daily average calculation included times for starting wood and charcoal and also collecting firewood.

| | Day 1 | | | Day 2 | | | Day 3 | | | Day 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Meal | E | W | Meal | E | W | Meal | E | W | Meal | E | W |
| Meal 1 | Makande | 60 | 180 | Meat | 23 | 37 | Tea | 5 | 5 | Tea | 5 | 5 |
| Meal 2 | | | | Rice | 35 | 20 | | | | Uji | 10 | 10 |
| Meal 3 | | | | | | | | | | Makande | 60 | 180 |
| Fire Starting | | 0 | 2 | | 0 | 4 | | 0 | 2 | | 0 | 6 |
| Wood Collection | | 0 | 6 | | 0 | 6 | | 0 | 6 | | 0 | 6 |
| Daily Total | | 60 | 188 | | 58 | 67 | | 5 | 13 | | 75 | 207 |
| **Daily Average** | **Electric Pressure Cooker** | | | | **50** | | **Wood Cooker** | | | | **119** | |

**Table 2:** Example of data collected from a food diary recorded by a user who cooked with a pressure cooker. All times shown are in minutes. Values shown in Columns marked E (for "Electricity") were based on the times users recorded in their food journals. Values shown in Columns marked W (for "Wood") were derived; values in blue were derived from a user-reported average, whereas values in pink had no useful user-given data, so the time from the pressure-cooker diary was used.

### Calculating Ease of Use

To compare the ease of use of different cooking methods, we asked users the following questions:

- How difficult is it to cook with firewood?
- How difficult is it to cook with charcoal?
- How difficult is it to cook with the pressure cooker?

Users indicated the difficulty on a 1-10 scale, with 1 being very difficult and 10 being very easy. When answering this question, users were asked to consider many factors and indicate their overall satisfaction.

### Calculating Cost

To calculate the cost of cooking with wood and charcoal, we interviewed users about their purchasing habits. All users collected rather than purchased firewood, meaning the calculation was relevant only for charcoal users. Users reported their frequency of purchase and average purchase cost.

A cost was not calculated for the electric pressure cooker, as the tested pressure cookers were not optimized for energy-efficiency. Still, we hope our cost data sets a benchmark for product developers that they can use when designing future energy-efficient appliances.

## Additional Discussion of Methodology

### Margin of Error, Confidence

We indicate no margin of error or confidence interval for the resulting data as the purpose of this data is not to precisely quantify the time, difficulty, or cost of cooking. Stated times and costs should be treated qualitatively.

### Possible Sources of Error, Bias

Cooking is a complex subject and in our research we faced huge variations between household demographics, energy usage, meals, cooking and eating patterns, reporting habits, weather, and many other potentially important factors. While the use of surveys and self-reported journals as a data source can be prone to error and bias, we believe this relatively simple approach is acceptable for the required precision of our answer, especially considering that the conclusions drawn from the user data were generally consistent.

### LPG and Gas Cooking

Several users did use LPG to cook and we did collect data on it, however we did not include this in the analysis of our study because:

- All users that cooked with LPG reported using it for less than 15 minutes a day
- Many of the negative impacts of cooking with biomass are not associated with LPG cooking

As LPG is not the main means of household cooking and does not have the same negative impacts as biomass cooking, we do not view it as the primary technology that we hope to displace with clean cooking technology, and chose to exclude it from our analysis.

### Out of Scope Results

Due to the qualitative nature of the research, we were able to gain topical insights that while interesting, were not directly relevant to our guiding question. We have included many of these findings in Appendix 2 of this report.


# Overview of Results

## Summary of Results

The results of the research are summarized in Tables 4 and 5 below.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Wood Cooker | 132 minutes/day | 2 – very difficult | $0.00 |
| Electric Pressure Cooker | 53 minutes/day | 7 – easy | - |

**Table 4:** The above table shows the comparison between wood and electric pressure cooking. The electric pressure cooker was reported to save time and be easy to use, however none of the households had to pay to cook with firewood.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Charcoal Cooker | 124 minutes/day | 7 – easy | $14.10/month |
| Electric Pressure Cooker | 47 minutes/day | 8 – easy | - |

**Table 5:** The above table shows the comparison between charcoal and electric pressure cooking. Users generally found charcoal easier and more expensive to use than firewood.

"However, the food journals also point to a more complicated reality: not all meals were cooked on the pressure cooker"

## Interpretation of Results

The data collected during the pilot suggests that the use of an electric pressure cooker is both time saving and easy to use in comparison with a wood or charcoal stove. If the operating costs for an electric pressure cooker drop below the benchmark of $14.10, we would expect charcoal users to adopt the technology. For users that cook with wood, the answer is unclear, and more research would be needed to clearly define a cost benchmark.

However, the food journals also point to a more complicated reality: not all meals were cooked on the pressure cooker.

One of the most common dishes in Tanzania is ugali, a dense ball of starch made from maize flour. Users reported that cooking ugali in a pressure cooker was not possible, and consequently it did not appear in any of the food journals.

What does it mean that people did not cook ugali? When a user reported that it is very easy to use the electric pressure cooker, they only accounted for the dishes that they cooked, which were coincidentally all the dishes that were easy to cook in a pressure cooker. Had the users been instructed to cook all of their meals in the electric pressure cooker, we would expect that they would have become frustrated and the ease of use score would be significantly lower.

**Above:** A meal of ugali and ndizi (stewed bananas) made in a pressure cooker at the A2EI Lab. No users that tested the electric pressure cooker reported cooking ugali, despite it being the most common staple starch in Tanzania.


## Conclusions - A Complex Picture

From our results, we conclude that an electric pressure cooker would be desirable by off-grid households that cook with charcoal assuming that the operating cost is lower than the household expenditures for charcoal. For households that use wood, we conclude that they are open to using electric pressure cookers, but more research is needed to understand their price sensitivity.

We also conclude that an electric pressure cooker is desirable for specific dishes, and hence it is desirable only when used in combination with other cooking methods. Although users were given a free electric pressure cooker, many continued to use wood and charcoal to cook their staple meals during the test period despite the financial, time, and labor costs.

What does this mean for the adoption of pressure cookers? Similar to the use of LPG in households to boil water for tea, we expect that households are willing to adopt electric pressure cookers and use them for specific instances such as cooking beans. However, we also expect that even if they use an electric pressure cooker, they will continue to use other cooking methods such as wood and charcoal stoves until faced with a new impetus of change, such as the widespread proliferation of pressure-cooked ugali recipes or strong economic incentives.

## Recommendations

We make three primary recommendations based on our conclusions.

### Short-term Adoption Strategies

Promoters of clean cooking technologies should accept the reality of mixed method cooking. A one-size-fits-all electric cooker – whether pressure cooker or hot plate or otherwise – is likely untenable at this moment due to cost and usage barriers. Rather than looking for an electric cooker that suits every meal, we suggest stakeholders focus on specific use-cases, such as a small solar-powered pressure cooker that is sized to cook a pot of beans each day. By narrowing our expectations for how clean cooking technologies are to be used, we can optimize the value propositions that we deliver to users.

### Long-term Strategies for Improving Impact

Strategic planning must focus on addressing the deficiencies of existing electric appliances. How can we help someone cook their favorite meal with an electric pressure cooker? How can we drive down costs and improve energy efficiencies of electric stovetops? How can we incentivize users to behave in ways they don't want to? By understanding these limitations, we can target our efforts at addressing them.

### Suggestions for Improving Product Development

Finally, product developers should remember that from a user perspective, what you do with energy is more important than where the energy comes from. In this instance, people's interest stemmed from the pressure cooker more than the solar. It is important for us to remember to translate the value proposition of clean energy into something that is meaningful to users.

**Left:** Ugali made in a pressure cooker at the A2EI Lab in Arusha, Tanzania. The recipe for pressure-cooked ugali is different than stovetop ugali, so users continued to cook ugali with biomass stoves during the test period. To improve and fully replace biomass cooking, stakeholders should focus on these areas with initiatives such as including targeted customer education during product introduction.

# Outlook – Next Steps

## Continued Research at A2EI

Following the release of this report, A2EI will commence a new research project to investigate household cooking and build off the learnings in this report.

The guiding question for the upcoming research will be: how energy efficient should an electric cooker be in order to be cost-effective?

During the next phase of research, A2EI will equip both rural and urban households with electric cooking appliances (electric pressure cookers, hot plates, and water boilers) and have them use these appliances for the duration of a month. The households will also be equipped with data loggers, which will track the appliance usage and power consumption.

From this research, A2EI and industry stakeholders will have a data set that shows when users cook, what they cook, and how long they cook for. By combining this data with appliance data and market data, we will be able to develop a model that accurately relates user costs to an appliance power consumption, market electricity prices, and user cooking behavior.

We believe this research will give insights that can guide product developers as much as policy makers and that the results will be relevant to solar home system, mini-grid, and primary grid providers. As electricity prices drop and as efficiencies improve, we foresee that this tool can assess progress and guide strategic interventions to increase adoption of clean cooking technologies.

User Cost = f(Power, Electricity Price, Cooking Behavior)

# Appendix 1 - User Profiles


## Profile 1: Mama Baraka Nnko

Mama Baraka lives with her four family members in the community of Maji ya Chai, which is located 42 km from Arusha. She is a stay-at-home mother and farmer without access to the grid. To supply her family with food, she uses a combination of firewood, charcoal, and gas to cook meals.

In the morning, Mama Baraka wakes up and turns on her gas stove to prepare a quick and light breakfast. Gas cooking is quick, however, the $26 USD upfront cost of the gas stove and refilling of the gas tank every three months presents a heavy cost to this method. For lunch, she uses tree branches collected from her farm and spends three hours to make makande (boiled maize and beans). Meals cooked during lunch are often in larger portions so they may be eaten for dinner.

Mama Baraka found it very easy to use an electric pressure cooker, and appreciated that it reduced the cooking time of makande from three hours to just one hour. However, she wasn't able to cook every food she wanted in the pressure cooker, such as ugali.

| **Wood** | Time | Ease of Use | Cost |
|---|---|---|---|
| Wood Cooker | 94 minutes/day | 1 – very difficult | $0.00 |
| Charcoal | 119 minutes/day | 9 – very easy | $17.39 |
| Electric Pressure Cooker | 52 minutes/day | 10 – very easy | - |

**Table:** The table above show how Mama Baraka compared wood, charcoal, and electric pressure cooking. While charcoal is easier and takes longer to use, it also presents a cost. Understanding these cost, time, and ease of use dynamics better can help product developers understand what features users value.


## Profile 2: Mama Ndekirwa Nathan

In Maji Ya Chai, Mama Ndekirwa lives with her husband and three children. She uses firewood to cook most of her meals, which she prunes the tree branches in her family farm. She makes two 15 minute trips a week to gather enough wood for a week of cooking. A family serving of rice usually takes 20 minutes for Mama Ndekirwa to cook and is easily started by using kerosene.

In addition to this method, she has been using LPG since 2016, which she uses to cook items that require less than 10 minutes of cooking time. However, the downside of LPG lies in the cost of the cooker plus the $9.50 gas refill that she has to purchase every three months.

Mama Ndekirwa found it very easy to cook using the electric pressure cooker, however she wasn't able to use it to make ugali or stewed meat.

| Day 1 | | | Day 2 | | | Day 3 | | | Day 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Meal | E | W | Meal | E | W | Meal | E | W | Meal | E | W |
| Beans | 40 | 96 | Makande | 70 | 180 | Beans | 40 | 96 | Makande | 90 | 180 |
| Rice | 35 | 20 | | | | Meat | 48 | 37 | | | |
| | | | | | | Rice | 25 | 20 | | | |

**Table:** Data from 4 days of Mama Ndekirwa's food journal. Recorded times from the pressure cooker are shown in the columns E, whereas column W shows cooking times deriived from user surveys.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Wood Cooker | 141 minutes/day | 1 – very difficult | $0.00 |
| Electric Pressure Cooker | 75 minutes/day | 8 – easy | - |

## Profile 3: Mama Godwin Michael

Mama Godwin's family of three live in Imbasseli, Maji ya Chai located 37 km from Arusha. She uses firewood for foods that take a long amount of time to cook and LPG for foods that take a shorter time. Due to the small family size and the convenient supply of tree branches in their farm, Mama Godwin only needs to make one 15 minute trip to collect enough firewood to last her family for a week. She takes about eight minutes to start the fire and common foods that she cooks include meat for 45 minutes and Makande for 210 minutes.

Her upfront gas cooker cost proved to be quite expensive at $39 with refilling that needs to be made every 2 months. The upside is that during the rainy season when it is very hard to ignite the fire, she can instead use the gas stove.

Mama Godwin had a moderate perception of the ease of use of the solar-powered electric pressure cooker. She reported that it saves time, however she found it was difficult to use when it rained and scored it moderately.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Wood Cooker | 75 minutes/day | 1 – very difficult | $0.00 |
| Electric Pressure Cooker | 46 minutes/day | 5 – moderate | - |

## Profile 4: Mama Malaki Ayo

Mama Malaki lives with her six family members in Imbaseli as a stay-at-home mother. She does not have access to firewood and consequently uses charcoal and gas to cook family meals. Mama Malaki pays about $15 to $20 for a stack of charcoal that supplies her for six weeks. She can cook food such as beans for 120 minutes and Makande for 180-240 minutes, but starting the fire is not as easy as it can take up to 15 minutes to get a completely active fire.

Mama Malaki has been cooking with gas since 2008. She spent $95 to purchase a two-plate gas stove and LPG canister but she must refill the tank for $22 every three months. Though the cost presents a hefty sum to her family, she can quickly cook food such as rice in 15 minutes and vegetables in eight minutes.

Mama Malaki found it simple to use the pressure cooker and appreciated that it reduced the time she spent cooking makande, however she wasn't able to cook ugali in it.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Charcoal Cooker | 129 minutes/day | 7 – easy | $13.04 |
| Electric Pressure Cooker | 41 minutes/day | 7 – easy | - |

## Profile 5: Mama Ruth

In the region of Maji ya Chai, Mama Ruth lives with her husband and two children. She uses firewood to cook meals that take a long time, and gas for shorter meals and when it rains. Three 20 minute trips to collect firewood gives her enough supply for a week, and she spends only three minutes starting the fires for her meals. However, Mama Ruth is bothered by the smoke inhalation from the cooking process.

Mama Ruth purchased a gas cooker stove in 2015 for $22.50 and refills the gas tank every two months for $9.50. She uses the gas for food that takes less than 15 minutes to cook.

Mama Ruth had a moderate impression of the ease of use of the pressure cooker, which she mostly used for cooking makande, rice, and beans. Most days, Mama Ruth only used the pressure cooker to cook one dish.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Charcoal Cooker | 120 minutes/day | 3 – difficult | $0.00 |
| Electric Pressure Cooker | 43 minutes/day | 6 – moderate | - |

| Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|
| Beans | Makande | Rice | Tea | Makande | Meat | Makande |
| Rice | | Meat | | | | |

**Table:** Mama Ruth's food journal. Despite the time savings, she cooked less than most users.

**Above:** A2EI team interviews users about their cooking methods.

## Profile 6: Mama Michael Nyiti

Mama Michael lives in Maji ya chai 45 km from Arusha town at Kimandamu village. She lives with her husband and one child and uses firewood to cook the family meals. She conducts a 20 minutes trip twice a week for firewood collection, which is made easier as she keeps much of the wood from her annual tree pruning. She spends 10 minutes to start the fire for her meals and it's always very difficult for her to start the fire during the rainy season.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Conventional Cooker | 125 minutes/day | 1 – very difficult | $0.00 |
| Electric Pressure Cooker | 44 minutes/day | 7 – easy | - |

During rainy season mama Michael uses charcoal for cooking in the morning when preparing breakfast and evenings for making simple foods. She uses three 5 litre buckets of charcoal per week. Normally a 5 litre bucket costs $0.87, however she doesn't incur cost for the charcoal because her mom provides it to her.

## Profile 7: Mama Radegunda

In Monduli, Mama Radegunda lives with her husband, child and housekeeper. It is hard for her to access firewood, so she uses charcoal which she finds easy to use as well as kerosene. She cooks in the morning and afternoon every day.

For charcoal, she buys a bucket for $11 every month and starts her fire within five minutes. Some examples of the foods she cooks on charcoal includes bananas for 90 minutes and meat for 45 minutes. Mama Radegunda uses kerosene for tea in the morning and dishes such as ugali and bananas for dinner. The cost of one liter of kerosene is $1.10 which lasts her four days.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Conventional Cooker | 135 minutes/day | 5 – moderate | $10.87 |
| Electric Pressure Cooker | 46 minutes/day | 8 – easy | - |

## Profile 8: Mama Nice

Mama Nice is a stay-at-home mother who lives with her 3 family members at Muriet, 15 km from Njiro, Arusha. She's able to afford charcoal and gas uses them for all of her cooking. She cooks 3 time a day and uses gas in the morning and charcoal in the evening. She pays $15 for a sack of charcoal, which she uses for 1 month. She uses up to 10 minutes to start fire. She uses charcoal for heavy meals that take longer to cook.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Conventional Cooker | 113 minutes/day | 6 – moderate | $15.22 |
| Electric Pressure Cooker | 47 minutes/day | 8 – easy | - |

Mama Nice also uses gas for cooking. She paid an upfront price of $39 in 2015 for her gas stove and refills the gas tank every 2 months for $9.50. She uses the gas to cook foods that take less than 20 minutes to cook.

| Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 |
|---|---|---|---|---|---|---|---|
| Rice | Makande | Meat | Beans | Beans | Meat | Meat | Beans |
| Potatoes | | Rice | | Potatoes | Pasta | | Fish |
| Meat | | | | | | | |

**Table:** Mama Nice's food journal logs. She cooked potatoes and pasta which none of the other users did.

## Profile 9: Mama Leskari

Mama Leskari lives with her husband and four kids 20km from Arusha in Mkonoo. Her primary and only cooking method relies on firewood as there are no other alternatives for her. In three or four trips to a forest, Mama Leskari collects her supply of firewood, but her trips are a lengthy as they take up to five hours per week. After gives minutes, she is able to get the fire going to cook meals such as Ngararumu for five hours and Loshoro for three hours.

| | Time | Ease of Use | Cost |
|---|---|---|---|
| Conventional Cooker | 236 minutes/day | 5 – moderate | $0.00 |
| Electric Pressure Cooker | 56 minutes/day | 6 – moderate | - |

# Appendix 2 – Out of Scope Results

Apart from the findings mentioned above in the report, there were certain commonalities as well as differences between the nine users that participated in the study that may be of interest but were not crucial to the purpose of the report.

### Lengthy Wood Collection Times

One of the users, Mama Leskari, reported an average weekly firewood collection time of five hours, which was significantly higher than other users. Despite the significant time savings of using an electric cooker, she perceived the pressure cooker as similarly difficult to use as cooking with firewood. Users such as Mama Leskari require separate research and analysis to better understand the means by which they would switch cooking methods – although there is huge impact potential by reducing her labor in the kitchen, there is also challenges around educating the user on use of the product as well as overcoming the price barrier.

### Appliance Surveys

The users were also surveyed on the appliances they use to cook meals, such as pots and pans. Most users reported that using pots was very difficult and that they needed to be extra careful in comparison with using a pan. Developers of cooking appliances may want to consider that even common kitchen appliances can present a learning curve if unfamiliar to a user.

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# Authors & Acknowledgments

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