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**USAID Translating Research into Action (TRAction) Project  
“Testing the Effects of a Novel Offer & Marketing Messages on Uptake and  
Usage of Fuel-efficient Improved Cookstoves in Rural Uganda”**

**Feasibility Stage Report**

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## Executive Summary

This report summarizes project preparation activities during the feasibility stage that ran from August 2011- January 2012. The main activities of the research relate to improving adoption of fuel-efficient cookstoves and behavior change, particularly transitioning households from primarily utilizing their three-stone fire to usage of the fuel-efficient cookstove(s) for cooking. Our three randomized controlled trials (RCTs) are testing: (1) What marketing messages are effective at increasing willingness to pay for a more efficient stove in rural Uganda; (2) What sales offers (e.g., free trial and time payments) increases willingness to pay and uptake; (3) What effects does ownership of an efficient stove have on the use of old and new stoves, fuel use, and indoor air pollution from kitchen level concentrations of particulate matter. To prepare the program to meet its objectives and achieve maximum results, the team hired a qualitative researcher local to the Mbarara region in addition to the broader staff of 3 Supervisors from our data collection partner CIRCODU. The team successfully completed the following feasibility stage activities:<sup>1</sup>

1. Selecting a region in rural Uganda appropriate for the intervention;
2. Evaluating and understanding household practices, patterns, and preferences related to cooking, as well as how improved stoves fits in households priorities;
3. Testing four different fuel-efficient improved stoves and evaluating the best choice for households within the study zone;
4. Designing training on how to use the chosen fuel-efficient stove;
5. Determining how to reduce use of traditional stoves, given that households commonly use two cooking points;
6. Designing and testing the efficacy of different marketing messages related to fuel-efficient cookstoves;
7. Designing protocol and survey materials for measuring and installing Stove Usage Monitors (SUMs), UCB Particulate Matter (PM) Monitors, and Kitchen Performance Tests (KPTs) that measure fuel usage;
8. Evaluating lessons learned from other research on disseminating efficient stoves.

The report is organized by the different activities completed in the feasibility study, which include:

- Meeting with District Chief Development Officers from eight districts and visiting households in each of these districts to select the best region for our study based on key criteria (Section 1);
- Holding three focus groups, lending four different fuel-efficient improved stoves to 28 households, and visiting them to understand traditional practices relating to cooking and to determine which of the four fuel-efficient stoves is best for the local population (Sections 2 and 4);
- Lending Envirofit G-3300 cookstoves to 10 additional households and interviewing them to design best practices of use of the Envirofit G-3300 as well as understanding how owning an Envirofit affects the usage of households traditional cookstove (Section 3);
- Holding six additional focus groups to test and design different marketing messages (Section 5);
- Visiting households to design protocol for SUMs, PM Monitors, and KPTs, and to design survey forms (Section 6,7, & 8).
- Pre-testing survey questions related to demand determinants hypotheses about which household characteristics are associated with WTP and adoption of the Envirofit cookstove (Section 9);
- Reviewing lessons learned from other research and wherever possible incorporating these lessons learned in our research program (Section 10).

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<sup>1</sup> Principal Investigator, Theresa Beltramo, spent a month in Uganda during the feasibility stage joined by co-P.I. Dr. David I. Levine, and research collaborator Dr. Garrick Blalock for a week to ensure proper preparation of the project.

# 1. Regional Selection

## Methods

To determine the ideal area for the study, the team initially targeted 16 districts as potential sites in both the Central and Western regions of Uganda. The team visited eight districts in both the Central and Western regions including: Luwero, Kayunga, Nakaseke, Nakasongola, Mbarara, Rukungiri, Isingiro, and Ntungamo. In addition, the team made phone calls to the other eight districts and immediately eliminated seven districts due to a large ongoing GIZ (formerly GTZ) program to disseminate fuel-efficient Lorena mud stoves.<sup>2</sup> The team did not visit the remaining district as they had already identified four districts that sufficiently meet the criteria.

The key criteria the team considered are outlined in tables 1 and 2 and include the: total number of parishes in the district must consist of at least 60 parishes with preference for shorter travel time to Kampala, high percent of households who cook with wood burning stoves, number of hours per week spent gathering wood, percent of wood users that buy wood, low number of local languages spoken, average number of cookstoves used per household, low level of polygamy, average number of meals eaten and prepared daily, and whether there is an ongoing or recent (in the last two years) fuel-efficient improved stove initiative in the region.

To evaluate each district by the above criteria, the team met local government and NGO representatives in each parish, depending on availability, including the district's Chief Development Officer, Senior Environment Officer, District Gender Officer, and District Biostatistician.<sup>3</sup> Based on local officials' estimates, the team assessed each district by the relevant criteria.

Across the eight districts that remained contenders, the following characteristics were uniform:

- Average household size of six persons per household
- Quality of roads is satisfactory near town centers, but is worse in rural areas;
- Electricity is only in wealthy town centers and not typical in rural areas;
- Lunch is the main meal and the most typical foods cooked include: matooke, cassava, potatoes, posho, millet, beans, and peanuts.
- All of these foods are prepared by either boiling or steaming and critically, frying is not a common practice;<sup>4</sup>
- Most Kitchens are separate from the main house and have a gap between the wall and roof, which allows smoke to escape.
- Kitchens walls are generally made of mud and wood, and kitchen roofs are typically made of grass or metal sheets;

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<sup>2</sup> The eight additional districts contacted by telephone are: Rakai, Bushenyi, Sheema, Rubirizi, Mitoma, Bunyaruguru, Ibanda, and Buhweju.

<sup>3</sup> In Nagasonkala the team met with the Chief Development Officer Simon Buyinza; in Nakaseke the team met with the Chief Development Officer Sarah Najjuma; in Luwero the team met with the District Gender Officer Mary Nakigunde; in Kayunga the team met with the Senior Environment Officer Patrick Musaaazi; in Isingiro the team met with the Chief Development Officer Atwine Angellah; in Mbarara the team met with the Chief Development Officer Vincent Nuwagira; in Ntungamo the team met with the Biostatistician Robert Muhwezi; and in Rukungiri the team met with the District Gender Officer Agaba Nemesius.

<sup>4</sup> To ensure the fuel-efficient improved stove selected could serve the local cooking preparation practices it was important to evaluate if the households fry foods.

- Most households use two cooking points in preparing one meal- one for the main part of the meal and the other for sauces or side dishes.
- Despite the differing percentage of polygamy in each district, it is common for each wife to have her own kitchen.

Based on these criteria, the Mbarara district was selected for the study as it has more than the necessary 60 parishes, it has not had any district-wide stove projects in the past decade, households reported the most amount of time collecting fuel each week, and a high ~90% rate of households in rural areas (outside of Mbarara’s town center) use wood for cooking fuel. As a secondary consideration, the Mbarara district was selected because it is relatively accessible and road infrastructure is particularly important in the rainy season.

<i>Table 1: Regional Selection Criteria for the Central Region</i>				
	Nakasongola District	Nakaseke District	Luwero District	Kayunga District
No. of parishes in district (60 needed)	52	48	90	61
No. of rural parishes where wood is scarce	52	30	75	26
Distance (and driving time) to district center from Kampala	120 km	110 km	65 km	72 km
	(2 hrs)	(2 hrs)	(1.5 hrs)	(2 hrs)
Percent of households using wood-burning stoves	90%	95%	70%	90%
Numbers of hours per week spent gathering wood	2 – 3	2 – 3	3 – 6	6 – 9
Percent of wood users that buy wood	~0%	~0%	5 – 10%	5 – 10%
The relative scarcity of wood*	3	3	2.5	2
Recent improved stove initiative? (percent of district effected)	N	N	N	Y (~60%)
Percent of population that speak the main language of the area	80%	80%	90%	~100%
Percent Polygamous	65%	< 50%	> 50%	50%
Percent cooking indoors	70%	< 50%	50%	> 50%
Average No. of stoves used daily per household	2	1	1	1
Average No. of meals eaten per day / Average No. of meals prepared each day	3/2	2/1	1/1	2/1

\*For rankings 1 = best match, 3 = worst match- assigned by team.

## Results

Of the five districts reviewed in the Central region, both Nakasongola and Nakaseke were eliminated because wood is plentiful and charcoal is abundant and widely used. Further, both Kayunga and Rakai were eliminated as possible sites because GIZ (formerly GTZ) had distributed fuel-efficient Lorena mud stoves in over half of both districts in the last several years. In Luwero, more than 30% of the population was estimated to use charcoal as their primary fuel for cooking which makes introducing fuel-efficient wood burning not consistent with the local residents cooking practices. In addition, the fuel-efficient mud stoves were highly prevalent in Luwero.

**Table 2: Regional Selection Criteria for the Southwest Region**

	Isingiro District	Mbarara District	Ntungamo District	Rukungiri District
No. of parishes in district (60 needed)	90	83	97	79
No. of rural parishes where wood is scarce	85	65	90	75
Distance (and driving time) to district center from Kampala	300 km	210 km	330 km	365 km
	(> 4 hrs)	(3.5 hrs)	(> 4 hrs)	(> 5 hrs)
Percent of households using wood-burning stoves	99%	80%**	95%	95%
Numbers of hours per week spent gathering wood	10 – 20	10 – 20	10 – 20	10 – 20
Percent of wood users that buy wood	10%	5%	3%	> 50%
The relative scarcity of wood*	1.5	1.5	1.5	1
Recent improved stove initiative? (percent of district effected)	Y	N	N	Y
	-5%			(< 5%)
Percent of population that speak the main language of the area	98%	96%	~100%	~100%
Percent Polygamous	> 50%	< 50%	< 50%	50%
Percent cooking indoors	> 90%	> 90%	95%	> 90%
Average No. of stoves used daily per household	2	2	2	2
Average No. of meals eaten per day / Average No. of meals prepared each day	2/1	2/1	2/1	2/1

\*For rankings 1 = best match, 3 = worst match- assigned by team.

\*\*Outside of the town center of Mbarara, 90% use wood-burning stoves

Compared to the central region, the four districts visited in the southwest region have substantially less firewood, which translates into households spending more time gathering firewood and a higher percentage buying firewood. Relative scarcity of firewood makes the fuel-efficient improved cookstove relatively more valuable as it will save more time and more money. These districts also have little to no recent improved cookstove initiatives, which increases the impact of our project. The majority of households cook in enclosed kitchens, which causes a stronger impact because of a higher reduction in indoor air pollution when cooking with a fuel-efficient improved cookstove in an enclosed space. As all four of these districts sufficiently meet our criteria, the Mbarara region was selected because the roads there are the most accessible.

## Outcomes

Because selecting the region is key to the project's success, the team allocated over a month of four full-time staff to complete regional selection. After a thorough review of the districts in both the Central and Western regions of Uganda, Mbarara is the best choice based on the project criteria. Particularly, the bulk of the rural population use primarily wood for cooking (90%), there are no recent or ongoing widespread improved cookstove program in the area, a large portion of cooks cook in an enclosed kitchen and thus are expected to benefit more from the emissions reductions of an improved cookstove than a cook cooking

outdoors, and the district has the average time spent collecting fuel, between 10-20 hours/week per household.

## 2. Focus Groups

### A. Socio-demographics and Common Cooking Patterns

#### Methods

The project identified two parishes in Mbarara to act as test parishes. We worked in these parishes to learn more about local cooking practices, household fuel use, design relevant marketing messages, and get user feedback on the four test stoves considered for this initiative (See Table 3). We also piloted our marketing interventions in these parishes.

We held three focus groups and a town hall meeting to assess households' willingness to pay and stove preference.<sup>5</sup> In both individual meetings and focus groups, we asked households: how many people they cooked lunch for yesterday, if anyone helped them cook, the process of preparing yesterday's lunch, whether dinner was cooked at the same time as lunch yesterday, which fuels are used for cooking, how frequently each fuel is used, what types and number of stoves are owned, is fuel purchased or collected, and what is liked and disliked about cooking.

Next we introduced each of the four stoves – the Envirofit, the Envirofit with Chimney, the Jikopoa, and the Ecozoom and gave an overview of each stove including how it works and its main benefits based on data from the manufacturers (see Table 3). At the end of this process we took women aside and asked them individually to rank each of the four stoves.<sup>6</sup>

At the focus groups we asked women if they would be interested in trying out a stove. We lent out at least four of each of the four improved stoves to different households. Our goal was to observe and understand households' typical cooking practices, to develop the marketing messages (see Appendix 2 for marketing scripts), surveys (see Appendix 3 for current drafts of surveys), and training to assist households in transitioning to new stoves.

#### Results

Table 4 summarizes our results. Most households started their fires with grass, though a few also used dried banana leaves or paper. Women stated that wood is their primary fuel for cooking, however a quarter of our participants also reported having used charcoal to cook lunch with yesterday. All participants were interested in trying one of our fuel-efficient cookstoves.

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<sup>5</sup> The Town hall meeting was held on November 3, 2011 while the three focus groups were held in October, 2011 (see Appendix 1 for the discussion guide of the focus groups).

<sup>6</sup> In our first focus group we neglected to ask participants individually and quickly realized by our results that it was likely that participants felt social pressure to conform to the group leader's preferences. For the remaining 2 focus groups and the town hall meeting we asked each participant apart from the larger group in private to rank his or her preferences over the 4 stoves.

**Table 3: Fuel Efficient Improved Cookstoves' Overview**

				
	Envirofit	Envirofit w/ Chimney	EcoZoom (without skirt)	JikoPoa
Model	G-3300	G-3355 Chimney Accessory	Zoom Dura (ZD- WMC26)	N/A
Price (before shipping)	\$35	\$70	\$20	\$30
Predicted Lifespan	5 years	5 years	5 years	3 years
% Reduction PM	51%	66% (without external venting)	57%	32%
% Reduction Fuel	50%	60%	43%	38%
Average Thermal Efficiency (vs. 8-16% for 3-stone fire)	33%	28%	27%	22%
Boiling Time	35 minutes	35 minutes	28 minutes	...
No. of People Can Cook For	6 to 8	12-16 using two pots	6 to 8	15

Table 4 summarizes the results from our three focus groups below. Household size varies significantly across our three groups. Two are very similar and have a mean (median) of 3.7 (3) and 3.2 (3); while the third group has a much larger average number of people they cook for of 8.1 (7.5).

In addition, we find some 15% of households report cooking dinner concurrently with the lunch meal, indicating that to replace a traditional three-stone fire in these households, the fuel-efficient new stove (at least for this minority) would need to have at least two cooking points, if not more.

**Table 4: Summary of Three Focus Groups**

Focus Group No.	Date	Number Attended	Cooked lunch yesterday	Mean No. of people cooked lunch for yesterday (Median)	# who had help cooking lunch	Cooked dinner yesterday with lunch	Cooked lunch yesterday with wood (charcoal)
1	10/19/2011	1 (9)	7	3.72 (3)	2	0	3 (4)
2	10/20/2011	1 (6)	5	3.2 (3)	1 (daughter)	2	5 (1)
3	10/21/2011	2 (10)	9	8.1 (7.5)	2 (daughter)	2	9 (1)

Like in many areas in the developing world, households cook with more than one fuel and more than one stove. 65% of participants in all three of our focus groups have at least one three-stone fire. Of those who use a three-stone fire, 70% have more than one three-stone fire. Of those who used wood last week, 50% bought wood while 50% collected wood, In addition, two women bought firewood in bulk. The high usage of a second three-stone fire of those who cook on three-stone fires is an important signal for our initiative- households use

more than one stove to cook because some cook lunch and dinner at the same time and/or they need two burners to make the main lunch and dinner meals.

In addition, a quarter of all households also own a wood-burning Lorena mud stove installed in their kitchen (pictured below in Figure 1). All the Lorena mud-stoves have at least two burners, while 1/3 have three burners. As members of these focus groups were randomly selected to trial one of our four stoves during the feasibility stage, the team visited three households who owned mud stoves. The team found that all mud stoves of houses visited, were either completely broken or only had one of the burners functioning.<sup>7</sup>



Figure 1: Broken Lorena Mud Stove Found in Household in Test Parish

The visits to households confirm that households tend to cook using at least two cooking points per meal. As a result, this causes us to consider selling two improved cookstoves in hopes of replacing the three-stone fire for the vast majority of cooking.

In our household visits of all the households that report cooking with wood, 80% use more than one three-stone fire frequently. The use of multiple traditional stoves could make abandoning use of three-stone fires difficult in our program.

Table 5: Types of Stoves Households Own and Whether They Buy or Collect Wood

Date of Focus Group (No. of Participants)	No. of Three-stone Fires				No of Mud Stoves (wood burning)					
	No. who have 3 stone fires	No. with one, 3 stone fire	No. with two, 3 stone fires	No. with three, 3 stone fires	No. who have mud stoves	No. of burners on mud stove				
10/19/2011 (9)	5	2	3	0	1	1 with two burners				
10/20/2011 (6)	4	0	2	2	2	2 with two burners				
10/21/2011 (10)	7	3	4	0	3	1 with two burners; 2 with three burners				
No. of charcoal stoves										
Date of Focus Group (No. of Participants)	No. who have charcoal stoves	1 charcoal stoves	2 charcoal stoves	3 charcoal stoves	Metallic stoves	Ceramic stoves	No. of gas stoves	No. who collected wood last week	No. who bought wood last week	
10/19/2011 (9)	4	1	3	0	0	0	1	3	1	
10/20/2011 (6)	2	1		3	1	2	0	5	1	
10/21/2011 (10)	1	1	0	0	0	1	0	2	8	

<sup>7</sup> In particular of note all the chimneys we saw were broken on the mud stoves. One lasted 8 years for a woman whose brother was trained to make them, but the other Lorena mud stoves lasted less than 2 years.

We found a significant amount of charcoal stove owners in focus group 1 (45%), though a much lower percent in focus group 2 (20%) and 3 (10%). After speaking with the research team and Community Development Officer of Mbarara District, Vincent Nuwagira, we have been advised that this trend is not representative of wider Mbarara. These two test parishes are likely anomalies, as they are close to the town center of Mbarara. In contrast, the use of charcoal is likely much less frequent in more rural parts of the district where we will be conducting the majority of the study.

The team asked questions in each focus group to understand how meals are commonly prepared. The most typical foods prepared for lunch and dinner include matooke (plantains), cassava, potatoes, posho,<sup>8</sup> rice, millet, beans, peanuts, and occasionally meat. These foods are prepared most commonly using three-stone fires, and less commonly using Lorena mud stoves or charcoal stoves. The main steps involved in cooking include peeling vegetables and fruits, steaming or boiling the main carbohydrates, and boiling sauce on a second stove, and then adding meat, beans, or peanuts to the sauce. The total time for cooking the main meal (lunch) takes on average five to six hours. Part of this time the cook is able to do other activities, as the preparation does not require constant attention.

The new stoves we are considering require less time for cooking, but more attention during cooking. This increased attention requires behavioral change to give more constant attention when cooking.<sup>9</sup>

The team also asked households to explain their likes and dislikes about cooking. The women stated that the main reason they enjoyed cooking is the satisfaction they get from their husbands and children eating their food. The women stated the following aspects that they disliked about cooking: hate smoke from the cookfire, requires a lot of time and work, requires a lot of time to collect firewood, makes them dirty, and causes their eyes to burn.

Cooking beans seems to be a particular concern with the new fuel-efficient cookstove because women in Mbarara normally cook dry beans, which take a few hours and cooking with the new fuel-efficient stove requires more constant attention for a shorter period.

The team experimented with teaching the women to first soak the beans 24 hours prior to cooking before cooking as this can cut cooking time by 2/3rds down to an hour. Despite training most women reported that soaking beans first substantially worsens the flavor. Our qualitative researcher experimented with cooking dry beans and cooking beans that have been soaked. She concluded that for Ugandans, beans that have been soaked first taste substantially worse than cooked dry beans. Thus, we concluded that we will not include marketing messages to soak beans prior to cooking.

## B. Stove Choice

### Results

In addition to the three focus groups which had only female participants, an additional town hall meeting was held on November 3<sup>rd</sup> for both women and men dedicated to test consumer's stove preferences of the four fuel-efficient new stoves.

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<sup>8</sup> Posho is a type of meal porridge.

<sup>9</sup> For more details on cooking preparation, see Appendix 5.

In all the three focus groups and the town hall meeting, participants expressed a real interest in purchasing these stoves. They asked about what materials the stoves were made of and questioned the stoves durability. They were particularly interested if they could be produced locally in the village, whether spare parts would be available, and commented that the stove looked too small to cook meals for their entire family.<sup>10</sup> Additional questions were asked related to each stove type summarized in Table 6 below.

*Table 6: Questions on Stoves*

<b>Jikopoa</b>	<b>Envirofit</b>	<b>Ecozoom</b>	<b>Envirofit with Chimney</b>
Can the ceramic liner break?	If the stove goes out, is it easy to re-light?	Can you steam food on it?	Can one lift off the double burner to use just the main burner?
If it breaks what can one do?	How long does the stove take to cool down, if one wants to leave something on it for warming?	Can I use charcoal in the stove?	Can someone mangle posho on this stove- i.e. hard stirring, will the stove break?
If the handle breaks, how can one carry it?	How long does it last?	Are there bigger sizes?	Can the fire in the second pot cook meat or “hard” food[1]?
Do you have a bigger stove?	If the handle breaks what can one do?	Can you use the stove in the house?	What temperature does the second burner get to vs. the first burner?
Since the stove has clay on the inside, does that make it retain heat better?	Are there spare parts- grate, etc.?	Can a child be burned by the stove?	Can it withstand large pans- will it break if the pan is too heavy?
			How firm and durable is the stand?
			Can it make millet bread?

Across all stove types, villagers expressed doubt about the durability of the ICS in rural Ugandan conditions.<sup>11</sup> In addition, we gained valuable information to incorporate in our marketing messages that many participants doubted traditional foods and particularly that millet bread could be prepared on the ICS. To counter that perception we have incorporated the preparation of millet bread into our stove demonstrations as well as dedicated additional resources to design stove product care instructions as part of our sales meetings and additional training so as to maximize durability and prolong the useful lifetime of improved stoves.

During the group discussions with villagers at the town hall meeting, there was a male bias that women were ‘made to cook’ and some men expressed a limited desire to spend money on a fuel-efficient new stove. It also became apparent that the downside of these fuel-efficient new stoves was that they required fuel preparation by chopping large pieces of wood into small ones, a task typically done by the man.

Each participant during our focus groups and our larger town hall meeting was asked to rank the order of the 4 fuel-efficient new stoves being tested. In all but our first focus group, we asked participants in private to

<sup>10</sup> Additional questions included whether the ICS could sit directly on the ground if it was raining, and whether loans to pay the stoves would be made available.

<sup>11</sup> Upon learning the Envirofit stoves and Ecozoom stoves are produced in China, participants expressed even more doubt in the product quality, exhibiting a bias that goods made in China were not durable over time.

rank their preferences for the four fuel-efficient cookstoves. Because we were interested in selecting the product which is the best fit with households need, we never discussed the price of the stove. Results are shown in Table 7 below.

*Table 7: Ranking of Women's First Choice of 4 Stoves*

Focus Group	Date	No. of Participants	Jikopoa	Envirofit	Ecozoom	Envirofit with Chimney	Ranking done in Private
1	10/19/2011	7	0	0	0	7	No, as a Group
2	10/20/2011	8	2	0	2	4	yes
3	10/21/2011	11	1	5	2	3	yes
Town Hall Meeting	11/3/2011	59	10	20	21	8	yes
<b>Total</b>	-	<b>85</b>	<b>13</b>	<b>25</b>	<b>25</b>	<b>22</b>	-
<b>Total without Focus Group 1</b>	-	<b>78</b>	<b>13</b>	<b>25</b>	<b>25</b>	<b>15</b>	-

Regardless if we leave out focus group 1, our results show a tied 1<sup>st</sup> choice between the Envirofit and Ecozoom stoves. These results are not surprising as both stoves are similar in attributes and design. Both participants who choose the Envirofit and Ecozoom as their first choice described the top reasons being the stove used little wood, produced little smoke, was portable, lite fast, and the flame was concentrated- making the stove both safer than a three-stone fire and enabled fast cooking (see Appendix 4 for responses on each stove).

Because consumers ranked the stoves equally and there are only small differences between the stoves, and based on other logistical factors, the team decided to select the Envirofit stove for this research. Feedback from our test households who were randomly selected to receive one of the four stoves to try after our focus groups, reported overall satisfaction with the Envirofit stove. Thus, given both feedback from users hands-on feedback of use of the Envirofit stove and our three focus groups and town hall meeting; the team determined that the Envirofit stove is the best product choice for our research. Notably, this selection does not imply we are confident that the Envirofit stove is a significantly better option for all customers in our target population.

## Outcomes

Based on the outcome of our three focus groups, larger town hall meeting, and stove trials in 28 households the team will incorporate the following lessons learned into our study:

- Since the number of people women cook for varies and since the Envirofit stove can only cook for an estimated maximum of 10 people, the team will attempt to focus RCT 3- Impacts of the Envirofit Stove- on households that cook for 8 people or less, in order to maximize the chances that the team can replace the three-stone fire.
- The team has minimal concern regarding the presence of Lorena mud stoves since most of them are broken and are no longer in use.

- Since 80% of women who cook with wood, cook with more than one three-stone fire, the team will use two Envirofits in our study to enable households to transition the majority of cooking from three-stone fire use to the fuel-efficient cookstoves.
- From past research, people’s time is likely to have less value than spending money. The finding that of those households which use wood, half of them purchase wood, will likely increase a households willingness to pay and likelihood of acceptance of purchasing the Envirofit stove.
- It is probable that since households in Mbarara are relatively better off than some parts of Uganda, they are more likely to have the resources to purchase an improved cookstove.
- The team hopes that since households in Mbarara have exposure to other modern technologies it will be easier for them to change behavior regarding cooking and transitioning from a three-stone fire to the Envirofit fuel-efficient new stove.
- The team is pleased that the vast majority of those in attendance were a primary cook for their households because they will be more likely to want to buy an improved cookstove given they are directly impacted by the reduction of indoor air pollution, time and money savings associated with the Envirofit.
- If women use the Envirofit stove for cooking beans, they will likely continue to cook dry beans, which will require more constant attention than using the three-stone fire and take a significant longer period than if the beans were soaked.
- The team has incorporated the women’s dislikes of cooking into our marketing messages and explain how the improved cookstove will lessen these effects in hope of increasing their willingness to pay (e.g. less smoke, less time collecting firewood and cooking, etc.).

### 3. Best Practices of Cooking with the Envirofit Stove

#### Methods

In order to address villagers concerns from our focus groups that the Envirofit stove could indeed cook typical Ugandan meals, 10 households were given Envirofit stoves for a period of four months. The qualitative researcher conducted follow-up interviews to help determine best practices for usage of the stove. In addition, our qualitative researcher practiced cooking with the Envirofit stove to help determine best practice for usage of the stove.

#### Results

As a result, the following best practices on cooking with the Envirofit stove were developed and will be incorporated into our stove marketing and follow-up stove training sessions:

- The Envirofit can accommodate different pan sizes ranging from 27 cm in diameter to 36 cm in diameter. These sizes cook well on this stove. Sizes out of this range will not cook as effectively as ones within this range.
- The Envirofit is able to accommodate Ugandan portions for approximately 10 people, thus households that regularly cook for more than 8 people should not be focused on in this study.
- Paper, dry grass, and dry banana leaves can be used to start the fire.
- Our training will include encouraging using dry firewood to minimize smoke and increase fuel efficiency.
- Over-feeding wood into the stove should be avoided as this will decrease the efficiency of the cookstove.

- The ashes from the stove should always be emptied when finished cooking to avoid ware on the cookstove.
- It is important to keep the stove as dry as much as possible to avoid ware and rust. Never pour water into the cookstove as this will decrease the life of it.
- Cooks should clean the outside of the cookstove daily with a wet towel and then dry it to properly maintain and improve the life of the stove.
- For cooking foods that take a long time, larger pieces of wood are recommended to avoid wasted time in constant feeding of the fire.
- Cooks should allow the cookstove time to cool before moving it.

## Outcomes

In order to address the key behavior change aspects of shifting users from cooking on a three-stone fire to the Envirofit fuel-efficient new stove, the team has spent significant time understanding how to train users to maximize results with their stoves. Integral to the design of this research program the team will provide additional group level training to households in all parishes to ensure optimal usage of the Envirofit stove by reviewing with participants the key maintenance instructions outlined above.

## 4. Comparison of Users' Experiences with Four Fuel Efficient Cookstoves

As part of our feasibility design we loaned out four of each type of the improved stove being considered for four months, from late October to late February. Box 1 describes some feedback the team received about households' experience using these stoves

### *Box 1: Household's Stories Related to Cooking<sup>12</sup>*

Mary was randomly selected to try two Envirofit stoves in tandem. She told the team that without the improved stoves, it would be difficult to prepare meals due to the scarcity of firewood. She told us that the same amount of fuel she would use previously cooking on the three-stone fire would last one week but now this lasts her an entire month when cooking on the Envirofits. Mary's husband told us he was content about the two Envirofit cookstoves particularly because it allowed his wife to breathe in less smoke from the three-stone fire.

Jessica said that she liked the fuel-efficient cookstove because it elevated her social status and her neighbors were envious. She says the stove cooks fast and uses such little wood, she now has the rest of the time, as well as enough energy for her other responsibilities. She noted that recently she had a sick child in the hospital and she did not need to buy food since she could easily carry the stove in a bag and then cook from the hospital.

Betty told us the Envirofit maintains cleanliness and helps keep her beautiful. She said that she appreciates the reduction of the smoke and has experienced less health issues such as runny nose or red eyes from cooking since cooking with the Envirofit. She said that the Envirofit also cooks much faster, including cooking dry beans.

Sally said that the Envirofit helps her a lot more than the three-stone because it gives her an opportunity to do other activities like cleaning the house, weeding, or working on the farm. She said that when it rains, the rain water drops in her kitchen and onto the three-stone fire since they are fixed in one position, but the Envirofit is portable and she can lift it to a place where the rain is not dropping.

<sup>12</sup> The actual names of the women referred to in Box 1 have been replaced with fake names for confidentiality purposes.

## A. The Experience of Owning Two Envirofit Stoves

### Methods

As noted above, many cooks in Mbarara use two three-stone fires concurrently to cook the different components of each meal, or to cook dinner at the same time as lunch. Consistent with the focus group reports, in the households where the team placed just one Envirofit, the majority of households used the Envirofit concurrently with a three-stone fire (see Section 8: Optimal SUM Placement).

In the feasibility stage, the team gave one household two Envirofit stoves and measured usage to see if the household was able to completely replace the three-stone fire (except on special occasions), which is one of our goals in our intervention. This household regularly cooks for six people and prior to our intervention used two three-stone fires.

### Results

Two weeks after giving the household two Envirofit stoves and after installing stove usage monitors on both the Envirofits and the two traditional stoves, the team visited the household to determine usage. The household had dismantled the three-stone fires and no longer used them. The household was only using the two Envirofits. The mother, who is the main cook, successfully trained her children to use the Envirofits, so when she is away they are still able to cook using only the Envirofits.

### Options to provide a second cooking point

Having two cooking points is essential to transition most women away from regular use of three-stone fires. Given most households use two cooking points at each meal, the best way of replacing both cooking points is with two fuel-efficient new stoves or one new stove with two burners.

We field tested the two-burner Envirofit with chimney stove during the feasibility stage. Unfortunately, users who tried this stove did not like it. The main concern users had with the two-burner Envirofit with Chimney was durability- particularly a perception that the two-burner attachment and chimney was not durable. After 10 days in the field, the top of one of the burners had begun to rust (see figure 2). In addition, the second burner does not receive as much heat as the first burner and cannot boil water. Thus, households with the Envirofit with chimney concluded the functionality of the second burner is limited and cannot replace a second fire.

Reducing indoor air pollution substantially requires that the chimney extend outside the kitchen.



Figure 2: Burner Attachment for Envirofit Stove

Unfortunately, the chimney on the Envirofit with chimney is short and would require additional material to extend it outside of the kitchen. This would require puncturing a hole in the kitchen wall or roof. Given, the Envirofit stove with chimney costs twice as much as the Envirofit without chimney, the additional costs to install a chimney would make the stove about three times as expensive and require additional maintenance. In addition, we fear an installed chimney would be fragile when bumped by children and other family members. The substantial additional costs required to install the chimney, the limited functionality of the second burner, and our concerns about durability of the two burner stove attachment have led

us to conclude the two-burner Envirofit is not the best choice for our study.

As we are interested in determining if fuel-efficient stoves can substantially reduce concentrations of particulate matter and indoor air pollution, we still want to find a product that can almost entirely replace the three-stone fire. Thus, for RCT 3: Measuring the Effects of the Envirofit on Indoor Air Pollution concentrations and Fuel use we decided to test the effect of providing two fuel-efficient new stoves. With two Envirofit stoves we hope to have the best opportunity to transfer the majority of cooking from three-stone fires to ICS, and thus observe the largest effects on wood use, time spent collecting fuel, and kitchen level concentrations of indoor air pollution.

## 5. Marketing Messages

### Method

The goal of research on marketing messages is to determine what information (if any) can increase willingness to pay for an improved cookstove. In our feasibility stage, the team tested three messages including the fuel-efficient new cookstove can: 1). improve health by reducing kitchen level concentrations of indoor air pollution, 2). save time and money, and 3. is aspirational, modern or of high status. Based on these results, the team will use the two most effective messages in RCT 1.

Each of these marketing messages was designed specifically for the Envirofit stove in the local setting in rural Mbarara and was a collaborative effort between the Uganda-based research team- CIRCODU- and the wider U.S. based research team<sup>13</sup>. A variety of key feedback already mentioned fed into the formation of the marketing messages including women's likes and dislikes of cooking, common cooking practices, and qualities that women enjoyed from testing the fuel-efficient new stove. To further inform the marketing messages, the qualitative researcher asked eight households what in their view were the top three development issues facing communities in Mbarara. The main concern voiced was increasing income generating activities and improving livelihoods. As improved cookstoves can save households about 50% of the wood used for cooking, the fuel-efficient new cookstove save time and money message was designed specifically to reflect the fact that fuel savings will increase households livelihoods and reduce expenditure. The marketing messages designed for this program are in Appendix 2.

To determine the effectiveness of these messages, the team held six additional focus groups with a total of 66 participants. In each focus group the team randomized the order of messages delivered and at the end of all 3 messages the team asked each person individually to rank the messages in order of importance in motivating themselves to want to purchase an Envirofit. The team used posters to explain all three messages and the team referenced back to them to ensure that each person remembered each individual message before ranking them.

### Results

Each participant ranked the messages in order of preference, where 3 points indicated the highest ranking, 2 for second, and 1 for lowest ranking. Table 8 shows the two top messages were saves time and money, and health.

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<sup>13</sup> Particularly key contributors were Juliet Kyayesimira the Research Supervisor of CIRCODU, Moreen Akankunda the Qualitative Researcher of CIRCODU, Dr. Theresa Beltramo the Principal Investigator, Dr. David I. Levine the Co-Principal Investigator, Stephen Harrell the Research Assistant, and Dr. Garrick Blalock, Research partner.

Table 8: Marketing Message Rankings



### Outcomes

As a result of the outcome of our field testing and focus groups, we will use the saves time and money message and health message for RCT 1.

## 6. SUMs Optimal Placement

### A. Optimal SUM placement in a traditional three-stone fire

#### Method

Part of our study measuring behavior change and adoption of the Envirofit stove involves measuring quantitative stove usage of both the traditional stoves alongside the Envirofits. To measure usage the team is using ibutton temperature sensors (referred to as Stove Usage Monitors, or SUMs) that are placed in stove usage holders. To determine optimal placement of the SUM in the three-stone-fire the team experimented with placement based on the following criteria:

- the variable temperature when cooking is clearly detectable;
- the temperature when cooking does not exceed 85 degrees Celsius (the SUM's maximum);
- the SUM does not interfere in any way with cooking with the stove;
- the SUM is in a location where children are unlikely to remove it.



Based on consultations with Dr. Kirk R. Smith and his team's recent innovation of a traditional SUM holder (see Figure 3), the team experimented with this pre-existing SUM holder design and adopted the design to best fit with the local setting. The traditional SUM holder is made of stainless steel and conducts heat from the fire while shielding the SUM from extreme temperatures.

Figure 3: Traditional SUM Holder copyright of Kirk Smith's lab used in Mexico study

In October and November of 2011, the team placed multiple SUMs in diverse positions around three-stone fires in households where the team lent out the Envirofit stoves. In October the team installed 15 SUMs in six households for a period of two weeks and in November the team installed 14 SUMs in seven different households for three weeks. The goal of the experimentation was to assess whether

one of the three stones was better for SUM placement and if burying the SUMs at different depths had any effect on data collection.

## Outcomes

Relatively more SUMs suffered damage from heat exposure in the three week trials in November-6/14, while 5/15 were damaged in the two week trials in October. This could suggest that prolonged use causes the SUMs to get damaged at higher rates. However given the SUMs were placed in similar locations in the three stone fire, after observing women cooking it seems more likely that heat damage is due to the placement of firewood and where it burns. Because of diversity of how women feed the fire, the research team concluded that no one of the three stones were better for placement and all three stones seem to be equally effective in placement of the SUMs.

Exact placement of firewood and where it burns is not possible to regulate because this varies each time a meal is cooked, so it is best to place multiple SUMs on each stove (whenever possible) to ensure that the team have data on each stove. In addition, the team concluded it is best to place the SUMs below stones and bury them in a few centimeters of ash as this proves to be beneficial in helping maintain temperatures that are below 85 degrees Celsius while providing accurate temperature readings which reflect usage.

The team attempted to place SUMs on mud stoves, which are found in some households in Mbarara, but were not able to find a way of doing it without damaging the mud stove (by putting a hole in it to place the SUM), or without burning the SUM by having it too close to the fire, or without having the SUM impede fueling the stove. Thus, we will not measure usage with SUMs of mud stoves. We will measure usage of other traditional stoves, such as charcoal or mud stoves, in our measurement households for RCT 3 by proxy through observation at each of the ~22 household visits throughout the six month initiative.

Finally, the team experimented with diverse placement of the SUM. The placement of the SUM on the ceiling of the cooking hut yields a similar temperature distribution as placing a SUM under a stone. However, placing the SUMs on the ceiling of the kitchen will not work for data collection for RCT 3 because it could measure heat from both the improved stove as well as the three-stone fire. Given these results, the research team will install two SUMs on each three-stone fire alongside SUMs on the Envirofit stoves for RCT 3.

## B. Results from SUM Usage in 28 households

### Outcomes

All the households where the team placed the SUMs on three-stones fires also received an Envirofit stove to try. This data has been analyzed to provide insight into three-stone fire usage in households which have one Envirofit stove. The team did not have SUMs attached to the Envirofits, so we only have data on the three-stone fire usage. Half of the households (3/6) used a three-stone fire approximately once a day or more. The other half of households (3/6) used a three-stone fire between 33-44% of the days, despite having an Envirofit. For one household, a random sampling of four days shows she used the three-stone fire daily-cooking breakfast half the time, and lunch and dinner 75% of the time on the three-stone fire.

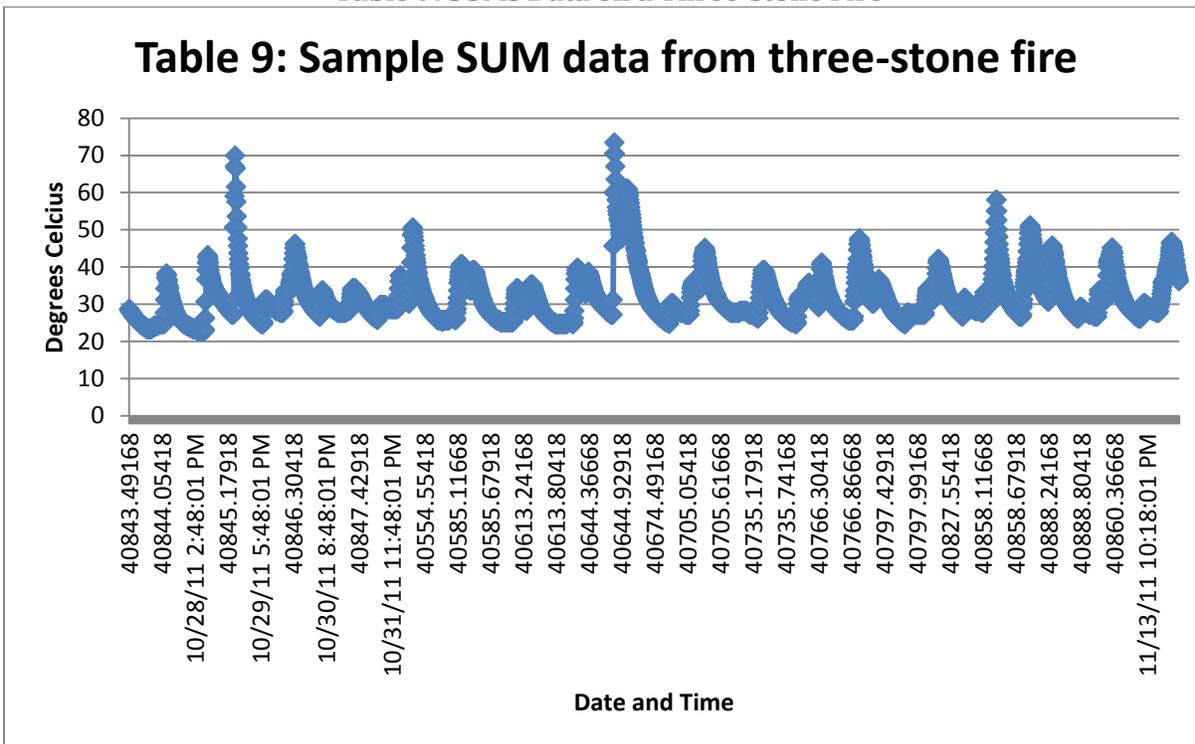
Figure 9 is an example of the SUM data from a three stone-fire in our sample.<sup>14</sup> For RCT 3 an event of actual usage and a temperature floor will be established building on methodology established in Beltramo and Levine (2010). To establish local temperatures, in at least one home in each parish a SUM will be set in an area of the kitchen which is not used for cooking. The goal is to establish a local temperature inside the kitchen away from the fire. Based on the indications for air temperature several possible temperature floors will be

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<sup>14</sup> Additional data are available from the authors.

tested by analyzing the entire data set and the variation of the number of events between ceilings. The team will also vet the methodology by Ilse Mercado-Ruiz who in joint research with Dr. Kirk R. Smith designed the traditional SUM holder and is an expert in measuring stove usage with SUMs.

**Table 9: SUMs Data on a Three-stone Fire**



**C. Optimal SUM placement on the Envirofit Stove**

From December 2011 to January 2012 the team tested different placements of SUMs on the Envirofit stove to determine the optimal placement based on the following criteria:

- the temperature is detectable but does not exceed 85 degrees Celsius (the SUM’s maximum);
- the SUM is securely attached to the stove so that it will not fall off;
- the SUM does not interfere with cooking with the stove or transportation of it;
- the SUM is in a position that it is difficult for children to remove it.

The team designed a metallic improved stove holder to decrease heat exposure which ties around the stove using a copper wire to secure it. After experimenting with several positions (see Appendix 6), position 2 and 3 were deemed the best, as temperatures did not exceed 70 and 50 degrees Celsius, respectively. Position 1 and 4 had temperatures that exceeded 80 degree Celsius. Position 5 had such high temperatures that the SUM was damaged and the team could not get and data from it.

It was established that the best place to install the SUM and it holder is on the lower, back side of the Envirofit stove (see position 3, Appendix 6) as this location showed temperatures that did not exceed 50 degrees Celsius, which will decrease the likelihood of the SUM getting damaged from exposure to excessive heat, and registered clear stove usage events. Further, this location also does not interfere with using the Envirofit stove.



To test and refine the installation protocol and data collection procedures, the team placed PM Monitors in 8 households for a 24 hour period. While visiting the households, the team observed that of the eight households, five households were using only three-stone fires to cook, two households were using both the Envirofit and a three-stone fire, and one household was using just the Envirofit stove. The equipment was set at a logging interval of one minute for the sampling period of 24 hours. All the PM monitors functioned correctly during the field trials and data collected was consistent with previous researchers' samples of PM concentrations.

## Results

The main result from field trials with the PM Monitor was to establish the Particulate Matter Monitor Protocol, attached below in Appendix 7. In addition, household visits reinforced the need for two cooking points on the ICS in order to replace three-stone fire use substantially.

## 8. Kitchen Performance Test

### Method

To measure the reduction in fuel consumption due to usage of the Envirofit stove, the team will perform a kitchen performance test (KPT). For a KPT, the method used is to weigh all the fuel types that the household is planning to use in the next 24 hrs. On the first visit, the fuel is weighed, and the time of the visit to the household is noted. On the second visit (after 24 hours has passed), the unused fuel is weighed and the foods prepared during the last 24hrs plus the number of people cooked for is also recorded. Then the new fuel that will be used in the next 24hrs is weighed. Table 11 summarizes the results from households.

**Table 11: Results from four Households where KPTs were conducted**

Household Name	Type of stove	Average Fuel consumption per stove per day (kg)	Total Average for All Stoves of fuel consumption per day (kg)	Foods prepared	Average # of people cooked for
HHId 15	3-stone	4.7	8.75	Milk, mushrooms, matooke, and beans	9
	Envirofit	4.05		Milk, Matooke, and Beans	
HHId 17	Two Envirofits	3.4	3.24	Millet Porridge, Beans, Matooke, Cassava and Potatoes	8
HHId 18	Envirofit	7.3	7.3	Porridge, Beans Cassava, milk, Greens, and stiff porridge	6

## Results

The design of the protocol and data collection methods for conducting the KPT to be used during RCT 3 is outlined in appendix 8.

## 9. Pre-testing S1: Demand Determinants for purchase of an ICS

### Method & Results

During the six focus groups where the team tested our marketing messages, we asked a few questions related to wealth in order to determine what factors best predict the likelihood of someone buying an improved cookstove.<sup>17</sup>

The results of these questions from the 66 households are summarized in Tables 12-15. On average 21% of the population own a television, 30% own cows, 52% own a bicycle, 45% own chickens, and 41% own a mobile phone. In addition, 6% have electricity, 50% have

	TV	Cow	Bicycle	Motorcycle	Poultry	Phone
# of Households	14	20 (30%)	34	18 (27%)	30 (45%)	41
Owning the Item (% of HHs)	(21%)	(range: 1 – 20 cows per HH)	(52%)		(range: 1 – 150 poultry per HH)	(62%)

kerosene candles, 53% own a lamp, 6% own some type of solar-powered light, and 9% use wax candles. Some 83% of women earned income vs. 56% of their husbands. In addition, 11% of

	Electricity	Kerosene Candles	Lamp	Solar	Wax Candles
# of HHs With Type of Lighting (% of HHs)*	4 (6%)	33 (50%)	35 (53%)	4 (6%)	6 (9%)

\*Some respondents answered with more than one source of lighting, so percentages add up to more than 100%.

children also earn income for these households. For women who work, 84% work in farming, 22% own small businesses and 2% teach.

	Husband	Wife	Children
Person in HH earning income (% of HHs)	37 (56%)	55 (83%)	7 (11%)

<sup>17</sup> Appendix 9 is a full list of question pre-tested.

**Table 15: Demand Determinants 4**

	Farming	Small Business	Teaching
If Wife earns own income, from what type of work? (% of income earning women)*	46 (84%)	12 (22%)	1 (2%)

\*Some women had multiple sources of income (e.g. farming and small business), so percentages should add up to more than 100%.

Based on these results, the team decided to include these questions in our demand determinants survey for all of our RCTs including:

1. household items owned (tv, motorcycle, bicycle, number of cows);
2. whether woman own a mobile phone; and
3. Whether woman earn their own income.

Because the team is constrained to surveys which last about 5 minutes, these few questions are likely to best predict demand determinants which influence a participant’s decision to purchase an improved stove and their willingness to pay for one.

## 10. Lessons Learned from Other Research

### Method

To refine our study design the team studied other ongoing and recent research on behavior change and adoption of fuel-efficient improved cookstoves.<sup>18</sup> In addition, we consulted with other colleagues including Dr. Kirk R. Smith, Dr. Garrick Blalock, and colleagues from Berkeley Air Monitoring Group; presented the study design to the USAID TRAction Technical Advisory Group and other grant awardees for feedback in October, 2011; and consulted with local practitioners in Uganda with experience selling improved stoves and other modern technology products during the multi-stakeholder workshop jointly held with PATH in Kampala in November, 2011.

### Results

Based on best practice from existing research and practitioners, the following lessons learned were incorporated:

- Following Victor (2011), the team considered different social implications of the use of the traditional three-stone fire in society. As suggested in previous research, we found out that in our study zone in rural Mbarara some households listed their three-stone fire as being used for providing warmth and light at night. Understanding the other uses of a three-stone fire, lead us to believe that it is unrealistic to expect the Envirofit stove to be used for the purpose of social gatherings or providing light.
- In our study design, like Victor (2011) we carefully considered the complexity of behavioral change necessary in using an improved cookstove such as the Envirofit. In particular, after recognizing that the Envirofit requires the behavior change of chopping wood, we have built in training on explaining the

<sup>18</sup> Relevant literature reviewed includes: Victor. 2011. “Sustaining Culture with Sustainable Stoves”; Miller and Mobarak. 2011. “Intra-Household Externalities and Low Demand for a New Technology”; CEIHD, 2005. “Installing Indoor Air Pollution Instruments in a Home”; Smith *et. al.*, 2007. “Design Considerations for Field Studies of Changes in Indoor Air Pollution Due to Improved Stoves”; Ruiz-Mercado and Smith. 2011. “Adoption and Sustained Use of Improved Cookstoves”; and D. Still *et. al.* 2012. “An affordable, effective method for decreasing indoor air pollution in kitchens.”

importance of chopping the firewood into smaller pieces and then not over-filling the chamber as these are not common practices for Ugandans.

- Following Miller and Mobarak (2011) and Victor (2011), we have incorporated the idea of including husbands in the decision making process of purchasing the improved cookstove. Because the decision making power often lies with the husband and not just the wife, the team will encourage the husbands to attend our sales meetings. We also include several questions attempting to measure intra-household bargaining power and whether women have their own income.
- Similar to Miller and Mobarak, the team is testing the impact of a health marketing message on willingness to pay.
- The team has closely followed CEIHD (2005)'s recommendations on placement of Particulate Matter Monitors (see Appendix 7).
- Following Smith *et. al.*, (2007) "Design Considerations for Field Studies of Changes in Indoor Air Pollution Due to Improved Stoves", we have ensured that our sample size is statistically powered to measure changes in indoor air pollution due to our stove intervention and not due to other environmental or external factors. The power calculations for sample size related to our PM sample benefitted from discussions with both Dr. Kirk R. Smith and David Pennise.
- Following Ruiz Mercato and Smith (2011), the team is focusing on measuring usage patterns over time. In particular, we are conducting a sub-study on measuring long-term usage over nine months of stove ownership, as well as RCT 3 which will measure stove usage of all household stoves over the first six months of stove ownership. In addition, the design of the traditional stove SUM holder was designed based on the holder provided by Kirk Smith.
- Following Dean Still *et. al* (2012), we will include questions aimed at understanding air flow and related to kitchen design including the measurement of windows and doors to better understand the amount of air flow inside a kitchen. We will include size of window and door in our regression analysis to understand if there is a causal relationship between a proxy for air flow and kitchen level emissions of PM.

## Conclusion

After a thorough review of 16 districts in both the Central and Western regions of Uganda, the Mbarara district is the best choice based on the project criteria. Compared to the central region, the four districts visited in the southwest region have substantially less firewood, which translates into households spending more time gathering firewood and a higher percentage buying firewood. The bulk of the rural population primarily use wood for cooking and there are no recent or ongoing widespread improved cookstove programs in the area. In addition, the majority of households have an enclosed kitchen and thus are expected to benefit more from the emissions reductions associated with the introduction of an improved cookstove(s).

From our focus group participants in our test parishes in Mbarara we learned that 65% of participants in all three of our focus groups have at least one three-stone fire. Of those who use a three-stone fire, 70% have more than one three-stone fire. Of those who used wood last week, 50% bought wood while 50% collected wood. From past research, people's time is likely to have less value than value associated with spending money. The finding that of those households which use wood, half of them purchase wood will likely increase a households willingness to pay and acceptance of purchasing the fuel efficient cookstove.

The high usage of a second three-stone fire of those who cook on three-stone fires is an important signal for our initiative- households use more than one stove to cook because some cook lunch and dinner at the same time and/or they need two burners to make the main lunch and dinner meals. As we are interested

in determining if fuel-efficient stoves can substantially reduce concentrations of particulate matter and indoor air pollution, we want to find a product that can almost entirely replace the three-stone fire. Thus, for RCT 3: Measuring the Effects of the Envirofit on Indoor Air Pollution concentrations and Fuel use we decided to test the effect of providing two fuel-efficient new stoves. With two Envirofit G-3300 stoves we hope to have the best opportunity to transfer the majority of cooking from three-stone fires to the improved cookstoves, and thus observe the largest effects on wood use, time spent collecting fuel, and kitchen level concentrations of indoor air pollution. While the results are far from conclusive, the one household who was given two Envirofits stoves to trial during our feasibility stage, completely shifted usage of cooking with the three-stone fires to the two Envirofits and reported wood lasted four times as long. These results, though not conclusive, are encouraging.

Based on careful field testing and trial of all four stoves, the Envirofit 3300 was chosen as the best fit for the majority of the population. The team has developed best practice for usage and care of the Envirofit stove and will include these messages in our sales meetings and follow-on training. The team has incorporated the women's dislikes of cooking into our marketing messages and designed marketing messages specific to the local population.

As our initiative is focused on behavior change and correct usage of the Envirofit, we have identified several potential obstacles to adoption of the ICS. From our focus groups, current cooking practices show women spend an average five to six hours cooking the main meal lunch. Part of this time the cook is able to do other activities, as the preparation does not require constant attention. The Envirofit stove requires less time for cooking, but more attention during cooking. This increased attention requires a behavior change to give more constant attention when cooking. To ensure women understand the tradeoff we highlight in our marketing messages that the new stove requires more concentrated attention but cooks meals in a much shorter time, thus giving households more time they are not cooking.

We also noted that during the group discussions with villagers at the town hall meeting, there was a male bias that women were 'made to cook' and some men expressed a limited desire to spend money on a fuel-efficient new stove. It also became apparent that the downside of these fuel-efficient new stoves was that they required fuel preparation by chopping large pieces of wood into small ones, a task typically done by the man. Following Miller and Mobarak (2011) and Victor (2011), we have incorporated the idea of including husbands in the decision making process of purchasing the improved cookstove. Because the decision making power often lies with the husband and not just the wife, the team will encourage the husbands to attend our sales meetings. We also include several questions attempting to measure intra-household bargaining power and whether women have their own income to test if either of these measures affect purchase decisions.

In addition, SUMs, PM Monitor, and KPT protocol have been successfully developed through testing out the methods on households in Mbarara. We also field tested our surveys to ensure questions were locally appropriate and understood. Finally, the team took the opportunity to learn from other researchers and have tried to incorporate best practice and ideas and lessons learned.

The feasibility stage has been instrumental in finalizing our study design. The team will continue to improve our study design as the team learns more with each study.

## Appendices

### Appendix 1: Discussion Guide for Focus Group

#### Focus Group Procedure

**ALL INSTRUCTIONS ARE IN UPPER CASE AND BOLD.**

**TAKE WITH US NEW STOVES AND IN ORDER TO REMOVE BIAS OF STOVES, DO A UNIFORM PACKAGING. UPON ARRIVAL LEAVE STOVES IN COMMON BOX AND BEGIN CHOPPING/PREPARING FUELS.**

#### Introductory speech

“Good day, the team would like to thank you for coming today to this meeting. My name is Juliet Kyayesimira and I work at CIRCODU and these are my colleagues from CIRCODU: Michael, Fred, and Moreen. Our American colleagues Theresa and Steve are from a University. Today the team will talk to you about how you cook. The information you share with us today is very important because you will help us to determine which improved cookstove is the right fit for families here in Mbarara. It is important that throughout this meeting you share with us your thoughts about the cookstoves that the team presents to you. Please do let us know what you think, whether positive or negative comments. Do keep in mind this is not a test, there are no right or wrong answers. When the team asks you a question, think about what you would tell a good friend and share it with us. Your input today will inform our work here in Mbarara, other regions in Uganda, and other countries in East Africa. Thank you in advance for your cooperation. If you have any questions, please feel free to ask them now or to ask them later on during the meeting directly to my colleagues or to me. Do you have any questions?”

COUNT THE NUMBER OF WOMEN PRESENT \_\_\_\_\_

**I. INTRODUCTORY QUESTIONS – ASK EACH WOMAN TO SAY HER NAME, FAMILY NAME, PHONE NUMBER, AND RECORD ON ROSTER. THEN HAVE EACH MEMBER OF THE TEAM FOLLOW 1-2 WOMEN EACH FOR THE TALLY OF THEIR RESPONSES TO THE QUESTIONS BELOW.**

1. Amongst you, who personally cooked lunch yesterday?
  - a. Did other people help you cook lunch yesterday? Who helped you?
  - b. How many people did you cook lunch for yesterday?
  - c. Did you cook dinner at the same time as lunch yesterday?
2. What fuel do you use in your home to cook? Please raise your hand for each fuel you use.
  - a. How many use Wood or twigs? Charcoal? Gas? Animal dung? Kerosine/paraffin? Farm scraps – dried banana leaves, grass, maize stalks, maize cobs, cassava stems, matooke, or sawdust.
3. Which fuel do you use most of the time when you cook? Raise your hand for which fuel you use most commonly.
4. How many different cookstoves does your household own? No. of 3 stone fires, no. of other wood-burning stoves, no. of charcoal-burning stoves, no. of gas stoves, and no. of electric stoves?

5. How many of you bought wood last week?
6. How many of you collected wood last week?

## **II. BREAK INTO SMALL GROUPS**

**READ** “Now that the team has talked about which stoves and fuels you use, we would like to talk more about your experience cooking on a daily basis. Please break into two groups.”

**SMALL GROUP LEADERS- SELECT TWO WOMEN (NOT THE FOCAL POINT PERSON) AND TAKE NOTES. LISTEN TO ONE WOMAN AT A TIME.**

7. Can you tell me about lunch yesterday and what time you started cooking, how long it took, and can you walk us through how you prepared the lunch meal from start to finish?
  - a. What meal did you cook yesterday?
  - b. How many different stoves did you use to cook it?
  - c. How many different pans did you use to cook lunch?

**REPEAT BACK- I HEARD YOU SAY YOU HAD THE FOLLOWING XX STEPS:** 1. Chopping; 2. Boiling; 3. Frying; 4. Steaming. Etc. **(FOR EACH OF THE TWO WOMEN)**

8. Likes/Dislikes about cooking.
  - a. Do you enjoy cooking? What aspects do you like about cooking?
  - b. What kind of problems do you have when you cook?

## **III. BRING BACK TO A LARGE GROUP**

**READ** “You were talking about cooking and what you do not like about it. The team is here to tell you about several cookstoves which use less firewood, emit less smoke, cook faster, and are more environmentally friendly.”

9. “Are you familiar with any such stoves?” **SHOW OF HANDS.**

“We will now explain to you about four such stoves and then the team shall do a cooking demonstration on all of them.”

“Each of the four stoves I am going to talk about today have these key features: shorten time cooking, use less fuel to cook the same meal as your three-stone fire, and improve your health by reducing harmful smoke which will make you and your children cough less.”

**TEAM TAKES OUT FIRST STOVE NOW**

**The Jiko Poa**



1. Cooks for 15 people
2. Cuts time cooking by 1/3
3. Cuts fuel use by 39% - **SHOW VISUAL TWO OF SIX STICKS REMOVED**
4. Cuts smoke by 1/3
5. It has two cook skirts that help to retain heat when cooking. They also help to hold the saucepans in place in order to help make cooking efficient and convenient.
6. The sturdy wood handles that do not get hot make it easy to move the stove even when it is hot and the steady feet minimize the risk of accidents when cooking.
7. The metallic wood support helps hold the firewood in place to avoid wastage.
8. It will last at least three years.

**SMALL GROUPS:** “Please can you now tell us in your small groups what is the number one reason you would want to buy this stove? What are the top three reasons you would like to buy this stove? Do you have any concerns about this stove?”

### The EcoZoom



1. Cooks for 6-8 people
2. Cuts time cooking by 1/3
3. Cuts fuel use more by 40% - **SHOW VISUAL TWO OF SIX STICKS REMOVED**
4. Cuts smoke by more than half
5. It is relatively durable and has a reinforced metal doorframe
6. It has a cast iron stove top that is compatible with large and small flat bottom pots
7. The metallic fire wood support helps hold the firewood in place
8. It lasts more than three years

**SMALL GROUPS:** “Please can you now tell us in your small groups: What is the number one reason you would want to buy this stove? What are the top 3 reasons you would like to buy this stove? Do you have any concerns about this stove?”

### The Envirofit



1. Cooks for 6-8 people
2. Cuts time cooking and fuel use by 50% - **SHOW VISUAL THREE OF SIX STICKS REMOVED**
3. Cuts smoke from cookstove in 1/2
4. Firewood support stand helps hold the firewood in place
5. It has a cast iron stove top that is compatible with large and small flat bottom pots
6. It has a ceramic plate to protect the floor of the stove
7. Lasts about five years

**SMALL GROUPS:** “Please can you now tell us in your small groups: What is the number one reason you would want to buy this stove? What are the top 3 reasons you would like to buy this stove? Do you have any concerns about this stove?”

### The Envirofit with Chimney



1. Cooks for 12-14 people
2. Cuts time cooking in half
3. Cuts fuel use more than 50% - **SHOW VISUAL THREE OF SIX STICKS REMOVED**
4. The double burner allows a household to use two pots at the same time
5. Firewood support stand helps hold the firewood in place
6. It has a cast iron stove top that is compatible with large and small flat bottom pots
7. It has a ceramic plate to protect the floor of the stove
8. Lasts about five years

**SMALL GROUPS:** “Please can you now tell us in your small groups what is the number one reason you would want to buy this stove? What are the top three reasons you would like to buy this stove? Do you have any concerns about this stove?”

“Now you have seen all four different stove models, the team would like to ask you to individually rate the stoves.”

1. Now you have heard about each of the four stoves and their quality, please tell us the following:
  - a. Which stove do you like the best?
  - b. Which stove do you like the worst?
  - c. Can you rank the stoves from favorite to least favorite?
  - d. Describe why you chose the XX stove as your favorite?
  - e. Describe why you chose the XX stove as your least favorite?

“You have shared with us your thoughts on the cookstoves and the team would like to thank you for this. Before concluding, the team would like to ask which of you would be interested in trying one of these stoves in your home. If you are interested tell your small group leader before you leave today. Do you have any questions?”

“The team thanks you for coming today to this meeting and taking the time to share your thoughts about cookstoves with us. The results of this meeting will help us understand which stove is the best stove to sell in Mbarara. The team will be offering you the opportunity to try one or more of our stoves in your home. In exchange the team would like to come to your house and talk to you about your thoughts on the stove and how you cook. The team appreciates all of your time today. Thank you again.”

## Appendix 2: Marketing Messages Scripts

### **INTRODUCE OURSELVES AND HAVE THEM INTRODUCE THEMSELVES.**

“Today the team is going to present to you three different messages on how this improved cookstove will benefit you and after presenting all three messages, the team wants to ask you which of these messages would motivate you most to buy the stove.”

### **Message: The high status of “Comfortable, Clean and Beautiful!”**

“Hello, we are here today to talk about a problem that all of us women face in cooking. We all want to be beautiful, clean, and comfortable. We all are African Queens in our own homes, are we not?” **SHOW PICTURE OF AN AFRICAN QUEEN.**

*African Queen*



“But a smoky cook fire messes this up. How does a smoky cook fire stop us from being the kind of women we want to be?”

**ASK THE WOMEN TO STATE THE PROBLEMS AND RECORD THE RESPONSES.**

- It is impossible to stay clean
- Clothes get soot on them and are dirty
- Smoke on clothes smells bad
- Eye irritation
- Runny nose
- Coughing
- By the time you finish cooking you feel dizzy

**SHOW PICTURES OF THESE PROBLEMS ASSOCIATED WITH COOKING.**

*Can't stay clean, gets soot on clothes, and causes bad smell.*



***Irritated eyes***



Inflamed or irritated conjunctiva

***Runny nose***



***Coughing***



“These issues will greatly decrease by using this energy efficient cookstove. **SHOW ENERGY EFFICIENT COOKSTOVE.** Less smoke will be produced, which will cause your eyes to be less irritated, less soot will be on your clothes, you’ll be cleaner, you won’t have a runny nose as often, you’ll cough less, and your clothes will smell less like smoke. You will be able to look more like the African Queens whom you already are. **SHOW PICTURE OF AN AFRICAN QUEEN.**”

“Question: What will people think if they see you using this stove? How would it make you feel to use this stove?”

“You can sit outside while the stove is cooking, and no one will see smoke or even know you are cooking because of the following:”

- you won’t have irritated eyes
- you’ll be cleaner
- less soot will be on your clothes
- you won’t have a runny nose as often
- you won’t cough as much
- your clothes will smell less like smoke

“Would you like to have a cleaner appearance and kitchen? This stove will help you with this.”

**IF HUSBANDS ARE PRESENT** “Husbands, don’t you prefer your wife to look like the African Queen whom she is? Invest in your wife’s true beauty!”

### **Message: Saves Time and Money**

“Who gathers wood and who buys firewood? Who does both? This improved stove uses only half the amount of wood compared to the three-stone fire. This will allow you to only spend half the amount of time gathering wood and / or half the amount of money spent on wood. This improved stove will allow you to have more time for other activities.”

### **DEMONSTRATE EFFICIENCY OF STOVE BY COOKING MILLET BREAD.**

“Can we get a volunteer to show us about how much wood they would use on the three-stone fire to cook this amount of millet bread?” **IF THE VOLUNTEER PICKS TOO LITTLE WOOD, ASK:** “Do others agree this is

enough wood? Let's see how much of this wood we use. Do you think this stove can cook this big pot of millet bread?" **DEMONSTRATE USING LARGE POT.** "Do you see how much wood is left?"

"As you saw in our demonstration of cooking millet bread, the team used about half as much wood as you would have needed for the three-stone fire and we were able to cook using that large pot. So, if you were to only use this improved cookstove, you would only need half as much wood each day."

**SHOW: HOLD OUT AN AVERAGE DAY'S WOOD NEEDED FOR THE IMPROVED STOVE VS. THE THREE-STONE FIRE.**

"Here is about how much wood you would use with the three-stone fire in one day. Is this correct?" **SHOW PICTURE OF WOMAN COOKING ON A THREE-STONE FIRE.**

**Three-stone fire uses a lot of wood.**



**REMOVE HALF OF THE WOOD.**

"Now this is how much wood you would need to use with the improved stove."

**Time Savings – Only if people in group gather wood**

"The team would like to ask you some questions for you to ponder, which are of great importance to you personally. We would like you to just think about them without giving us responses."

- "Have you ever had something valuable to do with your time, but you had to collect wood or other fuel for cooking?"
- "If you were to save a few hours a week by gathering less wood, could you use this time to do something to make money like working more in your gardens or businesses? If so, then the time you saved in collecting fuel will not only save you time, but could be used to make money."
- "Would you like to see your children have more time to study and play instead of spending so much time collecting wood?"
- "Do you ever get upset or bothered by the amount of time you spend collecting wood and cooking?"
- "Have you ever wanted to figure out a way to avoid spending so much time collecting wood and cooking?"
- **IF MEN ARE PRESENT**, "Men, are there important things that you would like your wife to do if she had an extra few hours a week?"
- "Yes? Then clearly this new stove can help you. This stove will help you save time to allow you to do the things that you care most about."

“Since you only need to use half as much wood, you only have to spend half the amount of time gathering wood. Everyone varies, but here is one example of how much time one family in Mbarara spends on gathering wood.” **WRITE DOWN NUMBERS FOR THE WOMEN TO SEE AS YOU TELL THE STORY.**

“In one family, the mother and two children gather wood. The mother collects wood once a week for about 4 hours and the two children collect wood both on Saturday and Sunday for 4 hours each day. This means that the family spends 20 hours a week, 80 hours a month, and 960 hours a year gathering wood. With the improved stove, the family now only has to spend half of that amount of time, so they would spend only 10 hours a week, 40 hours a month, and 480 hours a year gathering wood. This could also mean that the mother would never have to gather wood and the two children would only have to each spend 5 hours a week gathering wood. Now the mother has more time for other responsibilities and the children have more time to study and be attentive to school.” **SHOW PICTURES OF CHILDREN GATHERING WOOD AND COOKING VS. SAVING TIME.**

**Children spend a lot of time gathering wood and cooking.**



**Children could be spending more time studying and being attentive in class.**



## **Money Savings**

“For those of you that buy firewood, does anyone buy bundles of wood? Does anyone buy trees?”

**IF SOMEONE WHO BUYS WOOD BUNDLES IS PRESENT:**

“Everyone varies, but here is one example of how much money one family in Mbarara spends on bundles of wood.” **WRITE DOWN NUMBERS FOR THE WOMEN TO SEE AS YOU TELL THE STORY.**

“One family buys one bundle of wood for about 2,000 UGX. That bundle lasts them for one day, so they have to spend 14,000 UGX per week, 56,000 UGX per month, and 672,000 UGX per year. Since they spend 56,000 UGX per month on firewood, they now will only spend half of that amount per month, which is just 28,000 UGX per month. Using the improved stove will enable this household to save 336,000 UGX per year.”

**IF SOMEONE WHO BUYS TREES IS PRESENT:**

“Everyone varies, but here is one example of how much money one family in Mbarara spends on buying trees for firewood.” **WRITE DOWN NUMBERS FOR THE WOMEN TO SEE AS YOU TELL THE STORY.**

“One family buys a tree for about 12,000 UGX. It costs them 5,000 UGX to have it split and then an additional 3,000 UGX to transport it back to their house. This tree last about one month, so this house spends a total of 20,000 UGX per month on firewood, and 240,000 UGX per year. Since they spend 20,000 UGX per month on firewood, they now will only spend half of that amount per month, which is just 10,000 UGX per month. Using the improved stove will enable this household to save 120,000 UGX per year.”

**Message: Health**

“Have you ever heard of anyone going to the hospital because of breathing or lung problems? What was the problem? Has anyone in your family gone to the hospital from breathing problems?” **ASK FOR RESPONSES TO THESE QUESTIONS.**

“When you cook does it make you cough from breathing in the smoke from the cook fire? Do you feel light-headed or dizzy? Do you ever get sore eyes or a sore throat from the smoke? That is because you are being poisoned! The most important cause of breathing problems around here is breathing in all the smoke from cook fires.” **ASK FOR RESPONSES TO THESE QUESTIONS.**

“Smoke from cooking kills the same number of children as malaria each year in Uganda.” **SHOW PICTURES OF SMOKER, PERSON COOKING, AND SMOKERS LUNGS VS. HEALTHY LUNGS.**

**Smoke from fire vs. smoke from cigarette**



## Pictures of smokers' lungs vs. healthy people's lungs

**Smoker's lungs**



**Non-smoker's lungs**

“Would you let your baby smoke a cigarette? Then why would you let your baby stay in a smoky kitchen? A smoky kitchen can have a very similar effect on the child’s health as if the child was smoking cigarettes.”  
**SHOW PICTURE OF BABY SMOKING.**

## Child smoking



“Our improved stove greatly reduces the poisonous smoke, which will greatly improve your health and give you more energy. Reducing smoke will also improve your children’s futures and help them to live healthier lives.”

“Even the Obama administration believes that cleaner stoves are so important that they have formed a global partnership to provide millions of clean-burning stoves like these to villages in Uganda and around the world.”  
**SHOW PICTURE OF OBAMA.**

**Obama**



**Ranking of Marketing Messages**

**Name:**

**Parish:**

**Village:**

**Phone contact:**

“Rank the three messages – “Comfortable, Clean, and Beautiful,” “Time and Money Savings,” or “Health,” in order of importance in motivating you to want to buy the improved stove. Why did you rank them in that order?” **TRY TO DETERMINE THE DIFFERENCE IN SIGNIFICANCE OF THE THREE MESSAGES TO EACH WOMAN.**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

“Would you be able to buy this stove if the team brought it to you next week at the price you heard?”

“Would you want to buy two stoves (not necessarily at double the cost)? If so, at what cost?”

**Appendix 3: Surveys – Current Drafts**

**Demand Determinants Survey**

**1:ENUMERATOR READS INFORMED CONSENT: Agrees to Informed Consent**

Possible responses:

- Yes
- No

**2:Color (multi)**

Possible responses:

- Pink
- Orange
- White
- Yellow

**3:Select household id. (multi)**

Possible responses:

- All letters

**4:Record respondent's gender**

Possible responses:

- Male
- Female

**5:Respondent's First Name (text)**

**6:Respondent's Last Name (text)**

**7:Are you known by other names? Oyine amazina agandi? (multi)**

Possible responses:

- Yes
- No

**8:What other names are you known by? (text)**

**9:Does he/she live in this parish (Omuluka)? (multi)**

Possible responses:

- Yes
- No

**10:If he/she is not from this parish (Omuluka), what is the name of his/her parish? (text)**

**11:What is the name of this parish where the meeting is taking place? (multi)**

Possible responses:

- All Parish names

**12:Name of LC1 area (text)**

**13:Do you have a mobile phone? (multi)**

Possible responses:

- Yes and I know the number
- Yes but don't know number
- No

**14:Mobile Number. Enamba eyesimu (number)**

**15:What is the present marital status of (NAME)? Wagiziire amaka? (multi)**

Possible responses:

- Married (monogamous)

- Married (polygamous)
- Divorced or Separated
- Widow or Widower
- Single (never married)

**16:Spouse's First Name or Name of Head of Household. Eiziina eryokubanza erya nyine eka (text)**

**17:Spouse's Last Name or Last Name of Head of Household. Eiziina erya hamuheru erya nyine eka (text)**

**18:Does your spouse have a mobile phone? (multi)**

Possible responses:

- No
- Yes but I don't know the phone number
- Yes I can enter the phone number

**19:Husband mobile number. Enamba yesiimu ya nyineka. (number)**

**20:Is there another mobile phone in HH? (multi)**

Possible responses:

- No
- Yes but I don't know the number
- Yes I can provide the number

**21:How many other mobile phones are there in your HH? (multi)**

Possible responses:

- 0 through 5

**22:What is another phone number? (number)**

**23:Who is the primary cook in your HH? Ni the team orikukira kuteka omuka yawe? (multi)**

Possible responses:

- Respondent
- Spouse
- Maid
- Children
- Other

**24:How old are you? Oine emyaka engawe? (number)**

**25:Did you guess the person's age or did the person tell you his/her age? (multi)**

Possible responses:

- Told age
- Enumerator guessed age

**26:What fuel does your household use to cook with the most? Eka yawe nimutekysa ki? MARK ONE ANSWER, BUT IF THEY USE TWO EQUALLY, THEN MARK BOTH. (multi)**

Possible responses:

- Wood, Charcoal, Gas, Kerosene, Animal dung, Other, No one cooks

**27:Do you know how many people ate lunch at your house yesterday? (multi)**

Possible responses:

- Yes
- No

**28:How many people ate lunch at your house yesterday? Nabantu bangahe abarire kyamushana owawe? (number)**

**29:Is that a typical number of people eating at your house? (multi)**

Possible responses:

- Yes
- No the team had more than usual
- No the team had less than usual

**30:Did you and/or your family buy wood or a tree for cooking last week? Iwe nabeka yawe muguzire enku zokutekyesa ensande ehweire? (multi)**

Possible responses:

- Yes
- No
- I don't know

**31:Did you and/or your family buy wood or a tree for cooking last month? Iwe nabeka yawe muguzire enku zokutekyesa okwezi okuhweire? (multi)**

Possible responses:

- Yes
- No
- I don't know

**32:Did your household gather wood for cooking last week? Abeka yawe bashenyire enku zokutekyesa esande okuhweire? (multi)**

Possible responses:

- Yes
- No
- I don't know

**33:Did your household gather wood for cooking last month? Abeka yawe bashenyire enku zokutekyesa okwezi okuhweire? (multi)**

Possible responses:

- Yes
- No
- I don't know

**34:Do you earn your own income? Oyine entastya? (multi)**

Possible responses:

- Yes
- No

**35:If so, how were you paid for your work? Kukirabe kiri kityo, okashashurwa ota? (multi)**

Possible responses:

- Cash only
- Cash and in-kind

- In-kind only
- Not paid

**36:Who is your main employer? Noha orikukukozesa? (multi)**

Possible responses:

- Family member
- Non-family member
- Self-employed

**37:Last year what length of time were you employed? Omwaka oguhweire, omaziire obwire burikwigana ki orikukora? (multi)**

Possible responses:

- All year
- Seasonal
- Occasional

**38:Does your household own any cows? Ekayawe, eine ente? (multi)**

Possible responses:

- Yes
- No
- I don't know

**39:If so about how many cows do you own? Kumurabe muzeine, mwine zingahe? (multi)**

Possible responses:

- 0-16 cows

**40:Does your household own a television? Ekayawe eine TV? (multi)**

Possible responses:

- Yes
- No
- I don't know

**41:Does your household own a radio? Ekayawe eine radio? (multi)**

Data Field Name : radio

Possible responses:

- Yes
- No
- I don't know

**42:What means of transport do you own? Oine entambura omuka yawe? MARK ALL THAT APPLY (multi)**

Possible responses:

- None
- Bicycle
- Car
- Motorcycle
- I don't know

**43:Do you already own any stove other than a 3 stone fire. Oine esigiri endijo gatari mahega? MARK ALL THAT APPLY (multi)**

Possible responses:

- None
- Built-in Mud Stove
- Charcoal Stove
- Kerosene Stove
- Other type of fuel-efficient wood stove
- Other stove (NOT using wood)

**44:Who usually makes decisions about purchasing major household items? Noha arikusharaho mwaba nimuza kugura ebintu byahaka? MARK ONE ANSWER (multi)**

Possible responses:

- Respondent
- Spouse
- Respondent & Spouse Jointly
- Grandparents
- First Wife
- Father or Mother
- Other- DO NOT SPECIFY

**45:Please write any important notes / observations. (text)**

**46:What is the enumerator's name? (multi)**

Possible responses:

- All Names

**47:Please enter the enumerator name (text)**

**48:Thank you for completing the survey (label)**

### **Bidding Sheet Survey**

**1:What is today's date? (date)**

**2:What is the respondent color? (multi)**

Possible responses:

- Pink
- Orange
- White
- Yellow

**3:What is the household id? (multi)**

Possible responses:

- All Letters

**4:Don't read to respondent: Indicate respondent group. (multi)**

Possible responses:

- Group A: Health Only
- Group B: Saves Time and Money Only
- Group C: Both Health and Saves Time and Money

- Group D: No Message

**5:What is the respondent's first name? (text)**

**6:What is the respondent's last name? (text)**

**7:How much will you bid for a stove for which you will pay the whole amount next week? FILL IN RESPONSE IN UGX, IF RESPONDENT DOES NOT WANT TO BID, ENTER "99" (number).**

**8:How much, in total, will you pay for a stove that you can pay in four equal weekly payments over four weeks? FILL IN RESPONSE IN UGX, IF RESPONDENT DOES NOT WANT TO BID, ENTER "99" (number).**

**9:What is the parish? (multi)**

Possible responses:

- All Parish Names

### **SUMs HOUSEHOLD SURVEY**

HOUSEHOLD NAME:	HOUSEHOLD ID:	TEL:	DATE:
DISTRICT:	SUBCOUNTY:	PARISH:	TIME:

#### **READ THE GREETING/INTRODUCTION BELOW.**

“Good morning sir/madam, I am **INSERT YOUR NAME HERE** from CIRCODU which is an organization that promotes health awareness, sustainable energy resource use and environmental conservation by integrating research and development. The team is here to ask you some questions about your cooking habits, is that ok?”

#### **IF SHE SAYS YES CONTINUE.**

“Can you take me to the kitchen? Can you kindly ask your children to wait outside while we talk?”

- “The team has some gadgets called ibuttons that will help us know how often you use your cookstoves. These gadgets will help us understand how the cook’s life is affected by the emissions from your stove(s). We request that you allow us to place it on your stove(s) in order to help us know the number of times you cook.
- These buttons are harmless to you and your family so you should not get worried about them. Just leave them in the place they have been placed and the team shall come and pick them up.
- The gadgets are of no value to you so they should just be left in the place where they have been placed and they should not be touched or tampered with.
- These ibuttons are limited to read a given range of temperatures. Thus, If possible do not shift the stones from your three-stone fire from place to place because it may lead to the ibutton not getting the correct temperatures. Further, do not move the ibutton into the fire. Please leave it in the place where the team has placed it until the team comes back to collect it.
- The team knows children may be interested in playing with the gadget but please try to warn them not to play with the ibutton. The team will try to cover them with ash so that children cannot pick them up.”

**PLACE THE IBUTTON NOW AND SHOW THE WOMAN/MAN WHERE IT IS LOCATED AND GIVE THE FOLLOWING INSTRUCTIONS:** “In case you move the stones and the ibutton is exposed, please put it back right here and cover it with some ash. Thanks madam for your time.”

**THE FOLLOWING QUESTIONS ARE OBSERVATIONS:**

How many 3 stone fires does she have lite inside or outside?

Write in Number

How many mud stoves does she have lite inside or outside?

Write in Number

How many charcoal stoves does she have lite inside or outside?

Write in Number

How many gas stoves does she have lite inside or outside?

Write in Number

If she owns an improved stove from our program, is it lite?

How many other stoves does she have lite and what kind of stoves are they?

IBUTTON ID (RECORD NUMBER ON BACK OF IBUTTON)	LOCATION OF IBUTTON (WHERE PLACED ON OR NEAR THE STOVE)	STOVE TYPE WHERE IBUTTON IS PLACED	ID OF THE STOVE PHOTO

**Appendix 4: Top Reasons for Choosing First Choice of Stove**

Top Reasons for Choosing First Choice of a Stove				
Jikopoa	Envirofit	Ecozoom	Envirofit with Chimney	Common for all stoves
Less smoke	Less smoke	Less smoke	Less smoke	Less smoke
Little wood used	Little wood used	Little wood used	Little wood used	Little wood used
Portable	Portable	Portable	Portable	Portable
Lights fast	Lights fast	Lights fast	Lights fast	Lights fast
Different saucepans can fit	Ceramic at the bottom can	Skirt can be adjusted	Smoke goes through chimney	

	retain heat			
Paint resembles the soot, so can't see soot	The combustion space is bigger than in the Jikopoa	Good handles	Stand is good	
The handles are good and big	Flame is well distributed	Firewood holder is raised and the firewood cannot fall out	Smoke not filling the cooking place	
Likes skirt	Can fit in a small space	The flame does not get out of the stove	The inside space is big so ash stays inside and does not come down	
Can fit in different pot sizes and big pots	Looks great	No ash falls out	No soot on pans	
Unique	The handles are inside and cannot get broken	Unique	Two burners	
Keeps you and your clothes clean	Combustion chamber is big	Skirt	Cooks concurrently	
No soot on the pans	Flame is concentrated and will cook fast	Soot does not get on the pan	Less smoke, so less flu	
Retains heat	Child cannot push it over	Produces less smoke, so when have visitors you can use it	Cooks fast	
		Can put it anywhere and is private	Likes having a chimney come through the wall	

## Appendix 5: Individual Interviews on Preparing Lunch

### Individual Interviews About How Women Prepared Lunch Yesterday

No. of People Cooked For	Dishes Cooked	How many stoves did you use to cook it and what type of stove(s) did you use?	Steps	Describe the Steps you took to cook lunch yesterday starting from when you began preparing the food to when you served it.	Approximate Time Spent in each step.	Notes
15	Matooke	One 3 stone fire + 2 mud stoves + then she put her food in an insulated basket.	1	Peels Matooke	1 hour	Time does not reflect time doing activities concurrently.
	Millet		2	Puts in leaves	30 mins	
	Rice		3	Cook and mash	2 hours	

	Meat + Sauce		4	Smokes meat on fire	1 hour	
		5	Cuts meat, and adds tomatoes + onions to make sauce	2 hours		
		6	Keeps warm in a basket.	Total: 6.5 hrs		
4	Matooke and beans	Mud stove for matooke + charcoal stove for beans	1	Peels Matoke	15 mins	Time does not reflect time doing activities concurrently.
			2	Puts in the pan	5 mins	
			3	Putting on the fire and cooking	30 mins	
			4	First boil beans	4 hours	
			5	Cuts cabbage, tomatoes, onions	Total: 5 hrs	

## Appendix 6: Stove Usage Monitor Protocol

The team placed the SUMs in five different positions on the Envirofit to determine the best position. Here are the five positions:



*Position 1: At the handle*



*Position 2: On the side*



*Position 3: At the lower back side*



*Position 4: At the back (center)*



*Position 5: Near the wood chamber*

## Appendix 7: Particulate Matter Monitor Protocol

### Monday PM

Location: (Mbarara House)

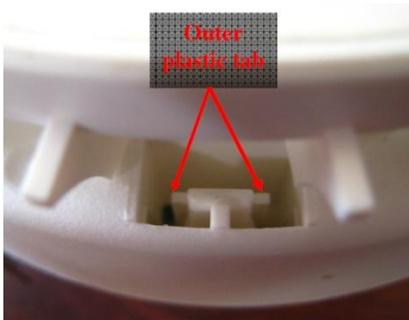
#### 1. Cleaning the Photoelectric Detector

(a) The photoelectric detector inside the monitor must be kept clean to ensure accurate measurements, as particles and dust will accumulate on it with use. The particle concentrations experienced by the monitor determine how often it must be cleaned. As a general rule, the detector should be cleaned after every ten 24-hour uses of the monitor or sooner.

(b) Remove the lid of the monitor (the base plate, used for wall mounting, must be removed before the lid can be removed). To remove the lid, use a small Allen key (or other rigid, thin implement such as an unfolded paperclip) to press gently inward (towards the center of the monitor) on one of the three plastic tabs located on the underside of the monitor. Be sure to press on the lower, outer part of the tab.

Simultaneously lift upward on the lid until it is released from that tab.

Do this for each of the three tabs. The location of one of the three tabs is shown in **Figure 1** below. Note that since the tabs are plastic, care must be taken to avoid breaking them. After all three tabs are loosened, remove the lid from the base by continuing to lift it upward (**Figure 2**).



**Figure 1:** Location of one of the three outer plastic tabs on the underside of the UCB PM monitor.



**Figure 2:** Space created by loosening the UCB PM lid from the base.

NB: The base plate, used for mounting the monitor on a wall, must be removed before you can access the tabs to remove the UCB PM lid.

(a) After you have removed the lid, remove the green circuit board from the base of the monitor to access the photoelectric sensor located on the underside of the board. The board is connected to the monitor base by three plastic tabs surrounding the circuit board and two metal prongs that sit inside metal clamps that connect to the 9-volt battery terminals (Figure 3). Pull back each of the tabs and slowly lift the circuit board out of the UCB PM. At the same time, you may want to use your small screwdriver to slowly pry the board prongs out from the metal clamps. If you pull on the board too hard, you may pull the metal clamp out from the base. If this happens, remove the metal clamp from the metal prong and insert the clamp back in its plastic holder in the base.

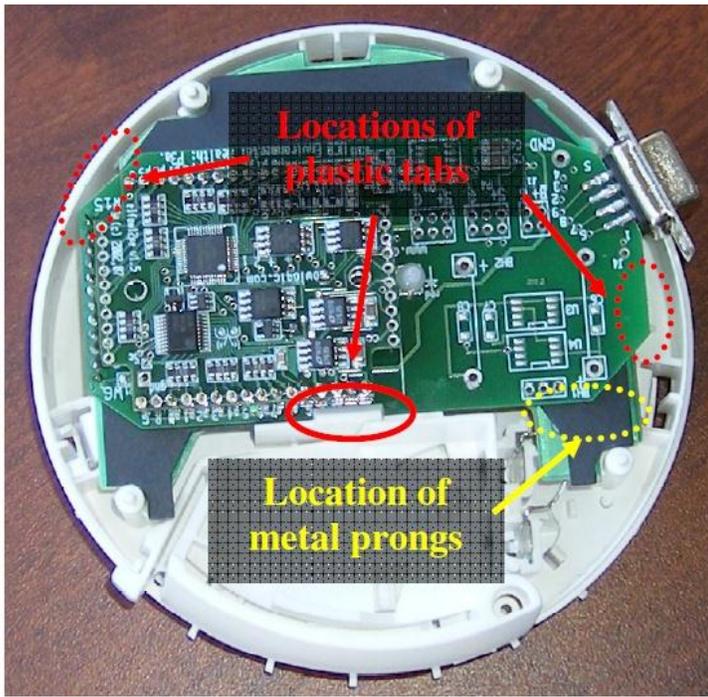


Figure 3: Locations of plastic tabs and metal prongs connecting circuit board to UCB PM.

Make sure you release the circuit board from all 3 plastic tabs before lifting.

(b) Turn the circuit board over, and remove the lid (black plastic) of the detector. To do this, gently unclip the four plastic tabs of the lid by gently pulling them outward. Remove and hold the lid by holding the tabs only; avoid touching the netting which encircles the lid, since it is easily torn and removed.

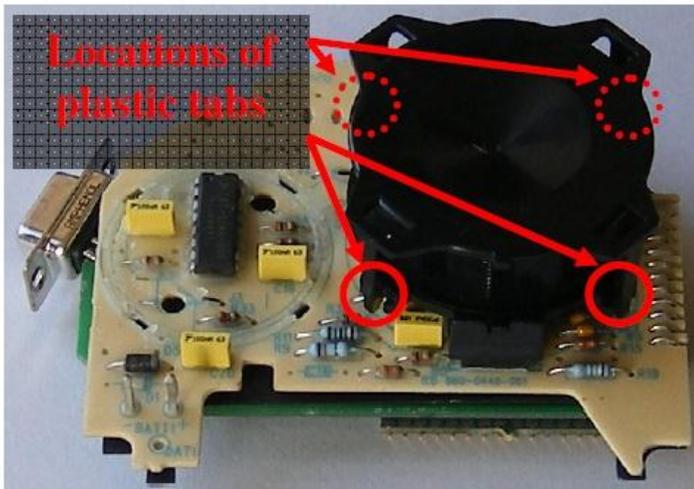
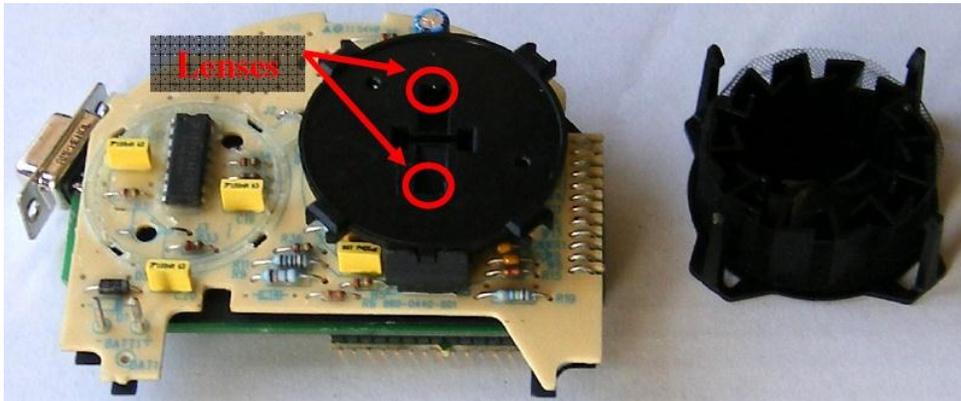


Figure 4: Underside of circuit board with photoelectric (PE) Chamber.

(c) Carefully clean (wipe or swab) all of the interior surfaces of the PE chamber with cotton Q-tips (or Kimwipes) and rubbing alcohol (e.g. isopropyl). Pay special attention to cleaning the two lenses (the LED and the photo detector) and the sloped paths leading down to them.

Be sure to also clean the inside of the lid of the detector. When cleaned properly, all of the detector surfaces should be shiny and free from dust and fibers. If Q-tips or Kimwipes are not available, use a small piece of tissue. If isopropyl alcohol is not available, use water. Do not use any other solvents. If you find any large debris before cleaning, make a note on the most recent UCB PM Sampling Data Form used for that monitor. Replace the lid to close the detector (it should snap into place).



**Figure 5:** Open photoelectric detector.

(d) Firmly snap the circuit board back into the monitor base (**Figure 3**).

To do this, line up the metal prongs with the metal clamps located inside the monitor base. You should hear a small click when it is set properly. Visually examine this connection to ensure that the metal prongs are firmly seated inside of the metal clamps. It is essential to complete this step correctly because these clamps provide the connection to the battery. If the prongs are not fitted exactly into the clamps, the UCB PM will not receive steady power and will be prone to failure.

Replace the monitor cover. It will snap into place when properly placed.

## **2. Install New 9 volt battery**

- a. Keep old batteries separate
- b. Berkeley Air states that a new battery will last 4-5 days of active data logging.

## **3. Launch PM Monitor:**

- (a) Check that your computer clock time is accurate
- (b) Connect UCB-PATs monitor to computer using USB cable
- (c) Make sure the UCB particle monitor contains a 9Volts battery and that the battery door is closed.
- (d) Open the UCB monitor manager V 2.5 software ( by double clicking on the desktop icon)
- (e) Click on '**Show log**' and then select "**next**"
- (f) Check that the temperature sensor readings display reasonable values( considering the current temperature)
- (g) Check that the photoelectric sensor signal is updating every second. If the PM device gives a photoelectric sensor signal value of above 40mV , then click "**Exit**" and open the device for cleaning [ see equipment maintenance procedure]
- (h) Ensure that the battery has at least 7.5 volts.
- (i) Select '**launch monitor**' and click '**next**'.

NB: Make sure the previously logged sample collected with this monitor is downloaded because clicking OK will delete the data on the device.

- (j) Select the data and time you want the monitor to start logging data.
- a. Start data to begin logging at 7am Tuesday morning (the next day).<sup>19</sup>
- (k) Enter the total number of hours over which you want the monitor to log data (in the logging duration cell).<sup>20</sup>
- a. Enter 90 hours for total Number of hours to monitor.
- (l) Set the logging interval to **1 minute**
- (m) Select **“launch”** in the launch confirm dialog box, check that the settings are correct.
- (n) Record the Launch information on the sampling data form.

#### **4. Zeroing the PM Monitor<sup>21</sup>**

- (a) Place the launched UCB particle monitor in a 1-litre Ziploc bag. Make sure the bag does not have any hole. Seal the Ziploc bag and place it in a location where the monitor will not be moved or disturbed.<sup>22</sup>
- (b) Berkeley Air informs us that the team should zero the monitors for at least 20-30 minutes, and it is not critical to know exactly the amount of time the team zeroed it out as long as the team allow for the minimum 20-30 minutes.

### **Friday**

After collecting all PM monitors from the field and upon return to the house in Mbarara

#### **1. Downloading Data**

The procedure for data down load is as follows

- (a) Remove the monitor from Ziploc bag
- (b) Connect monitor to PC computer using USB cable
- (c) Open UCB monitor manager V2.5 software (by double clicking on the desktop icon)
- (d) Select **“Next”**
- (e) Select **“download data”** and click **“next”**. NB: it will take a few minutes and the window will show progress of the download.
- (f) Select **‘Save’**, enter proper folder and select **‘Save’**.
- (g) Once notified that the data was saved, select **‘Exit’**.

#### **2. Storing UCB PM monitors**

- (a) Place UCB Particle Monitors stored in sealed Ziploc (or other airtight) bags. The bagged monitors should be placed in boxes and stored in a safe location, such as a shelf or secure cabinet. They should not be piled up or placed underneath other boxes. It is key that the UCB monitors are treated very delicately and not placed in a location where they can be easily bumped or dropped.

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<sup>19</sup> Assuming that the CIRCODU team does not leave the house on Tuesday before 7:30 am.

<sup>20</sup> i.e. for a 24-hrs HH monitoring period, select at least 30hrs to allow for the initial and final calibration periods, as well as delays.

<sup>21</sup> This is when the launched monitor is put in Ziploc bag to prevent particles from entering the device before or after sampling period. NB: Do not attempt to zero the monitor in the presence of large amounts of smoke or dust in the air.

- (a) <sup>22</sup> Record this initial (pre-sampling) zeroing start time on the sampling data form.
- (b) Leave the monitor in the bag for at least **20-30 minutes**, and only remove device when you are ready to install it at the actual sampling location.
- (c) Record the initial (pre-sampling) zeroing end time on the sampling data form. This completes the pre-sampling zeroing period.

## Appendix 8: Kitchen Performance Test (KPT) Protocol

### INSTRUCTIONS ARE IN BOLD AND UPPER CASE

#### PREVISIT

**LOOK AT THE ROSTER AND FIND THE WOMAN'S NAME. KNOCK ON THE DOOR. IF NO ONE ANSWERS THE DOOR, GO TO THE NEIGHBOR AND ASK THEM WHERE THE WOMAN IS AND WHAT TIME SHE IS COMING BACK. MAKE A NOTE OF THE TIME AND IF POSSIBLE VISIT THAT HOUSEHOLD LATER THAT DAY.**

1. "Is **INSERT NAME HERE** present?"

Yes- If yes skip Q.2 and continue with speech.

No

No one at home- Skip to End

2. "Is there someone who normally cooks at home now?"

Yes, a woman is at home who cooks.- Skip to Instructions 4.

No, but the person who answered the door is an adult and she can deliver the information about the KPT.

No.

**CHECK TO SEE IF WOMAN HAS A PHONE NUMBER. IF YES, TRY TO SET UP THE HOUSEHOLD BY CALLING AND PROCEED WITH THE KPT INSTRUCTIONS.**

**IF YOU CANNOT SET UP THE MEETING BY PHONE, ASK THE PERSON WHO ANSWERED THE DOOR (IF THEY ARE AN ADULT) IF YOU CAN GIVE HER INSTRUCTIONS FOR THE WOMAN.**

Good *morning/afternoon*, my name is \_\_\_\_\_. I am here on behalf of Centre for Integrated Research and Community Development Uganda (CIRCODU). CIRCODU is an organization that promotes health awareness, sustainable energy utilization and environment conservation through research and development. As **INSERT NAME HERE** discussed with our colleagues last week the team asked to visit you and your kitchen."

In this research, the team is to carry out KPT procedure, which requires us to weigh fuel used for cooking in your HH for 4 consecutive days. Based on your availability the team will select a time to visit you for the next 3 days. Each visit will be 24 hours after the last. During this exercise the team encourage to cook and eat normally like any other day. On each visit the team shall leave you with a food diary which will help you to recall things like foods cooked, # of people who ate, type(s) of stove used, etc. This survey will take about 20 minutes. The team request that during this exercise that each day you have enough fuel for a whole day's worth of consumption. If possible it would be best if you could have enough wood to cook for the entire 4 days. If you can gather several days of wood please remember to store it in a dry place so that it does not get wet. All the information the team collect will be kept private. Your name will not appear anywhere.

Visit 0:	Date:	Time:
Woman's Name:	Family Name:	
HHID #	Parish:	Village
Are you willing to participate in this KPT?	Yes	

	No	
At what time are you available tomorrow, and the team would like to visit you at the same time for the next few days. Please provide us with two times that you are available tomorrow.	Enter Time: 9:00-10:00 10:00-11:00 11:00-12:00 12:00-1:00 1:00-2:00 2:00-3:00 3:00-4:00 4:00-5:00	
<b>READ:</b> “Now that you have told me two times you are available the team will visit you tomorrow at one of these two times. When I arrive tomorrow, if you cook with wood I expect you to have enough wood for 24 hours. And if you cook with charcoal, I expect you to have enough charcoal for 24 hours.”		
Visit 1:	HH ID	Time: Date:
Is this the same woman who you met yesterday? Yes No, it is a new woman. Not sure, because you talked on the phone.		
<b>WRITE THE NUMBER OF THE SCALE THAT YOU ARE USING TODAY.</b> Scale # _____ <b>TURN SCALE ON. IF NOT AT ZERO THEN PRESS THE BUTTON “ON/ZERO” UNTIL IT BECOMES ZERO.</b> <b>IF HOUSEHOLD ALREADY HAS NEW STOVE ASK HER TO SEPARATE WOOD FOR TRADITIONAL AND IMPROVED STOVES. PROCEED TO WEIGH WOOD AND ONCE WEIGHED PUT THE WOOD IN THE BAG MARKED CLEARLY TRADITIONAL IF TRADITIONAL STOVE OR IMPROVED IF FOR IMPROVED STOVE.</b> <b>IN CASE HH DOES NOT HAVE ENOUGH OF ALL THE FUELS:</b> <ul style="list-style-type: none"> <li>• IF THEY ARE OUT OF WOOD, OFFER A FEW PIECES OF WOOD FROM YOUR PERSONAL WOOD PILE.</li> <li>• IF THEY DO NOT HAVE ENOUGH CHARCOAL AND IF THEY ARE USING CHARCOAL, YOU CAN GIVE THEM SOME CHARCOAL.</li> <li>• IF YOU GET A NEW GAS CANISTER BEFORE MY NEXT VISIT PLEASE DO NOT USE IT BEFORE I GET BACK.</li> </ul> <b>NEXT TIME THE TEAM WILL NOT HAVE FUEL WITH US, SO PLEASE FOR TOMORROW HAVE 24 HOURS OF FUEL READY.</b>		
<b>WHICHEVER FUELS SHE USES WEIGH THOSE FUELS. IF SHE DOES NOT USE OTHER FUELS LEAVE IT BLANK.</b>		
14. Wood-Traditional (Kg).	15. Wood- Improved Kg.	
16. Charcoal Total (kg):	17. Gas- Kg.	
18. Other Fuels- Specify	19. kg.	
<b>ASK WOMAN TO SEE KITCHEN:</b> <b>THE FOLLOWING QUESTIONS ARE OBSERVATIONS:</b> How many 3 stone fires does she have lite? (#) (inside/outside)		

<p>How many mud stoves does she have lite? (#)          How many charcoal stoves does she have lite? (#)          How many gas stoves does she have lite? (#)          Other Stoves lite -BLANK WRITE IN</p>		
<p><b>HAND OUT FOOD DIARY AND EXPLAIN:</b> “After every meal write what you made and the number of people there. If there are any visitors please include them, do not leave out visitors.”</p>		
<p><b>Visit #2</b> (~24 hours later)</p>	<p>16. Date (dd-Mon-YY):</p>	<p>17. Time (hh:mm):</p>
<p>Is this the same woman who you met yesterday?          Yes          No, it is a new woman.          Not sure, because you talked on the phone.</p>		
<p><b>WRITE THE NUMBER OF THE SCALE THAT YOU ARE USING TODAY.</b>          Scale # _____  <b>TURN SCALE ON. IF NOT AT ZERO THEN PRESS THE BUTTON “ON/ZERO” UNTIL IT BECOMES ZERO.</b></p>		
<p>18. UNUSED Wood- Traditional (kg).</p>	<p>19. UNUSED Wood Improved (kg).</p>	
<p>16. UNUSED Charcoal Total (kg):</p>	<p>17. UNUSED Gas- Kg.</p>	
<p>18. Other Fuels- Specify</p>	<p>19. UNUSED kg.</p>	
<p><b>REMOVE THE OLD FOOD DIARY AND HAND OUT NEW FOOD DIARY. AFTER EVERY MEAL WRITE WHAT YOU MADE AND THE NUMBER OF PEOPLE THERE. IF THERE IS ANY VISITOR PLEASE INCLUDE THEM, DO NOT LEAVE OUT VISITORS.</b></p>		
<p><b>IF HOUSEHOLD ALREADY HAS NEW STOVE ASK HER TO SEPARATE WOOD FOR TRADITIONAL AND IMPROVED STOVES. PROCEED TO WEIGH WOOD AND ONCE WEIGHED PUT THE WOOD IN THE BAG MARKED CLEARLY TRADITIONAL IF TRADITIONAL STOVE OR IMPROVED IF FOR IMPROVED STOVE.</b></p>		
<p>14. NEW Wood-Traditional (Kg).</p>	<p>15. NEW Wood- Improved Kg.</p>	
<p>16. NEW Charcoal Total (kg):</p>	<p>17. NEW Gas- Kg.</p>	
<p>18. Other Fuels- Specify</p>	<p>19. NEW kg.</p>	
<p><b>WHEN YOU GATHER NEW WOOD FOR THE REST OF THE WEEK PLEASE PUT IT SOMEWHERE ELSE. IF A NEIGHBOR OR SOMEONE ASKS TO USE SOME WOOD PLEASE USE FROM THE PILE I HAVE NOT WEIGHED.</b></p>		
<p>22. Breakfast</p>	<p># of people cooked for:          (a) Children aged 14 or below? -----          (b) Females aged 15 and above? -----          (c) Men aged 15-59? -----          ---          (d) Men above 59? -----          -</p>	<p>(e) Food(s) Prepared and which stove you used to prepare each food?</p>

Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas
23. Lunch	# of people cooked for: (a) Children aged 14 or below? ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- ---- (d) Men above 59? ----- -	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas
25. Tea/coffee	# of people cooked for: (a) Children aged 14 or below? -- ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- (d) Men above 59? -----	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas
25. Dinner	# of people cooked for: (a) Children aged 14 or below? -- ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- (d) Men above 59? -----	(e) Food(s) Prepared and which stove you used to prepare each food?
		(h) Fuel(s) used: Wood

Stove(s) used: (f) Types: ----- (g) # -----	Charcoal(s) used: Animal Dung Gas
---	---

28. Was yesterday a typical day of cooking for you? (Yes/No)

29. Were there any special events yesterday? (birthday, special occasion)

**ASK WOMAN TO SEE KITCHEN:**  
**THE FOLLOWING QUESTIONS ARE OBSERVATIONS:**  
 How many 3 stone fires does she have lite? (#) (inside/outside)  
 How many mud stoves does she have lite? (#)  
 How many charcoal stoves does she have lite? (#)  
 How many gas stoves does she have lite? (#)  
 Other Stoves lite -BLANK WRITE IN

<b>Visit #3</b> (~24 hours later)	16. Date (dd-Mon-YY):	17. Time (hh:mm):
-----------------------------------	-----------------------	-------------------

Is this the same woman who you met yesterday?  
 Yes  
 No, it is a new woman.  
 Not sure, because you talked on the phone.

**WRITE THE NUMBER OF THE SCALE THAT YOU ARE USING TODAY.**  
 Scale # \_\_\_\_\_  
**TURN SCALE ON. IF NOT AT ZERO THEN PRESS THE BUTTON "ON/ZERO" UNTIL IT BECOMES ZERO.**

18. UNUSED Wood- Traditional (kg).	19. UNUSED Wood Improved (kg).
16. UNUSED Charcoal Total (kg):	17. UNUSED Gas- Kg.
18. Other Fuels- Specify	19. UNUSED kg.

**REMOVE THE OLD FOOD DIARY AND HAND OUT NEW FOOD DIARY. AFTER EVERY MEAL WRITE WHAT YOU MADE AND THE NUMBER OF PEOPLE THERE. IF THERE IS ANY VISITOR PLEASE INCLUDE THEM, DO NOT LEAVE OUT VISITORS.**

**IF HOUSEHOLD ALREADY HAS NEW STOVE ASK HER TO SEPARATE WOOD FOR TRADITIONAL AND IMPROVED STOVES. PROCEED TO WEIGH WOOD AND ONCE WEIGHED PUT THE WOOD IN THE BAG MARKED CLEARLY TRADITIONAL IF TRADITIONAL STOVE OR IMPROVED IF FOR IMPROVED STOVE.**

14. NEW Wood-Traditional (Kg).	15. NEW Wood- Improved Kg.
16. NEW Charcoal Total (kg):	17. NEW Gas- Kg.
18. Other Fuels- Specify	19. NEW kg.

**WHEN YOU GATHER NEW WOOD FOR THE REST OF THE WEEK PLEASE PUT IT SOMEWHERE ELSE. IF A NEIGHBOR OR SOMEONE ASKS TO USE SOME WOOD PLEASE USE FROM THE PILE I**

HAVE NOT WEIGHED.		
22. Breakfast	# of people cooked for: (a) Children aged 14 or below? ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- --- (d) Men above 59? ----- -	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas
23. Lunch	# of people cooked for: (a) Children aged 14 or below? ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- --- (d) Men above 59? ----- -	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas
25. Tea/coffee	# of people cooked for: (a) Children aged 14 or below? -- ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- (d) Men above 59? -----	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas

25. Dinner	# of people cooked for: (a) Children aged 14 or below? ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- (d) Men above 59? -----	(e) Food(s): Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: (h) Fuel(s) used: Wood Charcoal
		Animal Dung Gas

28. Was yesterday a typical day of cooking for you? (Yes/No)		
29. Were there any special events yesterday? (birthday, special occasion)		
<b>ASK WOMAN TO SEE KITCHEN:</b> <b>THE FOLLOWING QUESTIONS ARE OBSERVATIONS:</b> How many 3 stone fires does she have lite? (#) (inside/outside) How many mud stoves does she have lite? (#) How many charcoal stoves does she have lite? (#) How many gas stoves does she have lite? (#) Other Stoves lite -BLANK WRITE IN		
<b>Visit #4</b> (~24 hours later)	16. Date (dd-Mon-YY):	17. Time (hh:mm):
Is this the same woman who you met yesterday? Yes No, it is a new woman. Not sure, because you talked on the phone.		
<b>WRITE THE NUMBER OF THE SCALE THAT YOU ARE USING TODAY.</b> Scale # _____ <b>TURN SCALE ON. IF NOT AT ZERO THEN PRESS THE BUTTON "ON/ZERO" UNTIL IT BECOMES ZERO.</b>		
18. UNUSED Wood- Traditional (kg).	19. UNUSED Wood Improved (kg).	
16. UNUSED Charcoal Total (kg):	17. UNUSED Gas- Kg.	
18. Other Fuels- Specify	19. UNUSED kg.	
<b>REMOVE THE OLD FOOD DIARY AND HAND OUT NEW FOOD DIARY. AFTER EVERY MEAL WRITE WHAT YOU MADE AND THE NUMBER OF PEOPLE THERE. IF THERE IS ANY VISITOR PLEASE INCLUDE THEM, DO NOT LEAVE OUT VISITORS.</b>  <b>IF HOUSEHOLD ALREADY HAS NEW STOVE ASK HER TO SEPARATE WOOD FOR TRADITIONAL AND IMPROVED STOVES. PROCEED TO WEIGH WOOD AND ONCE WEIGHED PUT THE WOOD IN THE BAG MARKED CLEARLY TRADITIONAL IF</b>		

<b>TRADITIONAL STOVE OR IMPROVED IF FOR IMPROVED STOVE.</b>		
14. NEW Wood-Traditional (Kg).	15. NEW Wood- Improved Kg.	
16. NEW Charcoal Total (kg):	17. NEW Gas- Kg.	
18. Other Fuels- Specify	19. NEW kg.	
<b>WHEN YOU GATHER NEW WOOD FOR THE REST OF THE WEEK PLEASE PUT IT SOMEWHERE ELSE. IF A NEIGHBOR OR SOMEONE ASKS TO USE SOME WOOD PLEASE USE FROM THE PILE I HAVE NOT WEIGHED.</b>		
22. Breakfast	# of people cooked for: (a) Children aged 14 or below? ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- --- (d) Men above 59? ----- -	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----	(h) Fuel(s) used: Wood Charcoal Animal Dung Gas	
23. Lunch	# of people cooked for: (a) Children aged 14 or below? ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- ---- (d) Men above 59? ----- -	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----	(h) Fuel(s) used: Wood Charcoal Animal Dung Gas	

25. Tea/coffee	# of people cooked for: (a) Children aged 14 or below? -- ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- (d) Men above 59? -----	(e) Food(s) Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: Wood Charcoal Animal Dung Gas
25. Dinner	# of people cooked for: (a) Children aged 14 or below? -- ----- (b) Females aged 15 and above? ----- (c) Men aged 15-59? ----- (d) Men above 59? -----	<del>(e) Food(s)</del> : Prepared and which stove you used to prepare each food?
Stove(s) used: (f) Types: ----- (g) # -----		(h) Fuel(s) used: (h) Fuel(s) used: Wood Charcoal
		Animal Dung Gas

28. Was yesterday a typical day of cooking for you? (Yes/No)
29. Were there any special events yesterday? (birthday, special occasion)  <b>ASK WOMAN TO SEE KITCHEN:</b> <b>THE FOLLOWING QUESTIONS ARE OBSERVATIONS:</b> How many 3 stone fires does she have lite? (#) (inside/outside) How many mud stoves does she have lite? (#) How many charcoal stoves does she have lite? (#) How many gas stoves does she have lite? (#) Other Stoves lite -BLANK WRITE IN

### Appendix 9: Demand Determinant Survey Questions Pre-Tested

1. Does your household own any of the following? If so, how many?
  - a) TV
  - b) Cow
  - c) Bicycle
  - d) Motorcycle

- e) Poultry
  - f) Mobile phone
    - a. Does the wife own her own phone?
2. What do you use for lighting in your house?
- a) Electricity
  - b) Solar
  - c) Lamp
  - d) Kerosene candles
  - e) Others (*specify*)
3. Who in your household earns income?
4. ***If she does earn her own income ask, how do you earn your own income? (goal is to determine how much she earns herself)***
- a. If you own your own business, what kind of business do you own? (***from this, the team should be able to tell if it is a small, medium, or large business***)
  - b. If you work for pay, what is the kind of work you do?
  - c. If you sell farm output, what kind of farm products do you sell? How often and how much do you sell?