Cookstove Field Study Resources

Information, tools, and sample forms
for researchers, communities, and organizations

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1. Introduction

This document provides resources to assist teams in developing and implementing field studies to evaluate the performance of cookstoves. These resources may be of use, for example, to researchers comparing an intervention cookstove to a baseline technology, cookstove designers or manufacturers assessing product performance, or organizations seeking to understand how cookstoves affect their community's exposure to pollutants.

In addition to a "Quick Guide to Field Study Development" intended to walk users step-by-step through the primary considerations involved in planning a study, this document also provides basic information on comparing different options for study design, determining sample size, considering different sampling methods, and selecting means of data collection. Examples of forms and survey questions are provided that may be freely used or amended to suit the needs of study teams. The final section contains prompts to aid teams in considering all aspects of cookstoves and cooking systems, behaviors, and environments that can affect cookstove performance.

This document was developed to facilitate the work of the Field Testing Working Group of Technical Committee 285 in International Organization for Standardization (ISO), focused on cookstoves and clean cooking solutions. The Field Testing Working Group organized these resources together to support work to develop an ISO standards document on field testing. This document has been shared to support the work of other experts doing field studies.

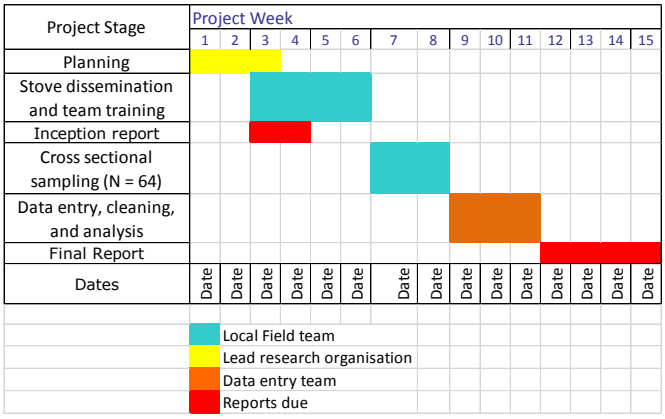
2. Quick Guide to Field Study Development

Planning a field study is a non-linear, iterative process that requires consideration of multiple aspects of the study to achieve a reasonable balance between the idealized study and real-world feasibility. Table 1 provides a guide to thinking through the different considerations for planning a field study. The table breaks down the planning phase into discrete components, with key questions and considerations to help frame decisions. The implementation column provides an example for that component of the planning process. For this table, the "Example Implementation" is based on a simple hypothetical study of a comparison of two cookstoves – a baseline and a new cookstove – at one site.

The process for study design, planning, budgeting, and implementation is variable and depends on many unfixed factors. Of importance are the research questions asked, study site location, field team number, site number, implementing institution requirements, and required equipment procurement.

Table 1 – Quick Guide to Field Study Development

Planning item	Key questions/considerations	Example Implementation:
Research question	What is the fundamental question you are trying to answer with the field study? Examples may include: How much fuel will be saved per meal? What are the emissions reductions achieved by a given cookstove for health or climate purposes? How does cookstove performance change due to switches in fuel or season?	We will answer the question, "How much fuel will be saved per meal?"
Decide on study design	Determine if a before-and-after or cross-sectional study design suits your budget, study site, and research question best. Assess the possible timeline and resources of your study. A before-and-after study requires fewer participants but a longer timeline. Seasonal	We will use a cross-sectional study design because there is only time for one field visit in the allotted time.

	variations also must be considered.	
Selecting samples	Households may be selected from the target community with the help of a local partner who has established relationship in the community.	The local field partner has identified households in the study community that are representative of the target population and potentially fit the selection criteria. The criteria are that the household does no commercial cooking, that the family size is between 2 and 6 members (+/-2 from the median family size of 4 in the area), and that no festivals or community celebrations are occurring during the week of sampling.
Determining sample size	Estimate expected variability by examining previous uncontrolled cooking test studies. For fuel consumption per meal, the coefficient of variation is between 20% and 60%. Set the change in fuel use per meal to a conservative estimate to ensure you can detect a difference.	In this example, our coefficient of variation is assumed to be 50%, based on previous fuel consumption studies of baseline cookstoves in this area. We are aiming to detect a minimum change in fuel consumption per meal of 35%. Using Table 3 (see 3.2) we determine a necessary sample size for this study to be 32. This means we will conduct a minimum 32 uncontrolled cooking tests (UCTs) with the baseline cookstove and 32 using the new cookstove. The team will attempt to get 35-40 UCTs per cookstove type to be conservative.
Developing a workplan	A workplan will guide you in assessing the study timeline. It will be structured around study design, sample size, field team number, reporting deadlines, seasonal changes, new cookstove availability/dissemination, new cookstove adjustment periods, and field team availability.	
Evaluating required resources	Required resources will vary depending on the research question. After determining your research question, you will need to assess what supplies and equipment are necessary to obtain the	A fuel study requires the use of scales, one scale per team. In this example, the study is in a region using wood, so moisture meters will be required as well. Post-sample equipment includes an ash separator and heat resistant gloves and hot pads. A 2-person field team measuring only fuel consumption can complete 6 to 10 samples per day, depending on the distance

	measurements to answer your research question. Your workplan will help to determine how many field team workers are required to conduct your field study. The study design will designate the necessary number of trips to the field site and the mode of transportation. The number of small gifts that are required for the participants is dependent on sample size. Samples and equipment will need to be transported to the primary research institution following collection.	between homes and the cooking duration. A total sample size of 64 (32 baseline cookstove + 32 new cookstove) can be completed in approximately 7 to 11 working days. The example sampling plan has allotted two weeks for field visits for a field team of two. The field team will also need to be trained, which will require an additional 2 to 3 days. Transportation for the two weeks of field visits for a field team of two will be arranged. Small gifts for all 64 of the participating households will be chosen, aiming for items that strike a balance of showing appreciation for participants' time without instilling envy among those in the community that were not selected to participate in the study. A t-shirt or small cooking tool, such as a kettle, may be appropriate. Resources for shipping back samples and equipment from the field site to the primary research institution will also be allotted.
Estimating costs	Budgets need to be developed for each project, and will be affected by the overall size of the project, personnel time and their associated wages, necessary travel, and equipment requirements. Field study costs vary greatly. An expected budget for conducting a field test, all the way from planning through reporting, may range from $20,000 to $150,000.	Since equipment requirements are minimal for a fuel-only study, and the time and travel requirements for a cross-sectional study are less than a before-and-after project, the budget for the example project would be on the lower end of the range, somewhere close to $20,000 to $40,000.

3. Key concepts and conventions in study design

3.1 Comparison of study design options

Cross-sectional and before-and-after studies are the simplest and most common studies employed for comparing performance of different models of cookstoves. This section provides descriptions of each type of study and outlines the benefits and challenges of each approach.

3.1.1 Cross-sectional study (independent samples)

In a cross-sectional study, the samples for the baseline and new cookstove(s) will be unrelated – the baseline-cookstove and new-cookstove groups will be made up of different cooks or households. Measurements for cross-sectional studies are taken during the same time period, so they are not influenced by seasonal changes. Since the measurements are taken in different households or with different cooks, the measurement comparison is on a population level rather than an individual level, which introduces variability.

3.1.2 Before-and-after study (paired samples)

In a before-and-after study, the samples for the baseline and new cookstoves will be collected from the same cooks or households. The sampling happens at two different time points, first with the baseline cookstove, and then after the introduction of the new cookstove. An adjustment period of at least three weeks is recommended between the cookstove distribution and the follow-up "after" cookstove measurements, so the users of the new cookstove can become accustomed to their new technology. Since the monitoring periods are separated in time, seasonal changes that exist between the monitoring periods can influence the measurements. Changes such as fuel quality or moisture content, fuel and food availability, and participant schedules can have impacts on measurements.

3.1.3 Benefits and challenges of cross-sectional vs. before-and-after studies

The benefits and challenges of cross-sectional vs. before-and-after studies are presented in Table 2.

Table 2: Benefits and challenges of study design approaches

Cross-sectional		Before-and-after	
Benefits	**Challenges**	**Benefits**	**Challenges**
- Requires least amount of planning	- Requires larger sample sizes	- Smaller samples sizes possible	- Greater burden on participants due to multiple required visits
- Can be conducted during a single field campaign without requiring a follow-up of study households at a later time	- New cookstove users and baseline cookstove users must be carefully matched	- Samples from new and baseline cookstove are directly comparable	- Possible changes between the before-and-after monitoring (i.e. seasons) can affect measurements

3.2 Sample size concepts and conventions

Tables 3 and 4 provide a guide for determining sample sizes for a field study. The tables assume the standard conventions described in 3.2.3 (p-value of 0.05; power of 80%, and a two-tailed statistical test). Given the assumed conventions, the remaining factors to consider are study design, expected/desired difference in the means, and expected variability.

EXAMPLE: If the detectable difference for the performance metric of interest is targeted to be 40% and a CoV of 60% is expected, then one would need 36 test samples in each group for cross-sectional study, or 18 in a before/after study (sampled once with the traditional stove and once with the improved stove).

Note that with large detectable differences and small CoVs it is theoretically possible to measure statistically significant differences with very small samples sizes; however, it is recommended that samples sizes less than 15 for uncontrolled field testing be avoided, to maintain a reasonable level of confidence in the results.

Table 3.- Sample size table for cross-sectional (independent samples) study design

Difference in means	Coefficient of Variation												
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	110%	120%	130%
5%	63	251	565	1005	1570	2261	3077	4019	5086	6279	7598	9042	10612
10%	16	63	142	251	393	565	769	1005	1272	1570	1900	2261	2653
15%	7	28	63	112	175	251	342	447	565	698	844	1005	1179
20%	4	16	36	63	98	142	193	251	318	393	475	565	663
25%	3	10	23	40	63	91	123	161	204	251	304	362	425
30%	2	7	16	28	44	63	86	112	142	175	211	251	295
35%	2	5	12	21	32	46	63	82	104	128	155	185	217
40%	1	4	9	16	25	36	48	63	80	98	119	142	166
45%	1	3	7	13	20	28	38	50	63	78	94	112	131
50%	1	3	6	10	16	23	31	40	51	63	76	91	106
55%	1	2	5	9	13	19	26	33	42	52	63	75	88
60%	1	2	4	7	11	16	22	28	36	44	53	63	74
65%	1	2	4	6	10	14	18	24	30	37	45	54	63
70%	1	2	3	5	8	12	16	21	26	32	39	46	54
75%	1	1	3	5	7	10	14	18	23	28	34	40	47
80%	0	1	2	4	6	9	12	16	20	25	30	36	42
85%	0	1	2	4	6	8	11	14	18	22	27	32	37
90%	0	1	2	3	5	7	10	13	16	20	24	28	33
95%	0	1	2	3	5	7	9	11	14	18	21	25	30
100%	0	1	2	3	4	6	8	10	13	16	19	23	27

(Adapted from Edwards et al.)

Table 4. Sample size table for a before-and-after (paired samples) study design

Difference in means	Coefficient of Variation												
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	110%	120%	130%
5%	31	126	283	502	785	1130	1538	2009	2543	3140	3799	4521	5306
10%	8	31	71	126	196	283	385	502	636	785	950	1130	1326
15%	3	14	31	56	87	126	171	223	283	349	422	502	590
20%	2	8	18	31	49	71	96	126	159	196	237	283	332
25%	1	5	11	20	31	45	62	80	102	126	152	181	212
30%	1	3	8	14	22	31	43	56	71	87	106	126	147
35%	1	3	6	10	16	23	31	41	52	64	78	92	108
40%	0	2	4	8	12	18	24	31	40	49	59	71	83
45%	0	2	3	6	10	14	19	25	31	39	47	56	66
50%	0	1	3	5	8	11	15	20	25	31	38	45	53
55%	0	1	2	4	6	9	13	17	21	26	31	37	44
60%	0	1	2	3	5	8	11	14	18	22	26	31	37
65%	0	1	2	3	5	7	9	12	15	19	22	27	31
70%	0	1	1	3	4	6	8	10	13	16	19	23	27
75%	0	1	1	2	3	5	7	9	11	14	17	20	24
80%	0	0	1	2	3	4	6	8	10	12	15	18	21
85%	0	0	1	2	3	4	5	7	9	11	13	16	18
90%	0	0	1	2	2	3	5	6	8	10	12	14	16
95%	0	0	1	1	2	3	4	6	7	9	11	13	15
100%	0	0	1	1	2	3	4	5	6	8	9	11	13

(Adapted from Edwards et al.)

3.2.1 Expected or required difference in means

The difference in means is the change you either expect or desire to see between average performance of the baseline and new cookstove models.

EXAMPLE If a study team is conducting a screening study in which only new cookstoves that save at least 30% on fuel consumption will be considered for further study or deployment, then 30% would be the difference in the means.

Detecting smaller differences requires larger sample sizes. Conversely, the larger the difference in the means, the smaller the sample size needed to detect a significant difference.

3.2.2 Coefficient of variation (CoV)

The CoV is a relative measure of variability, defined as the ratio of the standard deviation to the mean for a given sample (CoV = SD/mean).

EXAMPLE If the standard deviation of a set of fuel consumption measurements was 100 grams and the mean was 400 grams, then the CoV would be 25%.

The larger the CoV, the larger the sample size will need to be to detect a significant difference.

3.2.3 Conventions for statistical purposes

3.2.3.1 P-value

The p-value describes the odds, using a Student's t-test, that the results from a study will support the hypothesis (e.g. the new cookstove saves 30% on fuel), when in fact it is false.

Standard convention is to use a p-value of 0.05 (e.g. only a 5% chance that measured difference in performance is false).

3.2.3.2 Power

The power of the study is the chance that it correctly rejects the null hypothesis (e.g. there is no difference in fuel consumption performance between the baseline and new cookstove) when the null hypothesis is false.

Standard convention is to set the power at 80%.

3.2.3.2 Number of tails

A one-tail statistical test assumes that difference in means can only go in one direction. For example, a one-tail test would assume that an intervention cookstove could only cause a reduction in fuel consumption, not an increase in fuel consumption. A two-tail statistical test allows for a change in either direction (e.g. an increase or decrease in fuel consumption).

Standard convention is to use a two-tailed test.

3.3 Sampling methods and considerations

Sampling methods and considerations for their use are described in Table 5.

Table 5 – Sampling methods and considerations

Sampling Method	Description and considerations
Convenience	Uses participants from the target population who immediately give their consent to participate. This method is based on convenience and opportunity**.** This is a quick way to choose participants, but may not provide a representative sample, and has the potential to be biased.
Random sampling	All people within the target population have an equal chance of being selected. Random samples require a method of labelling the target population and then using random selection to determine who makes up the sample. Random samples are the best method of selecting a sample from the target population, provided the participants chosen have the characteristics necessary for the study, such as cooking with a certain type of fuel. For large populations, however, it can be time consuming to identify all individuals in the population.
Clustered	Used when relatively homogeneous groups are evident in the target population. In this method, the total population is divided into groups and a random sample of the groups is selected. The required information is then collected from a simple random sample of the elements within each selected group. Assuming a fixed sample size, the clustered method gives more accurate results when most of the variation in the population is within the groups, not between them.
Stratified	Divides the target population into the different groups that may influence the results, and calculates the proportions needed for the sample to be representative of the population. The sample is intentionally tailored to reflect variability in the population. It can be time consuming to identify the sub-categories to stratify by and then calculate the fraction within the population.

3.4 Data collection methods

3.4.1 Interview methods

Interview methods involve direct interaction between the researcher and the user or study participant. Instruments used in interview methods can include individual interviews, expert interviews, group interviews, focus groups, and surveys.

3.4.2 Sensor-based methods

Small, battery-powered electronic temperature and datalogger devices, often called stove use monitoring systems (SUMs), in this document will hereafter be referred to as Continuous Stove Monitors (CSM) are placed on or near the cookstove for an extended period of time to record the temperature change of the cookstove surface which can be correlated to use. The tools can provide an objective measure of usage.

A datalogger logs temperature data. Data must be manually collected and processed into cooking duration to measure the frequency of cooking events and documentation of cookstove use (Ruiz-Mercado, 2011).

A wireless/real-time (cloud-based) CSM logs temperature data and wirelessly transmits data to a centralized server where data is automatically processed into cooking duration and accessible for anyone to view and export. Cloud-based CSMs can connect to an integrated system for the collection, transmission and analysis of cookstove temperature data, which leverages wireless data transmission over local cellular networks (Graham et al, 2014).

Table 6 offers a comparison of several types of cookstove use monitors currently available on the market.

Table 6 – Comparison of currently available cookstove use monitors

Device	Cost	Data collection life span	Placement requirements	Made/ Sold by:	Best for monitoring	Other factors
iButton	$15-75 USD	Memory: 2048 – 8192 data points Battery: 1 year of continuous measurements	Small and unobtrusive Difficult to interpret high thermal mass cookstove data	Made by Maxim Sold by Berkeley Air Monitoring Group	Low thermal mass portable cookstoves.	Mobile platform for instrument launching and data download
kSUMs	$150 USD	2-3 months	Data logger plus three thermocouple leads allow measurement of up to three pot openings plus ambient	Berkeley Air Monitoring Group	Built in, high thermal mass flaming cookstoves	High heat rating Rechargeable internal battery
Infrared thermo-couple	$100-150 USD	Memory: 16,300 data points Battery: several months	Place remotely pointed at cookstove around up to 3 meters away	General	Built in cookstoves Good for high thermal mass cookstoves	Data downloaded via USB Laser pointer for placement alignment
SWEET Sense	$400 plus about $50 for a data plan	6-18 months	Thermocouple based data logger	SWEETSense		Uses cellular network to upload data to an internet database where data is analysed and summarized
Stove Trace	$100-130 USD	Memory: Storage is configurable to preferences Currently stores up to 1 year on device,	Needs a safe place for wireless transmission equipment	NexLeaf	Any cookstove (with appropriate testing)	Automatically logs data and transmits real-time to a centralized server with customizable analytics

		and infinitely on the dashboard Battery life: Up to 3 years rechargeable battery				

3.4.3 Comparing interview and sensor methods

Table 7 compares interview-based and sensor-based measurement methods in terms of the quantity or attribute they measure and their associated protocols, data analyses, and limitations.

Table 7 – Comparison of data collection methods

	Interview-based methods	Sensor-based metrics
Quantity/Attribute Measured	Usage as determined from user interviews is an estimate of the frequency or total amount of time or occurrences during which the technology is employed for a cooking practice.	Use: Number of cooking events on baseline or new cookstove per day, duration of each event and total cooking duration/day Sustained Use: Average cooking duration per day calculated over 1 year Displacement: Fraction of total cooking duration per day on new cookstove calculated by measuring cooking on both new and baseline cookstoves. Displacement can be calculated over a 24 hour period or a longer-term period (e.g., one year)
Data analysis and calculations	-Use collected demographics to correlate with cookstove acceptance, in order to inform future distributions of the cookstove in light of correct demographics that are likely to accept the cookstove -Can pair this collected demographic data with measured cookstove use data to understand characteristics contributing to the 3 levels of adoption mentioned above (Use, Sustained Use and Displacement)	Pair the data with lightweight surveying to understand factors contributing to varying usage levels across homes. Understand the demographics associated with high usage (e.g., small household size, fuel cost low, only 1 other cookstove owned)
Limitations	-Resource-intensive at scale -Subject to bias (relying on households'/cooks' recollection of past cookstove usage)	-Costly to place sensors on all cookstoves in the home across many households, therefore hard to measure displacement -Accurate, repeatable measurements require intensive

		testing for placement on each cookstove model -Dataloggers may not be scalable as they require manual collection and data processing -Wireless sensors require some level of connectivity and power set-up for submission to server, which can be costly and difficult in remote areas -If the wireless sensor is removable, the household could move the sensor onto the baseline mud cookstove and then baseline cooking could get mistaken for new-cookstove cooking -An iButton attached to the lid of an empty pot and left out in the sun reached temperatures of 80 deg. C or higher. This could cause false positives in measuring usage of portable cookstoves or pots. (The manufacturer also warns of this risk.)

3.5 Developing a work plan and sampling matrix

3.5.1 Workplan

A workplan, also known as a Gantt Chart is a high level schedule of main activities that occur over the course of a project. A workplan generally includes major planning, implementation, and follow-up tasks, which are accompanied by project milestones and outputs. Development of the workplan starts with bookmarking the start and end dates of the project. Figure 1 shows an example of a workplan used for a before-and-after stove testing field study.

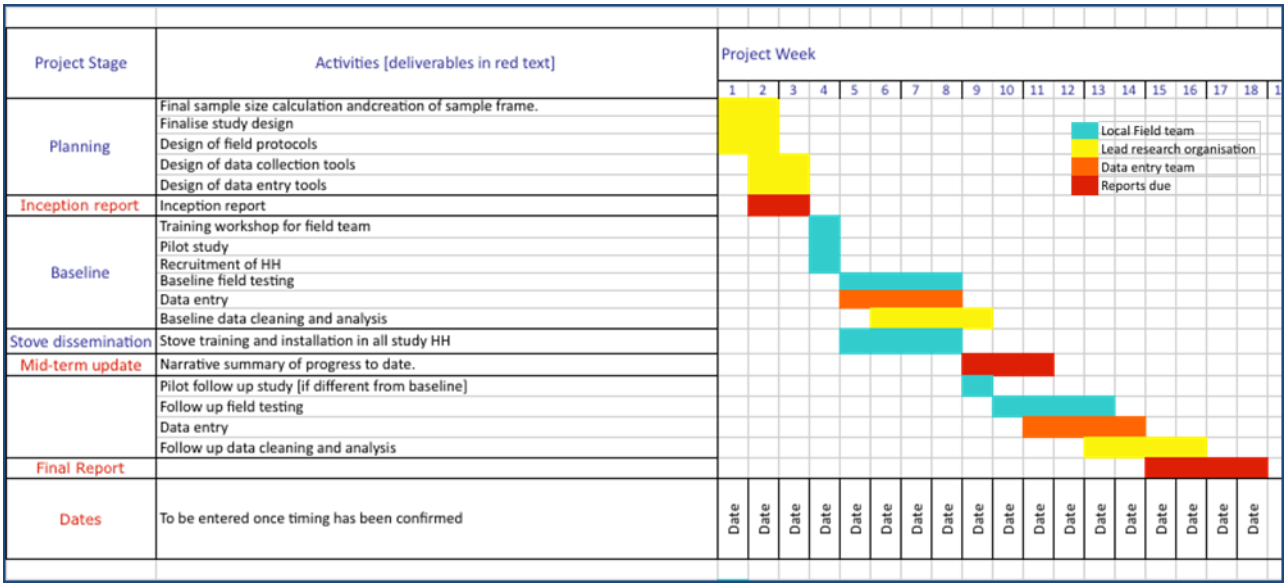


Figure 1 - Workplan example for before-and-after stove testing study

3.5.2 Sampling matrix

Within the workplan, a sampling matrix coordinates specific timing and organization of the measurements. The sampling frame consists of a list of study units - individuals, households, communities, or in the case of field testing stove performance, cookstoves. The list provides a detailed organizational plan for carrying out the measurements, sample by sample, which helps determine how many samples can be measured over a given time period. When designing the sample matrix, there are important factors to consider.

First, the sampling matrix needs to reflect the capacity of the field workers and equipment. The number of homes sampled will be dictated by the number of technicians and equipment sets available. For example, typically a two-technician team can conduct 3-5 uncontrolled cooking tests (UCTs) per day, depending on the cooking times, distance between households, and transportation options.

Second, the sampling matrix should reflect local circumstances. There may be specific days or times when sampling is impractical due to such factors as cultural events and household work schedules (e.g. harvest times). The sampling matrix should also take into account time that the field team will need to rest, check data, and potentially move between sites.

An example sampling matrix is provided in Figure 2 below.

	Week 1							Week 2							Week3							Week 4						
Sample type	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**
Emissions and Fuel	Prep and Practice	6	TC	3	6	2	Off	5	1	4	TC	3	6	Off	2	5	1	4	TC	3	Off	6	2	5	1	4	TC	Off
Emissions and Fuel		TC	1	4	TC	3		6	2	5	1	4	TC		3	6	2	5	1	4		TC	3	6	2	5	1	
Emissions and Fuel			2	5	1			TC	3	6	2	5			4	TC	3	6	2			1	4	TC	3	6		
Emissions and Fuel			3	6	2			1	4	TC	3	6			5	1	4	TC	3			2	5	1	4	TC		
Emissions and Fuel			4	TC	3			2	5	1	4	TC			6	2	5	1	4			3	6	2	5	1		
Fuel		4	5	1	4	TC		3	6	2	5	1	4		TC	3	6	2	5	1		4	TC	3	6	2	5	
Fuel		5	6	2	5	1		4	TC	3	6	2	5		1	4	TC	3	6	2		5	1	4	TC	3	6	
Fuel			TC	3	6			5	1	4	TC	3			2	5	1	4	TC			6	2	5	1	4		
Fuel			1	4	TC			6	2	5	1	4			3	6	2	5	1			TC	3	6	2	5		
Fuel			2	5	1			TC	3	6	2	5			4	TC	3	6	2			1	4	TC	3	6		
	Week 5							**Week 6**							**Week 7**							**Week 8**						
	M	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**	**M**	**Tu**	**W**	**Th**	**F**	**Sa**	**Su**
Emissions and Fuel	3	6	2	5	1	4		TC	3	6	2	6	1		2	Days for makeup												
Emissions and Fuel	4	TC	3	6	2	5		1	4	TC	3	TC	4		3	samples if needed												
Emissions and Fuel	5	1	4	TC	3			2	5	1	4	4	1		5													
Emissions and Fuel	6	2	5	1	4			3	6	2	5	5	2															
Emissions and Fuel	TC	3	6	2	5		Off	4	TC	3	6	6	3	Off							Off							
Fuel	1	4	TC	3	6	2		5	1	4	TC	4	TC		2													
Fuel	2	5	1	4	TC	3		6	2	5	1	5	1		6													
Fuel	3	6	2	5	1			TC	3	6	2	2	6		3													
Fuel	4	TC	3	6	2			1	4	TC	3	3	TC															
Fuel	5	1	4	TC	3			2	5	1	4	4	1															

TC = Traditional Chulha
1,2…n = new stove
320 total UCTs/Site
160 Emission samples
46 samples/stove
Indicates equipment mainenance and data checking

Figure 2 - An example sampling matrix for conducting 320 uncontrolled cooking tests (UCTs) over 7 weeks. In this example, 10 UCTs are typically planned per day, with half of the samples being planned to include fuel consumption and emissions sampling, and the other half including only fuel consumption measurements.

3.5.3 External factors influencing timeline

There are several external factors that can influence the work plan and so require consideration when designing the study schedule. Consultation with the local team should be carried out to identify any religious or cultural festivals/events occurring during the proposed study timeline in the target population. These can often cause the communities to be unavailable to participate in the study or might influence them to cook in ways that are not reflective of normal behavior. Such events can also mean that the field staff will not be available. If conducting the study in an agricultural community, care should be taken to ensure that the harvest and/or planting season will not complicate sampling due to participants' time demands. The influx of migrant workers and use of harvest-specific crop residues for cooking can also alter the normal cooking patterns and performance.

If a before-and-after study design is carried out with the baseline and follow-up data collection periods occurring in different seasons, there is a risk that the results will be confounded by seasonal changes in cooking and fuel use behavior. Although some of the confounding effects of seasonal behavior can be explored and controlled for, it is advisable to conduct the before-and-after sections of the study in the same season. In geographical areas with extreme climatic seasons, possible constraints imposed by the weather should to be taken into account. For example, physical access to the study site might not be possible during the rainy season.

3.6 Planning the field campaign

3.6.1 Roles and responsibilities

Clearly identifying roles and responsibilities of all study personnel during study planning will ensure that the team members have the skills and capacity to fulfill their roles, no part of the work is overlooked, and inefficiency by duplication of work is limited.

3.6.1.1 Organizational chart

All team members need to be aware of their role and how it relates to other members of the team. Having defined the responsibility of each of the working groups in the project, it is useful to create an organizational chart to help to define the inter-relationships in the team.

An example of an organizational chart is provided in Figure 3.

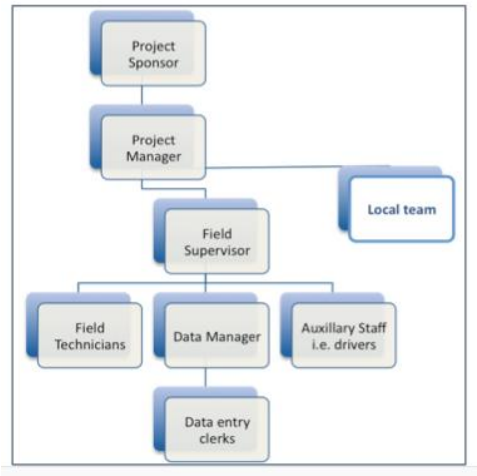


Figure 3 – Example of an organizational chart for a field study

3.6.1.2 Local team

The local team can be the organization conducting the field testing, or can work in an advisory role, which is recommended when third party evaluation is being implemented.

3.6.1.3 Local partner

An organization with direct experience working in the target communities is generally needed to help carry out a field study.

3.6.1.3.1 Local partner expertise

The local organization should be well established and respected in the study community and be familiar with the region's culture and geography. If the local partner has surveying experience or other technical expertise, they may be a good resource for recruiting field team members, especially if the field team selected from the secondary organization does not speak the local language. However, consideration should be given to the potential for bias (observer and reporting), if fieldworkers of the local group belong to the organization disseminating the intervention that is being evaluated.

The local partner is also a valuable resource when determining the most appropriate lodging and transportation for the field team while in the study location. Certain considerations when looking for lodging may be access to reliable electricity, internet, and refrigeration for storing filter samples.

The local partner can also advise on identifying a culturally appropriate participant gift, given as compensation for their time and willingness to take part in the study (see 3.6.2.3.5).

3.6.1.3.2 Local partner responsibilities

The local partner should help identify the necessary permissions required to carry out the fieldwork within the study location. The local partner will then initiate dialogue with all required organizations including local government and other community heads, as appropriate. The local partner will be instrumental in locating suitable participants, as guided by the project manager, and engaging households to determine their interest in participating. A guide from the local organization can help direct the field team during fact-finding sessions, while collecting selection criteria, and sampling.

3.6.1.3.3 Engaging the local partner in study development

During field study arrangements, it is important that the field supervisor or project manager engages the local team. Feedback during survey development is critical for incorporating relevant local cultural customs.

EXAMPLE The survey may need to reflect specific fuel types used, foods cooked, additional sources of smoke, and cooking techniques possibly observed in a given study location.

3.6.1.4 Field team roles

Typical roles and recommended responsibilities for the field team are outlined in sections 3.6.1.4.1 through 3.6.1.4.4.

NOTE Team structure and team member roles can differ substantially from the descriptions presented.

3.6.1.4.1 Project manager

The project manager is a member of the leading research organization. He or she facilitates communication between local field partners, field technicians, and other players involved in the study. This coordination includes ensuring that all individuals are clear on what their roles and responsibilities entail. These roles and responsibilities should be outlined in terms of reference, statements of work, memorandums of understanding, or other documentation.

The project manager is responsible for designing the general workplan (see section 3.5.1, Figure 1) and sampling matrix (see section 3.5.2, Figure 2). This schedule should take into account time needed for study planning, training, transportation, sampling, data downloading, instrument handling, data entry, and other time-intensive activities that take place in the field.

Plans for field transportation, participant incentives, participant selection, and field campaign scheduling should also be led by the project manager, or else delegated to another capable party. The project manager supervises and tracks the progress of all field study arrangements, implementation, and post-field activities.

3.6.1.4.2 Field supervisor

The field supervisor should have experience coordinating technical fieldwork, be well organized, and be able to effectively manage time and people. The field supervisor has many responsibilities and can have immense influence on the success of a field campaign. The main tasks fall loosely into four categories:

1) *Participant identification and selection* – The field supervisor works with representatives from the local team to identify and recruit potentially suitable households within the study area. It is important that the

person carrying out the recruitment is experienced, confident, and knowledgeable about the study and the topic of focus, and is aware of cultural sensitivities.

2) *Team management* – The field supervisor will work with the project manager, field team, and local partner to develop a detailed daily and weekly sampling matrix within the general workplan developed by the project manager. The schedule should be reviewed by the local partner for insight on unforeseen obstacles, such as holidays and significant cultural events that could lead participants to be occupied with activities differ from their typical day (i.e. harvesting) or seasonal transportation difficulties. It is highly recommended that the field supervisor speak the same language as the field team.
3) *Equipment handling* – The preparation of equipment, supplies, and instrumentation should be overseen by the field supervisor, with tasks delegated to field technicians as appropriate. The field supervisor should pay special attention to the quality assurance and control measures for maintaining and checking equipment.
4) *Data checking and safe storage* – The field supervisor is also expected to ensure that the surveys are correctly administered by checking survey forms for completeness, errors, and legibility (if using paper forms).

After arranging participant appointments and outlining the field sampling matrix, the field supervisor should confirm safe transportation for the entire field team, including any local guides or translators.

Once at the field site, it is the field supervisor's responsibility to ensure that the tests are being performed according to the protocol, that the field team is interacting with the participants appropriately, and that the team is working in a safe environment.

The field supervisor should hold regular team meetings to discuss any issues that arise during data collection.

3.6.1.4.4 Data manager

The data manager role may be filled by the project manager, field supervisor, or other personnel with the skills to understand and process the study data. The field supervisor can be responsible for checking the survey form database as well as downloading, labeling, and storing the electronic data from the monitoring equipment. It is recommended that the data manager is supported by at least one data entry technician, who may be one of the field technicians.

The data manager should create a data storage system that works best for him or her, the project manager, and the rest of the team. One suggestion is to use a cloud-based server with shared access for the team. The data manager should download all instrument data daily and uploaded to the server. It is important to have internet access so the server can sync to the cloud and be accessible by the project manager for quality assurance checks.

3.6.2 Participant interaction

3.6.2.1 Ethics committee approval

Depending on the type of field study being conducted, approval from a committee that reviews the ethical considerations of the study parameters may be required. An institutional review board (IRB), also referred to as an independent ethics committee (IEC), ethical review board (ERB), or research ethics board (REB), reviews study details for research on human subjects and determines whether the study follows ethical guidelines that protect the health and privacy of the subjects.

Depending on the implementing institution, study country, or partner organization, the type of IRB and the requirements for approval can vary. Independent research into the relevant country- and institution-specific requirements should guide the IRB application process.

3.6.2.2 Informed consent

For recruited households that have met the screening criteria and have indicated interest in participating in the study, the next step is to obtain informed consent to enter their home and carry out the study. The consent may come directly from the participant, or in some cultures, if the participant is female, it is expected that permission be granted from both the participant and the male head of household. The local partner should be able to provide guidance on local customs and expectations.

3.6.2.2.1 Consent form

The consent form should contain a detailed description of all procedures including time demands and all possible risks to the participant and their family members. The form should also include a member of the research team's contact information in the event the participant has questions or problems during the course of the study. Section 4.2 provides an example of an informed consent form.

3.6.2.2.2 Obtaining consent

The consent form should be read out to all people who need to give consent in the language of their choice. Both parties, the person giving and the person gaining consent, should then sign two copies of the form. If the participant is illiterate, two study team members should sign the form stating that the consent was informed and willing. A copy of the form should be left with participant.

If consent is given, it needs to be done on the basis of an informed decision without any coercion or bribery.

3.6.2.2.3 Gifts and payments

Small payments or gifts should be given only at the end of the study. See 5.3.2.3.5, Parting gift.

3.6.2.2.4 Consent form storage

Consent forms should be stored in a secure safe place, ensuring participant confidentially.

3.6.2.3 In-home data collection protocols

3.6.2.3.1 Arrival at the home

When talking with the participants or their families, the technician needs to be seen as someone who can be trusted to hold possibly sensitive and confidential information and should, therefore, be well dressed, polite to everyone in the home, and reliable. The technician should introduce him/herself and any other team members. Inform the participant of the expected time that the monitoring will take place and ensure the visit is still convenient for the participant.

3.6.2.3.2 Before beginning data collection

Before starting the interview/monitoring the technician should make sure that they:

a) are speaking to the right person for the monitoring;

b) ensure the correct ID number appears on all pages of the paper form and, if necessary, all pieces of equipment/supplies, such as filter holders.

3.6.2.3.3 During data collection

During the interview/monitoring the technician should**:**

a) ask all questions/carry out all procedures in the order they appear on the form;

b) not add anything to the questions; each person should be asked exactly the same questions, in the same way;

c) not tell the participant what to answer; if they do not understand the question, repeat it to them and allow them time to think;

d) always take the answers from the participant and not anyone else who may be watching;

e) record all answers during the visit (do not rely on memory);

f) complete all responses as clearly as possible;

g) make a note if the participant is unwilling or unable to answer; do not leave the box/ space blank as it may look like the researcher has forgotten to ask the question.

If a respondent gives an answer that appears inconsistent with another answer, in a sensitive manner, ask them to explain and list the question number and explanation at the end of the survey form in the space for surveyor observations.

3.6.2.3.4 Closing the interview

At the end of the interview the technician should thank the participant for their time and ask if they have any questions.

3.6.2.3.5 Parting gift

It is recommended that the study team provide a small gift as remuneration to the participants for their time and inconvenience. It is preferable to give this at the end of the study as a gift rather than at the beginning as an incentive to allow an unbiased decision to participate.

The value of the gift should be appropriate for the time and inconvenience demanded by the study. The local team can provide idea for gifts of this value that will be welcomed by the participants.

To avoid biasing the study results it is recommended not to give items such as food or fuel that could potentially affect the way the household cooks, as even when given at the end of the study, inter-household communication could have substantial impact. Rather, the gift should be given to the participant as a symbol of appreciation for their time and to reinforce their participation.

3.6.2.3.6 Final procedures

Before leaving the home the technician should look through the form and check that all parts and pages have been filled in, making sure any issues that occurred during the monitoring/survey are noted. Remove all equipment from the home and ensure the home is left as it was on arrival.

3.6.3 Mitigating bias and managing uncertainty

Mitigating bias and managing measurement uncertainty are critical for controlling the quality of the data collected during a field measurement campaign. Field measurements of cookstoves and cookstove systems are largely dependent on the cookstove operator. As with all studies dependent on human subjects, cookstove field studies are almost invariably subject to measurement bias.

3.5.3.2 Measurement error

Measurement error is expected in all types of measurements. It is the difference between a measured value and the true value, and can stem from systematic error or random error.

3.6.3.3.1 Systematic error

Systematic error is predictable and can be minimized if the source of the error can be identified.

Making sure all instruments are working and well calibrated, as well as following appropriate measurement protocols and instrument manuals, will minimize systematic error.

3.6.3.3.2 Random error

Random error, which is always present, is unpredictable and caused by natural measurement fluctuations, contributing to measurement variability.

Random error is expected but should average out to approximately zero with an appropriate sample size. Determining and reporting statistical measures of spread, such as standard deviation and interquartile range, help to define the extent of random error in a measurement.

In-field measurements, which are typically much less controlled than laboratory testing, are prone to greater random error and tend to be more variable. Measurement variability is natural, and contributes to the uncertainty of the measurement. Uncertainty can be managed by increasing the sample size number, which provides more confidence in whether a measurement is, or is not, reproducible.

Refer to 3.2, Sample size concepts and conventions, for further guidance.

3.6.3.3.3 Reporting guidelines

When reporting data, always include measures of spread such as the range, the interquartile range (IQR), variance, and standard deviation, to help contextualize test results and to help others when designing similar studies. One way to characterize uncertainty is to report the range in which 95% of the comparable measurements are expected to fall, referred to as 95% confidence intervals.

For more information on statistical analysis for calculating uncertainty and variability of a dataset, see Taylor (1996).

3.6.4 Quality assurance and control

Systematic bias can be minimized with good quality assurance and quality control practices.

3.6.4.1 Labeling and tracking

Instrumentation should be labeled with a unique identification number so that its functionality and response can be recorded and tracked. Using a QA/QC worksheet (see Figure 4 in 4.3.1 for an example), track all project instrument calibration, cleaning, maintenance, and functionality to ensure your instrument response is stable and equipment is being regularly attended to throughout the project.

3.6.4.2 Instrument maintenance

3.6.4.2.1 Calibration

Instrumentation should be calibrated according to protocol at the beginning and end of the study, and, if possible, weekly during field testing.

3.6.4.3.2 Testing

All instruments should be tested before fieldwork begins, and instrument response should be tracked during the campaign, to ensure that the instrument is running properly. If the instrument logs data, plotting test data before the field campaign begins, as well as regularly throughout the project, is advised to visually inspect whether the instrument is functioning correctly.

3.6.4.3.3 Battery power

If instrumentation requires replaceable batteries, rechargeable batteries are recommended along with a battery-charging unit that can accommodate a full set of replacement batteries to charge overnight between sampling days. If the instrument has internal batteries, it is important to charge the internal battery overnight for the following day.

3.6.4.3.4 Storage

During the field study, instruments should be stored in a dedicated, clean, dry, and safe space. Storage of instrumentation and supplies should be organized, and access to instrumentation should be restricted to those who require it to fulfill their roles and responsibilities.

3.6.4.3.5 Transport

Equipment should be securely packed and organized when going to and from the field. It is recommended that as much setup as possible be completed at the staging area (hotel/office) to minimize time spent installing equipment in homes. Equipment checklists should be used daily, before heading to the sampling site to ensure that no needed equipment or supplies are left behind.

When traveling with and shipping supplies and equipment long distances, there are measures that help protect equipment, samples, and instrumentation. Points to remember:

a) Remove batteries from equipment.
b) Conservatively cushion equipment with ample padding and pack securely.
c) Carry equipment in a hard carrying case, such as a hard walled suitcase.
d) Carry particulate filters that have been deployed on frozen ice packs to preserve the samples.
e) Avoid shipping or checking laptops in baggage.

3.6.5 Data management

Performance data is calculated from the combination of data collected via sampling forms, surveys, questionnaires, and instrumentation. Consolidating this data into a database for analysis requires several steps, for which various practices can help ensure an efficient, high quality process that minimizes errors.

3.6.5.1 Paper forms

3.6.5.1.1 Data entry and storage

The following steps should be followed for proper entry and storage of data collected via paper forms (surveys, questionnaires, and sampling forms):

1. The field supervisor should check survey forms before data entry starts to ensure most missing/unexplained data has been addressed.
2. Data entry staff should not make changes to the data itself, even if it is thought to be incorrect. All issues identified should be documented and communicated to the field supervisor to discuss the most appropriate way to address them.
3. Data should be entered into the data spreadsheet (such as an Excel or Access spreadsheet) designed to support the study survey form. Ensure the survey form and spread sheet correspond.
4. When all data on the survey form is entered in to the data spreadsheet, save the file and initial the survey form to indicate that the data has been entered. Note any issues that arose when entering the data. If no problems have arisen, store the forms in a secure location, organized in numerical order using the study ID number.
5. At the end of each data entry session, ensure the electronic file is backed up (e.g., by using a shared cloud-based server) and saved to project the folder. Include dates and version numbers in file names so the most current file can be easily identified.

3.6.1.1.2 Quality assurance

Once data entry is complete, there are several recommended quality assurance checks that should be implemented to ensure a complete, consistent and accurate database. It is recommended that the field supervisor or project manager carry out this task.

1. Check that the total number of survey forms entered matches the total expected number.
2. Review the spreadsheets for any anomalies such as:
    a) Duplicate household ID numbers.
    b) Large unexplained outliers or data that is extremely different from the same variables in other households;
    c) Unexplained gaps in data (other than for skip patterns);
    d) Numbers/dates entered in the wrong format, such as moisture meter readings not expressed as a percentage.
    e) Numbers not listed as a possible response when representing categorical data.

    EXAMPLE The options are 1-4, and 6 has been entered.

    NOTE A well-designed data spreadsheet will incorporate validation checks incorporated to prevent this type of error from occurring.

    f) Two numbers entered when only one is requested.

    EXAMPLE 4 and 5 entered instead of 4.5.

    g) Inconsistencies in different parts of the survey form.

    EXAMPLE 1 Final fuel weights recorded for charcoal when there was no initial charcoal mass.

    EXAMPLE 2 Total recorded study time over 5 hours when only tea and coffee was made.
3. If any anomalies are identified, the survey form should be consulted and the correct data entered if available.
4. If the database requires amendment, save a new version of the file so it is always possible to revert to the original.

3.6.5.2 Instrument data

3.6.5.2.1 Data entry and storage

Instrument data should be downloaded daily into secure, backed up folders. Using a shared, cloud-based server for backing up and sharing with the team is recommended.

3.6.5.2.2 Quality assurance

Files should be labeled according to standard file name conventions. Data streams should be checked for completeness and quality using QA/QC algorithms and/or visualization such as time series plots of data. Examples of these QA/QC procedures and a data processing template can be found in Section 4.

3.7 Logistical Considerations

When planning the study schedule it is important to factor in the time it takes to have key elements in place. Examples of logistical areas to consider include obtaining permissions, supplies, staff, and travel clearance.

3.7.1 Ensuring accessibility

The field site should be readily accessible to the field team, with safe, clean lodging and transport options. Cultural factors may also need to be considered, especially where religious practices may influence who can interact with participants or be present within households.

3.7.2 Local permissions

Obtaining the necessary permission from local political/ administrative leaders can often take time and resources. Advice should be taken from the local team as to who permission should be gained from, as well as the pathways through which it should be acquired. Further, authorization is often required from collaborating institutions, such as universities. Gaining approval from institutional review boards (IRB) can be a detailed and slow process (see 3.7.2.1). It is important to verify the permission(s) required to carry out the study at the early stages of planning.

3.7.3 Supplies

If ordering supplies or equipment, the possible delays created by limited product availability, shipping, and clearing customs should be considered. Calling the company selling the needed equipment to inquire about lead times is recommended.

3.7.4 Staff

The time required to hire high quality project staff needs to be factored into the planning, as well as their availability once hired. A common practice of using university students as surveyors sometime constricts the fieldwork to times during the university vacations.

3.7.5 Travel clearance

Depending on the country of citizenship and study location, visa applications for travelling project members can sometimes take considerable time to be processed.

4. Example data collection instruments and consent forms

4.1 Selection criteria example survey

Table 8 provides an example of a short selection criteria survey used in the field to screen potential participants for an uncontrolled cooking test.

The criteria are based on factors such as presence of commercial cooking in homes, people cooked for, and fuel and cookstove use patterns, to ensure a sample that has representative cooking patterns without extreme fuel demands associated with commercial cooking, larger than average numbers of people eating at home, or festivals/celebrations.

This template may be edited and adapted to meet the needs of individual studies.

Table 8 – Example screening form for an uncontrolled cooking test

If the answer to any of the questions below [1-4] is 'NO' omit the participant from the study.	Yes No
1. Is the primary cook willing to take part? (Explain what would be required)	
2. Does the participant use the baseline wood burning cookstove daily? (Note: does not have to be exclusive use)	
3. Does the participant cook in a secure location protected from wind and rain, and direct sun?	
4. Do they have enough fuel in the home for cooking during the emissions tests?	
If the answer to any of the questions below [5-6] is 'YES' omit the participant from the baseline survey	Yes No
5. Does the participant prepare food and/or drink for commercial sale?	
6. Are there any events taking place during the sampling or just after the sampling* that would dramatically increase or decrease the amount of cooking that will be happening? Ask about events such as festivals; wedding/funerals, large influx of migratory workers/ visitors etc.	

*Or in the 1-2 days immediately after the study period if they are starting to prepare food early.

4.2 Informed consent form

An example of an informed consent form follows.

Uncontrolled Cooking Test: Emissions of Cookstove X

India Consent Form

Hello, my name is [Interviewer name]. We are working for (organization name). We are carrying out a study on cookstove fuel use and air pollution emissions. The purpose is to find out how well different cookstoves work in homes to reduce smoke and fuel consumption. Emissions will only be measured in half of the homes included in the study.

If you agree to take part in the study, the study team will visit you 15-30 minutes before you plan to begin cooking to measure the fuel use, and possibly smoke emitted from your cookstove, during a cooking event. We will measure all fuels used to complete a cooking event by weighing your fuel inventory before-and-after you cook. If emissions are measured during the event, we will set up equipment that measures the air pollution just above the cookstove. The setup will take approximately 30 minutes, will remain in place until the cooking event is done, and will take another 15 minutes to disassemble once cooking is completed. The instruments are safe and make very little noise. We may also ask you a few questions about your cooking practices and take some photographs of your fuels, cookstove, and kitchen area.

If you agree to take part, you are free to withdraw at any time. All of the information we collect will be kept confidential, so it will not be possible to identify you or any member of your family in the reports that are produced from the study. In exchange for participating in this study, you will receive _____ to thank you for participating.

If you have any questions about the study at any time, you can contact us at the numbers below. I would now like to ask you whether you would like to take part, and whether you have any questions.

(Select one)

Accepted		Declined	

Print Name of Participant _____ ID (House) _____

Signature of Participant _____

Signature of husband if required _____

Interviewer [Print name and Sign] _____ _____

Date: ____ / ____ / 20_____

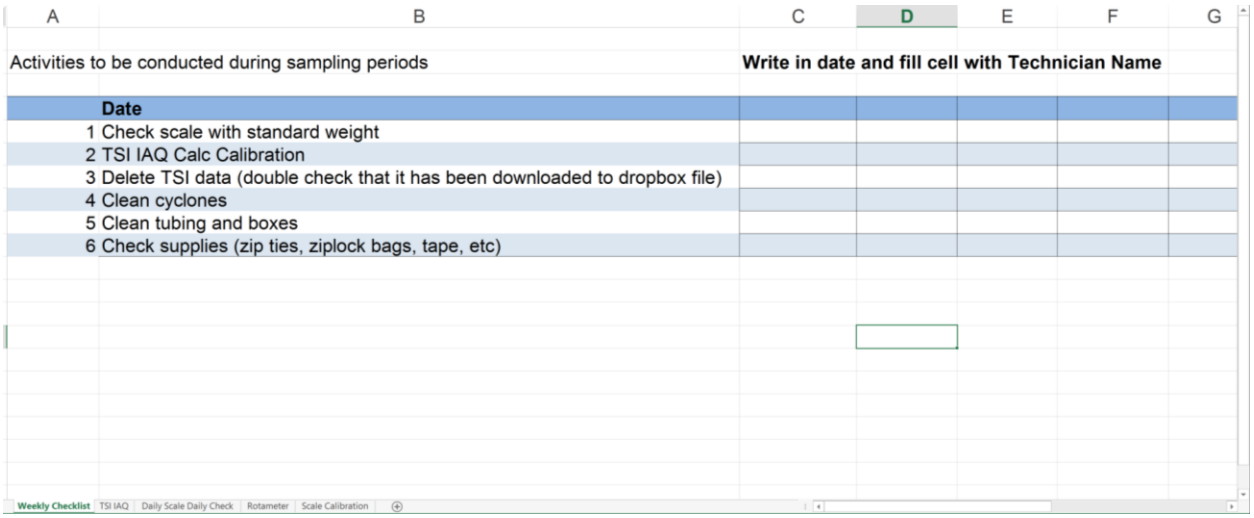
If you have any questions, you may contact us at:

NAME AND CONTACT INFO OF FIELD SUPERVISOR	NAME AND CONTACT FOR PROJECT MANAGER

4.3 Spreadsheet examples for quality assurance and instrument maintenance

4.3.1 Quality assurance and quality control

Figure 4 provides an example of a weekly checklist for tracking quality assurance and quality control. Enter the date and the initials of the technician who completed the task in the corresponding cell. The TSI IAQ Calc is a CO/CO2 meter.



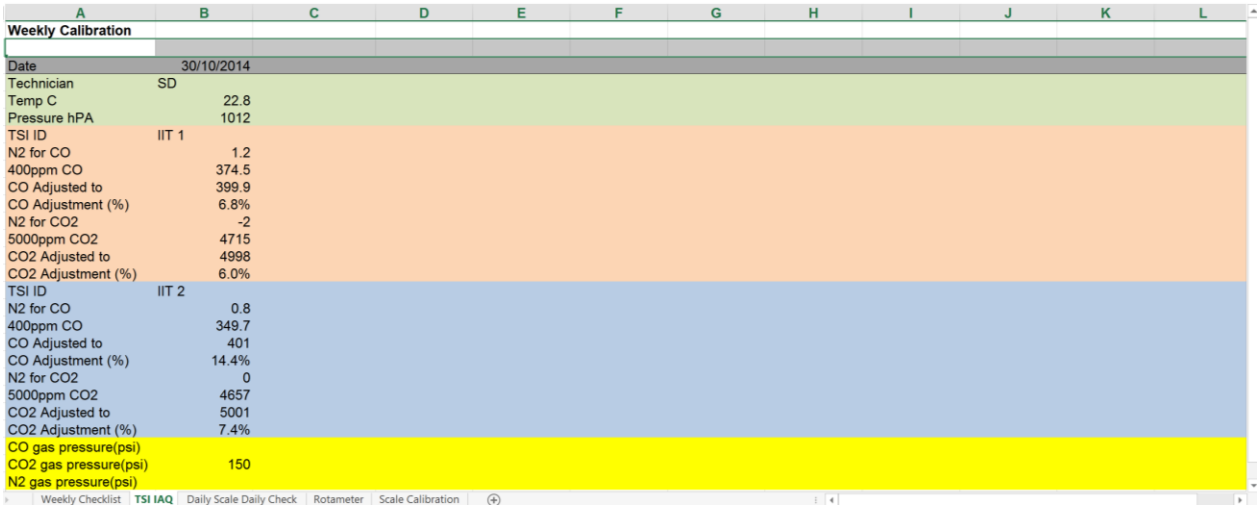
	A	B	C	D	E	F	G
	Activities to be conducted during sampling periods		Write in date and fill cell with Technician Name				
		Date					
1		Check scale with standard weight					
2		TSI IAQ Calc Calibration					
3		Delete TSI data (double check that it has been downloaded to dropbox file)					
4		Clean cyclones					
5		Clean tubing and boxes					
6		Check supplies (zip ties, ziplock bags, tape, etc)					

Weekly Checklist | TSI IAQ | Daily Scale Daily Check | Rotameter | Scale Calibration

Figure 4 – Weekly checklist for tracking completion of QA/QC tasks

4.3.2 Calibrating CO/CO2 meter

Figure 5 provides an example of a spreadsheet tracking weekly calibration of a CO/CO2 meter. Note the pressure of all three calibration tanks when calibrating. If below 150 psi, purchase new calibration tank.



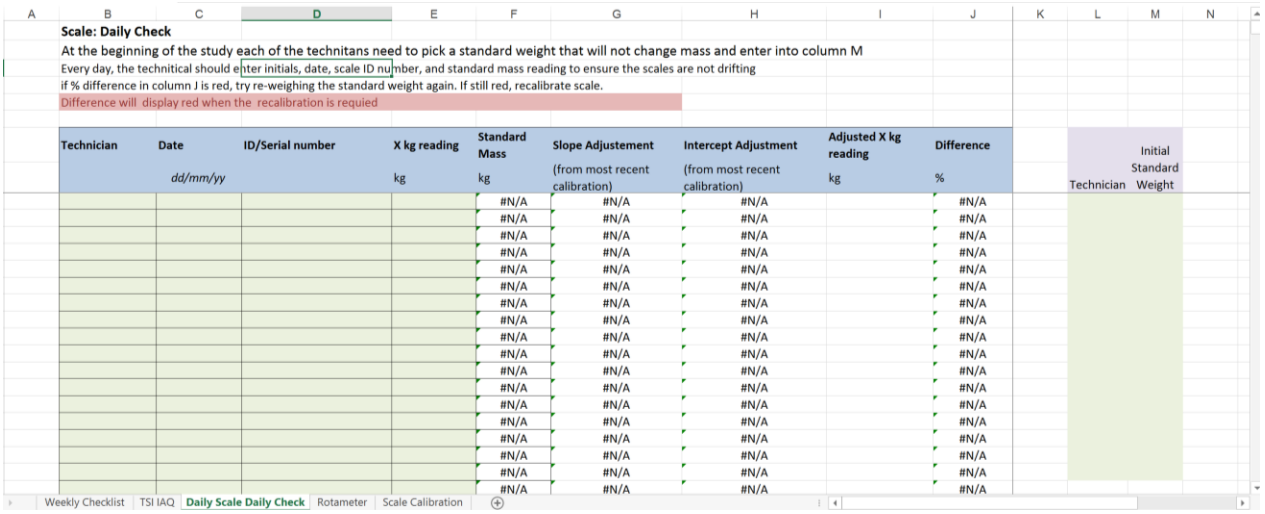
	A	B
	Weekly Calibration	
	Date	30/10/2014
	Technician	SD
	Temp C	22.8
	Pressure hPA	1012
	TSI ID	IIT 1
	N2 for CO	1.2
	400ppm CO	374.5
	CO Adjusted to	399.9
	CO Adjustment (%)	6.8%
	N2 for CO2	-2
	5000ppm CO2	4715
	CO2 Adjusted to	4998
	CO2 Adjustment (%)	6.0%
	TSI ID	IIT 2
	N2 for CO	0.8
	400ppm CO	349.7
	CO Adjusted to	401
	CO Adjustment (%)	14.4%
	N2 for CO2	0
	5000ppm CO2	4657
	CO2 Adjusted to	5001
	CO2 Adjustment (%)	7.4%
	CO gas pressure(psi)	
	CO2 gas pressure(psi)	150
	N2 gas pressure(psi)	

Weekly Checklist | TSI IAQ | Daily Scale Daily Check | Rotameter | Scale Calibration

Figure 5 – Template for calibrating the CO/CO2 meter (TSI IAQ calc), to be completed weekly

4.3.3 Daily scale check

Figure 6 provides an example spreadsheet for recording daily scale checks. Record the initial standard mass for each technician. Check daily that the scales are replicating the same reading for the standard weight by weighing the standard object and making sure that the % difference is less than 2.4%.



Scale: Daily Check

At the beginning of the study each of the technitans need to pick a standard weight that will not change mass and enter into column M

Every day, the technitical should enter initials, date, scale ID number, and standard mass reading to ensure the scales are not drifting

if % difference in column J is red, try re-weighing the standard weight again. If still red, recalibrate scale.

Difference will display red when the recalibration is requied

Technician	Date	ID/Serial number	X kg reading	Standard Mass	Slope Adjustement	Intercept Adjustment	Adjusted X kg reading	Difference
	dd/mm/yy		kg	kg	(from most recent calibration)	(from most recent calibration)	kg	%
				#N/A	#N/A	#N/A		#N/A

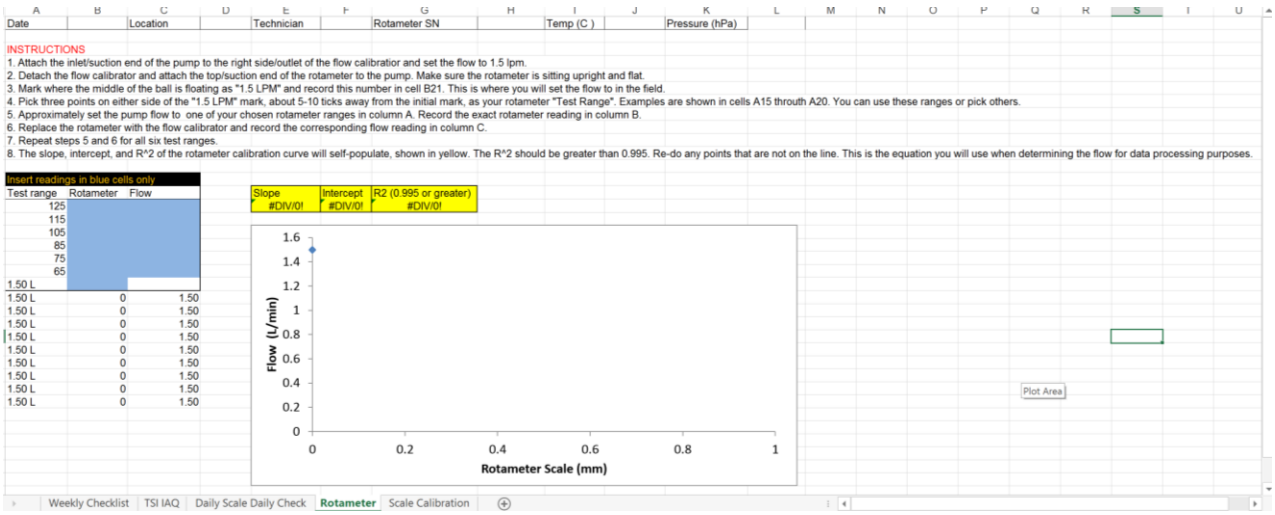
Technician	Initial Standard Weight

Weekly Checklist | TSI IAQ | Daily Scale Daily Check | Rotameter | Scale Calibration

Figure 6 – Daily scale check

4.3.4 Rotameter air flow calibration

Figure 7 provides an example spreadsheet for tracking rotameter air flow calibration.



Date | Location | Technician | Rotameter SN | Temp (C) | Pressure (hPa)

INSTRUCTIONS

1. Attach the inlet/suction end of the pump to the right side/outlet of the flow calibratior and set the flow to 1.5 lpm.
2. Detach the flow calibrator and attach the top/suction end of the rotameter to the pump. Make sure the rotameter is sitting upright and flat.
3. Mark where the middle of the ball is floating as "1.5 LPM" and record this number in cell B21. This is where you will set the flow to in the field.
4. Pick three points on either side of the "1.5 LPM" mark, about 5-10 ticks away from the initial mark, as your rotameter "Test Range". Examples are shown in cells A15 throuth A20. You can use these ranges or pick others.
5. Approximately set the pump flow to one of your chosen rotameter ranges in column A. Record the exact rotameter reading in column B.
6. Replace the rotameter with the flow calibrator and record the corresponding flow reading in column C.
7. Repeat steps 5 and 6 for all six test ranges.
8. The slope, intercept, and R^2 of the rotameter calibration curve will self-populate, shown in yellow. The R^2 should be greater than 0.995. Re-do any points that are not on the line. This is the equation you will use when determining the flow for data processing purposes.

Insert readings in blue cells only

Test range	Rotameter	Flow
125		
115		
105		
85		
75		
65		
1.50 L		
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50
1.50 L	0	1.50

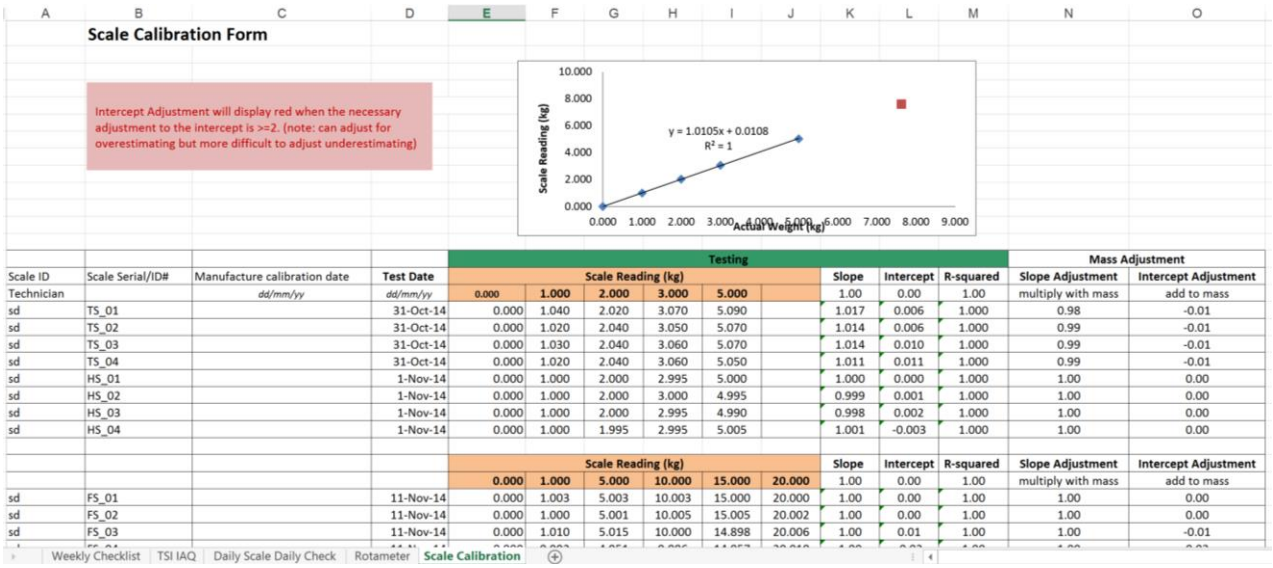
Slope	Intercept	R2 (0.995 or greater)
#DIV/0!	#DIV/0!	#DIV/0!

Weekly Checklist | TSI IAQ | Daily Scale Daily Check | Rotameter | Scale Calibration

Figure 7 – Rotameter air flow calibration form

4.3.5 Scale calibration

Figure 8 provides an example spreadsheet for tracking scale calibration. Use at least four standard weights of known mass that span the scale's working range to complete scale calibration.



Scale Calibration Form

Intercept Adjustment will display red when the necessary adjustment to the intercept is >=2. (note: can adjust for overestimating but more difficult to adjust underestimating)

				Testing										Mass Adjustment	
Scale ID	Scale Serial/ID#	Manufacture calibration date	Test Date	Scale Reading (kg)						Slope	Intercept	R-squared	Slope Adjustment	Intercept Adjustment
Technician		dd/mm/yy	dd/mm/yy	0.000	1.000	2.000	3.000	5.000		1.00	0.00	1.00	multiply with mass	add to mass
sd	TS_01		31-Oct-14	0.000	1.040	2.020	3.070	5.090		1.017	0.006	1.000	0.98	-0.01
sd	TS_02		31-Oct-14	0.000	1.020	2.040	3.050	5.070		1.014	0.006	1.000	0.99	-0.01
sd	TS_03		31-Oct-14	0.000	1.030	2.040	3.060	5.070		1.014	0.010	1.000	0.99	-0.01
sd	TS_04		31-Oct-14	0.000	1.020	2.040	3.060	5.050		1.011	0.011	1.000	0.99	-0.01
sd	HS_01		1-Nov-14	0.000	1.000	2.000	2.995	5.000		1.000	0.000	1.000	1.00	0.00
sd	HS_02		1-Nov-14	0.000	1.000	2.000	3.000	4.995		0.999	0.001	1.000	1.00	0.00
sd	HS_03		1-Nov-14	0.000	1.000	2.000	2.995	4.990		0.998	0.002	1.000	1.00	0.00
sd	HS_04		1-Nov-14	0.000	1.000	1.995	2.995	5.005		1.001	-0.003	1.000	1.00	0.00
				Scale Reading (kg)						Slope	Intercept	R-squared	Slope Adjustment	Intercept Adjustment
				0.000	1.000	5.000	10.000	15.000	20.000	1.00	0.00	1.00	multiply with mass	add to mass
sd	FS_01		11-Nov-14	0.000	1.003	5.003	10.003	15.000	20.000	1.00	0.00	1.00	1.00	0.00
sd	FS_02		11-Nov-14	0.000	1.000	5.001	10.005	15.005	20.002	1.00	0.00	1.00	1.00	0.00
sd	FS_03		11-Nov-14	0.000	1.010	5.015	10.000	14.898	20.006	1.00	0.01	1.00	1.00	-0.01

Weekly Checklist | TSI IAQ | Daily Scale Daily Check | Rotameter | Scale Calibration

Figure 8 – Scale calibration form

4.4 Suggested survey questions for measuring technology usage

1. Net Promoter Index Score: Would you recommend this cookstove to a family member or friend?
2. Instead of asking them what they don't like about the cookstove. Ask them what they think others may not like about the cookstove in their village
3. How many hours a day do you cook? How many meals do you cook?
4. Why did you buy the cookstove? (Finding out why they bought the cookstove could help explain why they may be disappointed with the cookstove, and thus do not use it much. Perhaps they did not get what they expected out of the cookstove)
5. How many cookstoves do you own? (This is important, because the more cookstoves they own, the less likely they are to adopt just one cookstove)
6. How many people do you cook for? (Larger household sizes will have a hard time just relying on one cookstove)
7. Do you own electric or gas? (This may be easier for them to use, and therefore they may not have needed the new cookstove in the first place)
8. How often does your cookstove break down? (This helps inform how durable the cookstove has been.)
9. Please sketch an ideal cookstoves that would best fit b ideal cookstove from a user perspective

4.5 Benchmark assessment

The benchmark assessment is used to measure user friendliness of a cookstove.

The purpose the benchmark assessment is to help a manufacturer measure the degree of user satisfaction with the cookstove design and operation.

NOTE There are limitations with measuring user-friendliness because there will be bias with self-reporting.

Benchmark Assessment

In order to claim user-friendliness of a cookstove, you should answer YES to 80% of these questions
(all questions are modified from ASTAE report on user needs)

1. Does the cookstove respond to the context and specific needs in which it will be used?
2. Does the cookstove meet the cooking needs of the household (eg: family size, kitchen size, types of food/cooking practices
3. Can the cookstove be used with the fuel that is locally available and affordable for the end user? OR Is the fuel needed for the cookstove easily attained and acquired?
4. Lighting (ignition) should not take more than 10 min to attain full power
5. Fire power control it should be easy to udjust as desired (high, midium or low).
6. Some question on height
7. IS it easy to operate (need to be more specific)
8. Is it easy to clean?
9. Does the cookstove meet the aesthetic desires of the household?

Recommended Survey Question for Users:

Ask the user: If there are any changes we could make to the cookstove that would fit your needs? Or how could the cookstove be made better?

4.6 Placement form example

Household ID		Surveyor Initials		# Buttons Placed		Date	
CSMs Placement Form							

	Main traditional stove	Secondary traditional stove	Ambient [if none enter N/A]	Intervention Stove
Visit 1				
Stove Type				
CSMs serial Number				
CSMs sticker				
Placement date [dd/mm/yyyy]				
Placement time [24 hr]				
Location [full description]				
Photo taken?				

Comments				
Visit 2				
Removal date [dd/mm/yyyy]				
Removal time [24 hr]				
CSMs serial number				
Download time [24 hr]				
Max temp				
Min temp				
Name of CSV file (if downloading data manually)				
CSMs serial if new CSMs needed				
Time of replacement [24 hr] (if removed)				
Location, if different from before				
Comments				
	Main traditional stove	Secondary traditional stove	Ambient [if none enter N/A]	Intervention Stove
Visit 3 – Last Visit				
Removal date [dd/mm/yyyy]				
Removal time [24 hr]				
CSMs serial number				
Download time [24 hr]				
Max temp				
Min temp				
Name of CSV file (if downloading data manually)				
Mission Disabled? [y/n]				
Comments				

4.7 Stove usage survey examples

The following surveys were developed for usage and adoption workshops hosted by Winrock International and United States Environmental Protection Agency by Berkeley Air Monitoring Group to assess cookstove usage patterns and perceptions.

These are sample questions only. Not all questions need to be included in the survey and others can be added to meet your study aims and objectives. They can also be in any order you think works best for your study community. Surveys can be repeated at subsequent visits to track patterns over time.

As these questions are taken from multiple surveys the numbering does not always flow correctly- this will need to be edited in your final version.

These questions are designed for the main cook.

[*Italic text in brackets is a question or instruction for the surveyor and is not to be read aloud*]

MA means multiple answers are allowed. SA means single answer only.

The design of this paper survey means that codes for repetitive categorical variables appear on a separate coding sheet.

If asking for photographs, ensure they are clear and informative and describe the location and condition of the stoves in detail. Each photo should **clearly show the HH ID number card**.

4.7.1 Example Questions for Exploring Stove Use in Control Homes

<table>
<tr><th colspan="6">B. Stove and Kitchen Area Observation.</th></tr>
<tr><td colspan="6">[Please ask the participant to show you the cooking area. If possible please go to this area rather than the participant bring the stove(s) to you.]</td></tr>
<tr><td>B1</td><td colspan="4">[Please take a photograph of the main cooking area in the household, including if applicable ALL stoves in that location. Enter a 1 in box when done. If you are unable to take a picture enter 99]</td><td></td></tr>
<tr><td rowspan="4">B2</td><td rowspan="2">[On arrival at the home, what stoves, could you see in the cooking area?]</td><td rowspan="2">[Use stove codes. The stoves you see do not have to match the stoves listed in C2]</td><td>Stove 1</td><td>Stove 2</td><td>Stove 3</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="2">[What was the status of these stoves on your arrival at the home?]</td><td rowspan="2">[Use ‘stove status’ codes]</td><td>Stove 1</td><td>Stove 2</td><td>Stove 3</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>B3</td><td colspan="5">[Please note any other observations in kitchen on arrival at home</td></tr>
</table>

C. Stove use					
C1	How many different types of stoves do you currently use **at least one time** in a week? *[Please note that this refers to number of stoves, not stove types. That is, if a household uses two stoves of the same type, mark 2.]*				
C2	Please list all the stoves that you use at least once per week. *[Use stove codes. MA allowed. Ensure they list the same amount as the number given for C1. Describe here if other]*	1st stove type	2nd stove type	3rd stove type	4th stove type

Primary cooking device			
C3	What would **you say** is the stove type you **currently** use **most of the time**? [SA]	*[Single answer. Use stove codes. Describe here if other]*	
C4	What fuel do you usually use on that stove at this time of year?	*[Use fuel codes]*	
C5	On average, how many days per week do you use this stove?	*[Enter number of days per WEEK]*	
C6	On the days it is used, how many meals per day do you use this stove?	*[Enter number of meals per day]*	
C7	What do you like **the most** about this cookstove, if anything?	*[Record one answer. DO NOT PROMPT. Use code sheet]*	
C8	What else do you like about the cook stove you value apart from what you have mentioned?	*[MA. DO NOT PROMPT. Use code sheet]* *[If they do not like more than the one thing entered in C7, enter 66]*	
C9	If any, what is the **biggest challenge** you experience with this cookstove?	*[Record one answer. DO NOT PROMPT. Use code sheet]*	
C10	Are there any other challenges with this cookstove?	*[MA. DO NOT PROMPT. Use code sheet. If they do not have more than the one challenge entered in C9, enter 66]*	
C11	How long ago did you purchase, receive or build this stove?	*[Record in months. If stove is the three stone fire, enter 99]]*	
C12	Did you purchase, receive or self-build this cookstove?	Purchased	1
		Self-built	2

		Received as gift from family	3
		Received as donation from non-family i.e. NGO	4
		Other [*describe*]	99
C13	How much did this stove cost to buy or build?	*[If it was a gift enter 0 and go to the next question* *If the stove is a three stone fire, enter 99 and go to C17]*	
C14	Have you ever repaired this stove?	No [go to C17]	0
		Yes	1
C15	How long ago was the last repair?	*[months]*	
C16	How much did that last repair cost you?	*[ENTER CURRENCY]*	
C17	Does the type of stove you use as your primary stove change during year? If yes, please describe in what way and why it changes.	No	0
		Yes [*please describe*]	1
Secondary cooking device			
C 18	What is type is your secondary stove? [*If no secondary stove enter 77 and go to C35*]	*[Use stove codes. Record one answer. Describe here if other]*	
C 19	How many **days per week** do you use this 2nd stove?	*[Enter number of days per WEEK]*	
C 20	On the days it is used, how many meals per day do you use this secondary stove?	*[Enter number of meals per day]*	
C 21	When did you purchase/receive/build this stove?	*[Record month and year.* *If stove is the three stone fire, enter 99]*	
C22	What do you like **the most** about this cookstove, if anything?	*Record one answer. Use code sheet]*	
C23	If any, what is the **biggest challenge** you experience with this cookstove?	*Record one answer. Use code sheet]*	

Tertiary cooking devices			
C24	Do you have any other stoves that you use **less than once per week?**	Yes	1
		No [Go to C27]	2
C 25	What stove types is it (are they)?	*[Use codes. MA allowed. Describe here if other]*	
C 26	On what occasions are they used? *[MA. Do not prompt]*	Weddings/festivals	1
		When visitors come	2
		When there is no dry/good wood available	3
		When I have the fuel I need	4
		Other [describe]	99
Simultaneous stove use			
C27	Do you ever use TWO STOVES at the SAME TIME?	*1=Yes* *2=No – go to C29*	
CX	On average how many times per week do you use TWO STOVES at the SAME TIME?	*[Times per WEEK]*	
C28	Why do you need to use two stoves at the SAME TIME?	To make two dishes at the same time	1
		When I am in a rush	2
		When cooking for large numbers	3
		When heating water and cooking	4
		When making animal feed and cooking	5
		Other [describe]	99
C29	Which stove do you usually use to cook [ENTER COMMONLY COOKED FOOD_1]?	[*Use stove codes. If they don't make this food enter '88'*]	
C30	Which stove do you usually use to cook ENTER COMMONLY COOKED FOOD_2?	[*Use stove codes. If they don't make this food enter '88'*]	
C31	Which stove do you usually use to cook ENTER COMMONLY COOKED FOOD_3?	[*Use stove codes. If they don't make this food enter '88'*]	
C32	Which stove do you usually use to cook ENTER COMMONLY COOKED FOOD_4?	[*Use stove codes. If they don't make this food enter '88'*]	

C33	Which stove do you usually use to cook hot drinks such as tea/coffee?	[*Use stove codes. If they don't make this food enter '88'*]	
C34	Which stove do you usually use to warm bathing water?	[*Use stove codes. If they don't do this task enter '88'*]	
Seasonal patterns			
C35	Does the amount of time you spend using your **stoves** change during the year? This can include cooking food for your family as well as other stove related tasks such as heating water for bathing, preparing animal feed etc.	Yes	1
		No [Go to C38]	2
C36	Do you currently spend **more or less** time using your stove **than at other times of the year**? [SA]	More [Answer C37]	1
		Less [Answer C3X]	2
C37	For what reasons do you currently spend **more** time using your **home stove** than at other times of year? *[Do not prompt. MA select all that apply*]	To heat the rooms for people	1
		To heat rooms for animals	2
		To heat bathing water	3
		Making more animal feed	4
		Fuel is plentiful	5
		Cook different types of food	6
		Cook for more people	7
		Many festivals happening at this time of year.	8
		Other *[Circle 99 and describe below]*	99
C3X	For what reasons do you currently spend **less** time using your **home stove** than at other times of year? *[Do not prompt. MA select all that apply*]	Do not need to heat room(s) for people	1
		Do not need to heat rooms for animals	2
		There is less fuel available	3
		Do not need to make animal feed.	4
		Cook different types of food	5
		Cook for less people	6
		We spend most of the day in the fields.	7
		There is little food available	8

		There are no festivals happening this time of year.	9
		Other *[Circle 99 and describe below]*	99

Other stove uses					
C38	Do you ever use a fire or stove for heating yourself or your rooms?			No [*go to C42*]	0
				Yes	1
C39	Which stove do you **currently** use for heating yourself or rooms?			[*Use stove codes. If no current space heating, put 99*]	
C40	Do you ever use this stove for the purpose of **only heating when not using** it for cooking?			No	0
				Yes	1
C41	For how many months of the year do you usually heat your rooms? [*If necessary help with this calculation using the seasons]*			[Months]	
C42	Do you carry out any of the following tasks on your stove or fire? If yes, which stove or fire do you use? [*Read though the list- if they use their stove for that task please enter a 1 in the first column and then the code for the stove type used. Then ask if they use their stove for any other purpose.]*			Enter 1 if do task. 0 if not	Stove code
		C4 2.1	Insect repellent		
		C4 2.2	Lighting		
		C4 2.3	Making animal feed		
		C4 2.4	Warming bathing water		
		C4 2.5	Making medicines		
		C4 2.6	Other [*describe*]:		
C43	Comments and observations				

Consider adding questions on decision making within the household in the demographic section.

XXX	Who makes the decisions in this house regarding the purchase of large household items?	I do alone	1
		I do with my spouse	2
		My mother does alone	3
		My father does alone	4
		My parents do together	5
		Other [describe]	99

Finally, consider asking the control group about knowledge of improved cookstoves and reasons for not having purchased them. Examples of possible questions are below.

D. Aspirational stoves				
D1	Which improved or modern cook stoves do you know of? *[Do not prompt. MA allowed]*	ENTER NAMES OF AVAILABLE ICS IN THIS MARKET		1
		XXX		2
		XXX		3
		XXX		4
		Other [describe]: _____		99
		Don't know what they are [Go to D6]		88
		Know about them but don't know their names		77
D2	Are you interested in owning any of these cookstoves? If so which one (s)? [*If yes circle '1' then enter codes from D1.* *If they didn't know the name of the stove enter 77. MA allowed]*	Yes	1 →	Enter code from D1
		No *[Go to T5]*	2	
D3	Why would you like to buy this stove? *[Do not prompt MA allowed]*	Saves fuel		1
		Looks stylish / attractive		2
		Less smoke		3
		Easier to light		4

		Cooks faster	5
		Better space heating	6
		Other [Describe]	99
D4	What are the main reasons you have not bought one of these yet? *MA allowed*	Too expensive	1
		Not available to buy in my community and other store is too far	2
		Don't know where to go to find one.	3
		The required fuel not easily available	4
		The HH decision maker doesn't see the value	5
		Other [Describe]	99

D5	What price would you be willing to pay for this stove(s)? *[If they mentioned more than one stove in D2 please ensure you get all a price for each. Use codes from D1]*	Stove 1 **code**	Stove 1 price	Stove 2 **code**	Stove 2 price
D6	Any questions or comments from participants.				

4.7.2 Example Questions for Exploring Stove Use in New Acquisition Group

B. Stove and Kitchen Area Observation.					
[Please ask the participant to show you the cooking area. ***If possible please go to this area rather than the participant bring the stove(s) to you****.]*					
B1	*[Please take a photograph of the main cooking area in the household, including if applicable ALL stoves in that location. Enter a 1 in box when done. If you are unable to take a picture enter 99]*				
B2	[*On arrival at the home, what stoves, could you see* ***in the cooking area?]***	*[Use stove codes. The stoves you see do not have to match the stoves listed in section C]*	Stove 1	Stove 2	Stove 3

			Stove 1	Stove 2	Stove 3
	[*What was the status of these stoves on your arrival at the home?]*	*[Use 'stove status' codes]*			
B3	*[If the [ENTER INTERVENTION STOVE NAME]* ***is not in the kitchen*** *please ask where it is and why it is not in the kitchen area. Write everything the participant says down below.]*				
B4	[Please note any other observations in kitchen on arrival at home				

C. Stove use			
Previous stove use			
CX	Before purchasing the [INSERT NAME OF INTERVENTION STOVE] which stove type did you use most of the time?	*[Single answer. Use stove codes. Describe here if other]*	
CX	What fuel did you usually use on this stove?	*[Use fuel codes]*	
CX	If any, what were the main advantages of this cookstove for you?	*[Record one answer. DO NOT PROMPT. Use code sheet]*	
CX	What else do you like about this stove apart from what you have already mentioned?	*[MA. DO NOT PROMPT. Use code sheet. If they only like the one thing given in CX, enter 66]*	
CX	If any, what were the main challenges/problems with this cookstove?	*[Record one answer. DO NOT PROMPT. Use code sheet]*	
CX	Are there any other challenges/problems with this cookstove?	*[MA. DO NOT PROMPT. Use code sheet. If they do not have more than the one challenge entered in CX, enter 66]*	
CX	Did you purchase, receive or self-build this cookstove?	*Purchased*	1
		Self-built	2
		Received as gift from family	3

		Received as donation from non-family i.e. NGO	4
		Other [describe]	99
CX	How much did this stove cost to buy or build?	*[If it was a gift enter 0 and go to the next question* *If the stove is a three stone fire, enter 99 and go to CX]*	
CX	How long ago did you purchase, receive or build this stove?	*[Record in months]*	
CX	Have you ever repaired this stove?	*No [go to CX]*	0
		Yes	1
CX	How long ago was the last repair?	*[months]*	
CX	How much did that last repair cost you?	*[ENTER CURRENCY]*	
CX	Before purchasing the [INSERT NAME OF INTERVENTION STOVE] did the type of stove you used as your primary stove change during year? If yes, please describe in what way and why it changes.	*No*	0
		Yes [please describe]	1

Current Stoves					
C1	How many different types of stoves do you **currently use at least one time** in a week? *[Please note that this refers to number of stoves, not stove types. That is, if a household uses two stoves of the same type, mark 2.]*				
C2	Please list all the stoves that you use at least once per week. *[Use stove codes. MA allowed. Ensure they list the same amount as the number given for C1. Describe here if other]*	1st stove type	2nd stove type	3rd stove type	4th stove type
Primary cooking device					
C3	What would **you say** is the stove type you **currently** use **most of the time**? [SA]	*[Single answer. Use stove codes. Describe here if other]*			
C4	What fuel do you usually use on that stove at this time of year?	*[Use fuel codes]*			
C5	On average, how many days per week do you use this stove?	*[Enter number of days per WEEK]*			
C6	On the days it is used, how many meals per day do you use this stove?	*[Enter number of meals per day]*			

Secondary cooking device			
C7	What is type is your secondary stove? [*If no secondary stove enter 77 and go to C11*]	*[Use stove codes. Record one answer. Describe here if other]*	
C8	How many **days per week** do you use this 2nd stove?	*[Enter number of days per WEEK]*	
C9	On the days it is used, how many meals per day do you use this secondary stove?	*[Enter number of meals per day]*	
C10	Why do you choose this stove to be your secondary rather than primary stove? *[DO NOT PROMPT Write down everything the participant says*].		
C11	*[Is the [INSERT NAME OF INTERVENTION STOVE] listed as either the primary or secondary device?]*	Yes [Go to C14]	1
		No	2
C12	How many days per week do you use the [INSERT NAME OF INTERVENTION STOVE]?	*[Enter number of days per week. If less than weekly enter a 0]*	
C13	On these days, how many meals per day do you prepare with this stove?	*[Enter number of meals per day]*	
Tertiary cooking devices			
C14	Do you have any other stoves that you use **less than once per week?**	Yes	1
		No [Go to C17]	2
C 15	What stove types is it (are they)?	*[Use codes. MA allowed. Describe here if other]*	
C 16	On what occasions are they used? *[MA. Do not prompt]*	Weddings/festivals	1
		When visitors come	2
		When there is no dry/good wood available	3
		When I have the fuel I need	4
		Other [describe]	99
Simultaneous stove use [*Please note if the HH has **only has one stove** please skip this section and go to question C26]*			
C17	Do you ever use TWO STOVES at the SAME TIME?	*1=Yes*	

		2=No – go to C19	
CX	On average how many times per week do you use TWO STOVES at the SAME TIME?	*[Times per WEEK]*	
C18	Why do you need to use two stoves at the SAME TIME?	To make two dishes at the same time	1
		When I am in a rush	2
		When cooking for large numbers	3
		When heating water and cooking	4
		When making animal feed and cooking	5
		Other [describe]	99
C19	Which stove do you usually use to cook [ENTER COMMONLY COOKED FOOD_1]?	[*Use stove codes. If they don't make this food enter '88'*]	
C20	Which stove do you usually use to cook ENTER COMMONLY COOKED FOOD_2?	[*Use stove codes. If they don't make this food enter '88'*]	
C21	Which stove do you usually use to cook ENTER COMMONLY COOKED FOOD_3?	[*Use stove codes. If they don't make this food enter '88'*]	
C22	Which stove do you usually use to cook ENTER COMMONLY COOKED FOOD_4?	[*Use stove codes. If they don't make this food enter '88'*]	
C23	Which stove do you usually use to cook hot drinks such as tea/coffee?	[*Use stove codes. If they don't make this food enter '88'*]	
C24	Which stove do you usually use to warm bathing water?	[*Use stove codes. If they don't do this task enter '88'*]	
C25	[*If they use a stove other than the [ENTER INTERVENTION STOVE NAME] for cooking any of the foods or tasks above, please ask why they don't use the [ENTER INTERVENTION STOVE NAME] for this task(s)? [Write down everything the participant says*].	Item	Reason
		[Food type 1]	
		[Food type 2]	
		[Food type 3]	
		[Food type 4]	
		Hot drinks	
		Bath water	

Seasonal patterns			
C26	Does the amount of time you spend using your **stoves** change during the year? This can include cooking food for your family as well as other stove related tasks such as heating water for bathing, preparing animal feed etc.	Yes	1
		No [Go to C30]	2
C27	Do you currently spend **more or less** time using your stove **than at other times of the year**? [SA]	More [Answer C28]	1
		Less [Answer C29]	2
C28	For what reasons do you currently spend **more** time using your **home stove** than at other times of year? *[Do not prompt. MA select all that apply*]	To heat the rooms for people	1
		To heat rooms for animals	2
		To heat bathing water	3
		Making more animal feed	4
		Fuel is plentiful	5
		Cook different types of food	6
		Cook for more people	7
		Many festivals happening at this time of year.	8
		Other *[Circle 99 and describe below]*	99
C29	For what reasons do you currently spend **less** time using your **home stove** than at other times of year? *[Do not prompt. MA select all that apply*]	Do not need to heat room(s) for people	1
		Do not need to heat rooms for animals	2
		There is less fuel available	3
		Do not need to make animal feed.	4
		Cook different types of food	5
		Cook for less people	6
		We spend most of the day in the fields.	7
		There is little food available	8
		There are no festivals happening this time of year.	9
		Other *[Circle 99 and describe below]*	99
Other stove uses			
C30		No [*go to C34*]	0

	Do you ever use a fire or stove for heating yourself or your rooms?			Yes	1
C31	Which stove do you **currently** use for heating yourself or rooms?			[*Use stove codes. If no current space heating, put 99*]	
C32	Do you ever use this stove for the purpose of **only heating when not using** it for cooking?			No	0
				Yes	1
C33	For how many months of the year do you usually heat your rooms? [*If necessary help with this calculation using the seasons]*			[Months]	
C34	Do you carry out any of the following tasks on your stove or fire? If yes, which stove or fire do you use? [*Read though the list- if they use their stove for that task please enter a 1 in the first column and then the code for the stove type used. Then ask if they use their stove for any other purpose.]*			Enter 1 if do task. 0 if not	Stove code
		CX .1	Insect repellent		
		CX .2	Lighting		
		CX .3	Making animal feed		
		CX .4	Warming bathing water		
		CX .5	Making medicines		
		CX .6	Other [*describe*]:		
C35	Comments and observations				

D. Perceptions of the Stove: Potential Drivers for Uptake and Adoption			
D4	If anything, what do you like **the most** about the [ENTER INTERVENTION STOVE NAME] ?	*[Record one answer. DO NOT PROMPT. Use code sheet]*	

D5	What else do you like about the ENTER INTERVENTION STOVE NAME apart from what you have mentioned?	*[Multiple answers allowed. DO NOT PROMPT. Use code sheet]* *[If they do not like more than the one thing entered in D4, enter 66]*	
D6	If any, what is the **biggest challenge** you experience with the ENTER INTERVENTION STOVE NAME?	*[Record one answer. DO NOT PROMPT. Use code sheet]*	
D7	Are there any other challenges with this cookstove?	*[Multiple answers. DO NOT PROMPT. Use codes. If they do not have more than the one challenge entered in D6, enter 66]*	
D11	If you could make any changes to the ENTER INTERVENTION STOVE NAME to make it easier or more pleasant for you to use, what would they be? *[MA Do not prompt]*	Allow it to retain heat longer	1
		Make it larger	2
		Make it more portable/lighter to move	3
		Allow it to take wet wood.	4
		Make it out of stronger materials	5
		Allow it to take larger pieces of wood.	6
		No changes suggested	7
		Other [describe]_____	99
D12	What do you think of the quality of the ENTER INTERVENTION STOVE NAME stove?	High / good quality	1
		Moderate quality [Go to D14]	2
		Poor quality	3
D13	If poor or high quality what features/ issues make you say this? [*Write down everything the participant says]*		
D14	How easy is to use the ENTER INTERVENTION STOVE NAME?	Easy	1
		Moderate [Go to D16]	2
		Difficult	3
D15	If easy or difficult why is this?		

	[*Write down everything the participant says]*		
D16	Compared to your previous primary stove, how safe do you think the ENTER INTERVENTION STOVE NAME is?	Safer	1
		Same as my previous stove [Go to D18]	2
		More dangerous	3
D17	If safer or more dangerous please describe the reasons for this. [*Write down everything the participant says]*		
D18	Comments and observations		

Consider adding in questions on decision making within the household in the demographic section.

XXX	Who makes the decisions in this house regarding the purchase of large household items?	I do alone	1
		I do with my spouse	2
		My mother does alone	3
		My father does alone	4
		My parents do together	5
		Other [describe]	99

Finally, consider observing and asking about damage and repair at the 3-month visit. Examples of questions you could use are below.

B6	*[How would you describe the appearance of the* ENTER INTERVENTION STOVE NAME?	Used and well cared for	1
		Used but dirty and not well cared for	2
		Not recently used and covered in dust/cobwebs	3
		No signs of recent use and clean	4

		CM stove not available to examine. [Go to B22]	5
		Other [describe]_____	99
B7	*[Please take a photograph that shows the **APPEARANCE and STATUS** of* ENTER INTERVENTION STOVE NAME *on arrival at the home. Cobwebs/ in process of cooking etc. Enter a 1 in box when done. **If unable to take a picture enter 99]***		
[If possible now please take a close inspection of the ENTER INTERVENTION STOVE NAME*, looking at all aspects of the stove, including if possible it's under side. Now please complete the following questions]*			
B8	*[Are there any signs of wear and tear or deterioration such as discoloration /small scratches or marks?]*	Yes	1
		No [Go to B11]	2
B9	*[Please describe the signs of wear and tear that you see]*		
B10	*[Please take a photograph of the **WEAR AND TEAR on the*** ENTER INTERVENTION STOVE NAME***.** Enter a 1 in box when done. **If unable to take a picture enter a 99]***		
B11	*[Does the* ENTER INTERVENTION STOVE NAME *appear to be currently damaged or broken?]*	Yes	1
		No and none reported by cook *[Go to B17]*	2
		Not able to fully check as cooking currently happening but none seen and none reported by cook. *[Go to B17]*	3
		Other [describe]_____	99
B12	*[Please fully describe the damage to the* ENTER INTERVENTION STOVE NAME*]*		
B13	*[Please take a photograph that shows **ANY DAMAGE/BREAKAGE to the*** ENTER INTERVENTION STOVE NAME***.** Enter a 1 in box when done. **If unable to take a picture enter a 99]***		
B14	Please ask: when did this damage occur? *[Enter month]*		
B15		Yes	1

	Please ask: Does this damage affect the stove performance in anyway?	No [Go to B17]	2
B16	Please describe how the damage is impacting on or stopping your use of the stove. [*Write down everything the participant says.]*		
B17	Since receiving the ENTER INTERVENTION STOVE NAME has it been damaged but has **since been repaired**?	Yes	1
		No [Go to B22]	2
B18	Please describe the damage that occurred which has now been repaired. *[Write down everything the participant says*]		
B19	Is the stove now working properly after being repaired?	Yes [Go to B21]	1
		No	2
B20	What problems do you still experience with the stove since it was repaired? *[Write down everything the participant says*]		
B21	Who repaired the stove?	I did myself/other family member	1
		The stove producer mended the stove for free.	2
		The stove producer mended the stove for a fee	3
		Other [describe]_____	4
B22	How much did the repair cost?	[INSERT CURRENCY]	

B23	Comments and observations.

4.8 Example form for collecting fuel consumption data

Date: _____

Description:_____

Fuel type: _____ Fuel notes:

Fuel wet weight before: _____ (kg / g / lbs)

Fuel wet weight after: _____ (kg / g / lbs)

Ash dry weight after: _____ (kg / g / lbs)

Total wet fuel weight: _____ (kg / g / lbs)

[before – after – ash]

Fuel moisture sample before drying (wet): _____ (kg / g / lbs)

Fuel moisture sample after drying (dry): _____ (kg / g / lbs)

Fuel fraction dry: _____ [dry weight sample/wet weight sample]

Total dry fuel used: _____ (kg / g / lbs)

[Total wet fuel weight □ Fuel fraction dry]

4.9 Questions for safety risk assessment committee

1. Have you suffered any burns or scalds when cooking with the cookstove in the last xx months?
2. If yes, how many times have you been burnt or scalded when cooking in the last xx months?
3. How severe was the most severe burn or scald during this period?
4. How did this burn or scald occur?

5. Compared to your previous cookstove, how safe do you think the [*new cookstove*] is? (You could the respondent to rate this!
6. Please describe the ways in which you feel that the *[new cookstove]* is **safer** than your previous cookstove?
7. Please describe the ways in which you feel that the *[new cookstove]* is **more dangerous** than your previous cookstove?
8. What temperature range for the outside cookstove surface should be considered as safe for household use?

4.10 Durability user survey questions

1. Does the cookstove last as long as is promised?
   (i.e., If you guarantee the cookstove will last for 1 year, does it actually last? Or does it break?
2. Do you know what happens to your cookstove after 3 months of use? 6 months? 1 year?
   (Is it still functional?)
3. Are there any signs of wear and tear or deterioration such as rusting/ corrosion on the cook cookstove?
4. Does the cook cookstove appear to be currently damaged or broken?
5. Could fully describe the damage to the cookstove or take the picture of the damage on the cookstove for further assessment after field work
6. How long ago did this damage occur?
7. Does this damage stop or in any way impact on your use of the cookstove?

4.11 Example informed consent forms

4.11.1 Semi structured interview

An example consent form for a semi-structured interview follows.

CONSENT TO PARTICIPATE IN RESEARCH

Semi Structured Interviews (SSI)

Introduction:

My name is *[name of team member]*. I work with [*organization name*]. I am a member of the team of researchers that is studying the way households in the community use fuel. I would like to talk with you about the fuel you use on your cookstoves for cooking and heating your home, how you collect and use that fuel and how this changes during the year.

We have selected you to help us as a representative of your community. We would like to interview people from a total XXX households in the village. This consent form is to invite you to participate in the study and describe what is involved if you choose to participate.

Purpose:

The purpose of the study is to explore the **fuel and cookstove use patterns** of your community and particularly how these behaviors vary through the year according to seasons, agricultural demands, migratory habits and other cultural activities. The information you provide will be used to help us deign a larger study in the region.

Procedures:

If you agree to help us with this part of the study, I will do the following at your home at an agreed time:

1. My colleague _____ and myself will meet with the primary cook and if carried out by a different person, the person responsible for the fuel collection and storage for this household.
2. We will then ask you a series of questions about your fuel and cookstove use at this time of year and during other seasons. We are interested in your thoughts and opinions and so there are no right and wrong answers.
3. We would like your permission to take notes and audio record the conversation during the interview.
4. We would like your permission to take photographs of your cooking and fuel storage areas. Faces and other identifying features will only been included in the photograph if you wish them to appear.

Time Commitment

Participation includes one interview that will last approximately XX minutes plus the time required to take photographs.

Study Location:

This study will take place at your house.

Benefits:

There are no direct benefits to you from participation in this study. However, the information you provide will guide a much larger study into the **impact of household fuel use on health and the environment**. This may also inform and motivate programs that aim to provide more efficient fuels and heating technologies to houses in your community and other regions that rely on biomass for heat.

Risks/Discomforts:

Beyond those risks that exist in your daily life, there are no known risks associated with the equipment or procedures that we will be use. There may be some inconvenience due to giving us some time away from your normal daily activities. We will try to time the interview to minimize these inconveniences.

Confidentiality:

The information we collect from you will be handled as confidentially as possible. If results of this study are published or presented, individual names or household identifiers or other personally identifiable information will not be used.

All study data will be kept in password-protected computers and databases.

To minimize the risks to confidentiality we will remove your name and other identifiable details from the study database. In the databases, your house will be identified only by an anonymous household number. The key to linking your name with the household number will be kept securely in a separate password-protected database, accessible only to a very few of our researchers who are highly trained in protecting confidentiality.

When the research is complete, we will keep the information we have obtained in this study for at least 5 years for possible use in future research done by this study team or others to whom permission is given. However long we retain the information collected, we will continue to maintain it with the same high level of confidentiality as referred to above.

Compensation/Payment:

We will pay you Rs. XXX as a small compensation for your participation in this study.

Costs of Study Participation:

There will be no costs to you or your household for participating in this study.

Rights

Participation in this research is completely voluntary. You have the right to decline to participate or to withdraw at any point in this study, including any time after your participation is complete, without

penalty or loss of benefits to which you are otherwise entitled. We will delete the data we have collected from you and your household from the study database.

Questions

If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact: [xxx]

CONSENT

I have had the opportunity to consider all the information presented and had my questions answered. I will voluntarily participate in the interview study. I give consent for [ask them to initial each box]:

To take part in the interview at the time mutually convenient time.	
For notes to be taken during the interview	
For audio recording of the interview	
For photographs to be taken in my home	

I understand that I will be provided with a signed copy of this consent form.

Name:	
Signature:	
Date:	

Witnessed by:

I confirm that the consent information was accurately explained and that the subject appeared to me to understand the information and informed consent was given freely:

[Note: If subject is illiterate, then the witness should be a person other than the person administering the informed consent]

Name:	
Signature:	
Date:	

4.11.2 Kitchen performance test

An example consent form for a kitchen performance test follows.

Informed Consent To Participate in Research

Introduction

To be read out by the fieldworker to the primary cook and if applicable head of household:

My name is _____, and I work with [*organisation name*]. Together with the University of Illinois in the USA we are conducting a study in Nepal to understand patterns of fuel use on cookstoves for cooking and heating homes. We want to understand the fuel use on cookstoves and heaters in households like yours.

What is involved?

We would like to invite you to join this additional part of the study. If you agree to take part in the study, it would involve the study team visiting your home in [*enter length of time until first visit*] weeks and then again every 3 months for one year.

Each visit will involve the same procedures. We would like to visit your home up to three times:

1. I will arrive at your house before breakfast to set up a small device in the chimney of your cookstove, or above your cookstove, that will sample smoke. This sampling device makes a small amount of noise when turned on but poses no risk to you or your family. We will turn on the sampling equipment and leave house. We may come in to check our equipment a few times throughout your cooking. We will repeat this a second time during the day.
2. I will place small air sampling device on a wall of the room where your main cookstove is. These devices measure the concentration of particles and carbon monoxide in the air. The particle devices will measure during the day that I am sampling smoke emitted by your cookstove in (1). The carbon monoxide sensor will stay in your house for between 2-6 days.

We may make a visit to your home again in 3 months, 6 months and 9 month to carry to the same procedures.

Compensation

There will be no costs to you for participating in the study. As a token of appreciation for your participation, you will be given a small gift at the end of the study.

Confidentiality

All of the information obtained from you during the monitoring survey will be kept confidential. Your name and other identifying information about you will not be reported anywhere. After this monitoring study is completed, we may save the field notes for use in future monitoring studies by others or myself. However, the same confidentiality guarantees given here will apply to future use of the materials. Any photos taken will not contain images of any individuals in this monitoring study unless permission is obtained from each individual concerned.

Risks

If you agree to take part, you are free to withdraw at any time. We will do everything we can to keep your personal information confidential. There are no other foreseeable risks.

At any time, if you have any questions or concerns we have provided a local contact below.

Agreement to consent

Do you have any questions? Yes / No

Do you agree to participate in this study? Yes/ No

SIGNATURE PAGE FOR PARTCIPANT- Leave in household

Household ID number_____

Name of study participant _____ (print)

Signature of main cook or household head

I have had the opportunity to consider all the information presented and had my questions answered. I will voluntarily participate in the interview study. I give consent for [ask them to initial each box]:

To be take part in the study and allow the research team to visit my home 4 times in the next year.	
For photographs to be taken in my home.	

I understand that I will be provided with a signed copy of this consent form.

Signature: Date:

Name of person obtaining consent _____(print)

Signature of person obtaining consent: _____

If the participant can not read or write please get a second person to witness and confirm that the field team representative has read this form to the participant and that they fully understand it and signed without coercion.

Name of person witnessing consent _____(print)

Signature of person witnessing consent: _____

Persons to Contact

If you have any questions about this monitoring study, you may contact either of the following:

In Nepal	**In USA**
xxx	xxx
We would like to thank you for considering participating in this study.	

SIGNITURE PAGE FOR STUDY RECORDS- Take back to office.

Household ID number_____

Name of study participant _____ (print)

Signature of main cook

I have had the opportunity to consider all the information presented and had my questions answered. I will voluntarily participate in the interview study. I give consent for [ask them to initial each box]:

To be take part in the study and allow the research team to visit my home 4 times in the next year.	
For photographs to be taken in my home.	

I understand that I will be provided with a signed copy of this consent form.

Signature: Date:

Name of person obtaining consent _____(print)

Signature of person obtaining consent: _____

If the participant can not read or write please get a second person to witness and confirm that the field team representative has read this form to the participant and that they fully understand it and signed without coercion.

Name of person witnessing consent _____(print)

Signature of person witnessing consent: _____

5. Factors affecting cookstove performance

This section contains prompts to aid study teams in considering all aspects of cookstoves and cooking systems, behaviors, and environments that can affect cookstove performance.

5.1 Fuel properties

Type, species, moisture content, & condition: split, sawn, chopped, chipped, with bark, recycled from previous fire.

Calorific value, shape, size, form (pellets/briquettes/sticks), preparation, elemental analysis, chemical composition, liquid, gas, solid, packaging,

5.2 Cooking vessel sizes and number of cooking vessels

Shape, dimensions, material, mass, volume, lid, service type such as a rice steamer with internal tray, rice cooker, pressure cooker, kettle, cooking, frying, wok, baking tray, double-boiler.

The vessel is a contributing variable to stove performance as it is where the heat transfer is occurring. The features of the vessel (e.g., shape, dimensions, material) define the surface and the thermal properties of the heat exchanger. It is therefore part of the system being tested and should be reported with the stove performance. The following parameters characterize the vessel used along with the stove. For each type of vessel used, theses parameters should be collected during field observations and reported with field performance. It also represents valuable information to reproduce in the laboratory the conditions observed in the field.

- Shape: What is the geometry of the vessel? Does it have a flat or round bottom?
- Dimensions: What are the main dimensions of the vessel (diameter, height, thickness)?
- Material: In which material is the vessel made of?
- Mass: What is the mass of the vessel?
- Volume: What is the capacity of the vessel?
- Lid: Is the vessel used with a lid? Is the lid used during the entire cooking and/or heating process?
- Insulation: Is the vessel insulated?
- Skirt: Is the vessel used with a skirt?
- Service type: For what type of service is the vessel used for?
- Number of vessels: How many vessels are used during the cooking and/or heating process? Are they used one after the other or simultaneously?

5.3 Stove description

Purpose, function(s): cooking, lighting, space heating, drying, social functions.

Materials, chimney description & height, installation, purpose, ventilation (fans), controls, cooking height

Homemade or produced elsewhere, portable or fixed, dimensions, presence or absence of hood,

Maintained by user or other parties, traditional/advanced, purchased, presence or absence of stove skirt.

5.4 User behavior during the burn cycle

Preparation, cleaning, fueling level, lighting techniques, tending, refuelling behaviour,

End of cycle behaviour, extinguishing technique, cooking vessel load and multiple cooking vessel use, and cooking vessel management.

Clearly describe this behavior in terms of burn cycle: Ignition, power management, cooking vessel management, extinction, cleaning.

5.5 User behavior: lighting techniques, tending, tasks

Lighting techniques: different lighting techniques can influence how a stove performs. Most common practices include use of fire starting materials (e.g., twigs, papers, leaves, kerosene, plastic items). The fire starting materials can lead to smoke production if not well combusted.

Task: adding more fuel to the stove or while tending fuelwood interferes with the flow of air. If the user covers the unburnt pieces of firewood with the hot ash, this leads to reduced air flow to the biomass resulting to smoke production and incomplete combustion of fuels. One the fuel has been added the user should allow either natural or forced drafted to ignite the refilled biomass.

5.6 Location of Stove

Outdoors, under shelter, open kitchen, indoors (well ventilated), indoors (closed room),

Mounted on a surface (counter/table), free-standing.

The location of a stove could either enhance or inhibit the overall performance of a cookstove. A stove situated outdoors is likely to experience the impact of the external weather conditions affecting the performance of the cookstove. In an airy/windy environment a stove may be considered as having high performance due to the natural ventilation and forced draft within that specific location. On the other hand, exposure to rainy conditions or even a very hot climate can influence the performance of the stove either positive or negatively. Exposure of stoves to rain conditions greatly reduces the life of stove by destroying the ceramic liners and the metallic parts by accelerating rusting.

When sited under shelter, depending on the height of the shelter, some emissions may diffuse easily into the atmosphere or return to the immediate environment of the user when not able to freely diffuse into the air and flow away.

Indoors where the kitchen is well ventilated, the performance of a cookstove is under control and can lead to ambient air quality. Combustion in a stove is influenced by the amount of air getting in to the stove and the mechanism of air circulation. Good ventilation ensures the natural draft leading to complete combustion greatly reducing production of CO, CO_2 and particulate matter.

Where the stove is located in a closed and poorly ventilated kitchens, the stove will incur poor combustion due to low intake of oxygen. This leads to production of carbon monoxide and non- combusted biomass leading to formation of soot. Both $PM_{2.5}$ and PM_{10} can be detected at substantial levels.

Mounted on a surface: it is common to find stoves mounted on a table or just on the ground but raised a bit. Before mounting a stove, it is critical to consider the location of the door and the window. The siting should avoid direct air inflow as this can lead to unnecessary combustion hence shortening the period of fuel usage. If mounted on a table the stove should leave enough space to hold the unburned firewood to avoid falling off the ground. By mounting of the ground, its critical to ensure the stove is a bit raised to allow enough air inflow for easing combustion.

Free standing: The advantage of a free standing stove is that its movable and the users can always adjust the inlet to face the direction of the wind. A free standing stove if in an enclosed environment should be located where movements are minimal to avoid accidents when users are conducting other chores like food preparations.

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