



Studying Use and Adoption of the Ecocina and Ecoplancha III Cookstoves in San Ramon and Las Brisas, Guatemala

Prepared for Winrock International and the United States Environmental Protection Agency by:

StoveTeam International

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**BERKELEY AIR
MONITORING GROUP**



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1. Executive Summary

Beginning in May 2016, StoveTeam International, working in collaboration with EcoComal Stove Factory, with funding from Winrock International and the United States Environmental Protection Agency, and with technical support from Berkeley Air Monitoring Group, conducted a cookstove adoption and stove use monitoring workshop and field-study in Guatemala. Two improved stoves were studied: the Ecocina and Ecoplancha III.

The stove-use monitoring workshop took place in Antigua, Guatemala in May 2016, with the field portion of the study taking place near Guanagazapa, Guatemala and continuing for seven months until December 2016.

The four-day workshop was led by Charity Garland of Berkeley Air Monitoring Group and Michael Naleid of Winrock International with logistical support and planning completed by Kim Forrest and Katie Laughlin of StoveTeam International. StoveTeam's local partner, EcoComal Stove Factory contributed significantly to the field component of the workshop, providing attendees with the opportunity to test the practical application of workshop lessons and SUMs technology in a real-time context.

The field-study was led by Katie Laughlin and Kim Forrest of StoveTeam International, with on-the-ground project support and implementation by Marco Guerra of EcoComal. The study took place in the impoverished communities of San Ramon and Las Brisas.

The study's focus was to determine the frequency of use of the intervention stoves compared to the traditional open fire as a means of judging and improving acceptance rates, encouraging adoption and advocating for strong support of fuel-efficient cookstoves. Key findings are presented below:

- **Displacement of the traditional fire (Ecocina):** Temperature data from both the traditional open fire and Ecocina cookstove reveals a 70-80% displacement of the traditional stove and indicates that roughly 70% of cooking is being conducted on the Ecocina cookstove.
- **Displacement of the traditional fire (Ecoplancha III):** Temperature data from both the traditional open fire and Ecoplancha III cookstove reveals a 56-60% displacement of the traditional fire and indicates that roughly 60-70% of cooking is being conducted on the Ecoplancha III cookstove.
- **Stove stacking (Ecocina households):** Within the Ecocina users households, 74% self-identified as using the Ecocina as their main cooking stove and 24% reported using the Ecocina secondarily to the traditional fire. Of these households, 47% reported the simultaneous use of the Ecocina and traditional fire.
- **Stove stacking (Ecoplancha III households):** Within the Ecoplancha III users households, 86% self-identified as using the Ecoplancha as their main cooking stove and 14% reported they use the Ecoplancha secondarily to the traditional fire. Of these households, 50% reported the simultaneous use of the Ecoplancha III and traditional fire.

2. Introduction

Roughly 40% of the world's population relies on solid fuels for their cooking and heating needs. In Central America and Mexico alone, 36 million people cook on rudimentary open fires, often inside their homes. The majority live in rural or peri-urban settings and rely primarily on wood fuel. Within Latin America, Guatemala has one of the highest levels of households cooking with wood. According to the Global Alliance for Clean Cookstoves, 64% of Guatemala's population cooks with solid fuels and roughly 10.5 million people are impacted by household air pollution. In Guatemala, more than 5,000 people die each year from preventable illnesses linked to household air pollution.¹ In addition to life threatening illnesses and burns, the use of solid fuels is responsible for escalating rates of deforestation.

Berkeley Air Monitoring Group (BA) and Winrock International, in association with the United States Environmental Protection Agency (USEPA) and StoveTeam International, conducted a Cookstove Adoption and Stove Use Monitoring Workshop and field campaign in Guatemala in May, 2016. The workshop was hosted by StoveTeam International in Antigua, Guatemala.

The workshop took place at the Hotel Antigua in Antigua, Guatemala, and was followed by an adoption and stove use field study in the rural villages of San Ramon and Las Brisas in Guatemala. Katie Laughlin and Kim Forrest of StoveTeam International, Marco Tulio Guerra Buezo of EcoComal, and Michael Naleid of Winrock International helped to manage and facilitate the workshop. The workshop was attended by 26 people; the roster of attendees is available in a separate document. Following the workshop, a before-and-after field study was conducted using the Ecocina in San Ramon and the Ecoplancha III in Las Brisas, in which surveys collecting demographic information, consumer preferences, and perceptions of fuel use were administered and direct measures of stove use were collected. The study ran for approximately seven months, from May until December of 2016.

The goal of the study was to make quantitative and qualitative measurements that indicate the frequency of use of the intervention stoves compared to the traditional open fire as a means of judging and improving acceptance rates, encouraging adoption, and advocating for strong support of fuel-efficient cookstoves.

¹ <https://cleancookstoves.org/country-profiles/focus-countries/2-guatemala.html>

3. Cookstove Adoption and Stove Use Monitoring Workshop

The workshop ran from May 2-5, 2016 and began with an introduction by Michael Naleid, followed with personal introductions by the participants. To lay the groundwork for the workshop and to ensure that all participants were using and understanding the same lexicon, Charity Garland presented an introduction to cookstove adoption. This important, although lengthy, presentation included why adoption is important, the different theories of adoption, how much use of a technology is required for it to be considered 'adopted', and culminated in a final collaborative definition of "adoption" to be determined by the workshop participants. Kim Forrest and Marco Tulio then gave a working lunch presentation on StoveTeam and EcoComal, respectively. After lunch, Charity discussed a range of stove use monitoring approaches and presented the different Stove Use Monitoring Systems (SUMs). She focused on the iButtons, which was used in the subsequent field study, discussing the process for launching and placing iButtons. The workshop participants then watched Charity demonstrate iButton placement on the Ecoplancha III and Ecocina stoves. Participants then had the opportunity to practice placement on their own. Time ran out to light the stoves and so this activity was saved for day 2 of the workshop.



Figure 1. A demonstration with practice iButtons

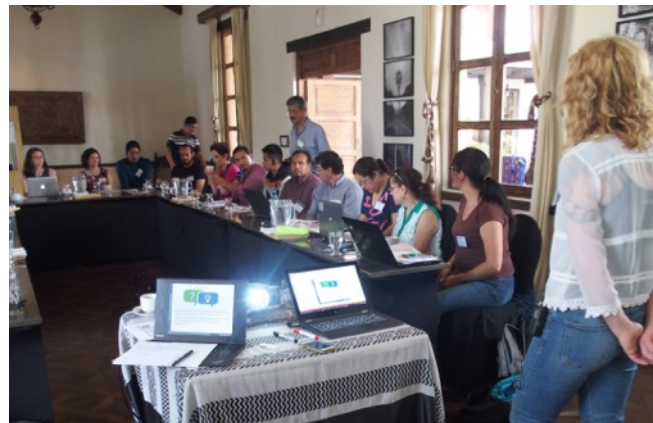


Figure 2. Charity presents an introduction to cookstove adoption.

The following day, the stoves with the practice iButtons placed on them were lit to collect stove use data. During the data collection and cooking of plantains, a brief recap of day one was given by Marco Maldonado. After the recap, Charity discussed the different options for study design for cookstove projects. During the following presentation, Charity discussed the ethical issues, which should be considered when implementing cookstove projects, including the proper way to gain informed consent from study participants. The final morning presentation covered the details of quantitative data collection; including surveys, SUMs, pollution sensors, fuel mass measurements, and other types of quantitative data with cookstoves that can be collected associated. After the morning presentations, the workshop participants were led by Charity in the removal of the iButtons from the practice stoves. During the working lunch, Claire Cuisset of Microsol gave a presentation on the carbon credit activities her organization is currently involved in. After lunch, Charity showed the workshop the practice iButton data and demonstrated how to interpret the placement data. The test data allowed the workshop to

determine as a group an effective location for iButton placement on the Ecocina, however, further testing was required for the Ecoplancha III and traditional stoves. The workshop group was then split into four groups, which went to the field to practice iButton placement and observational survey data collection.



Figure 3. A discussion of iButton placement techniques (left) and practice with iButton installation (right)

On the third day, Alma Eugenia Coronado did the daily recap, and then Charity led the group debrief of the practice field visit the day before. Charity then gave a presentation on qualitative data and mixed methods theory. The workshop then broke into smaller groups to practice the qualitative data collection method called semi-structured interviews (SSIs). The lunch presentation was given by Marcelo Gorrity on his research at Centro de Pruebas de Cocinas. In preparation for the second field visit, the team went over the observational survey that was used in the field and discussed the different types of stoves that may be encountered in local communities. The workshop participants then went to the field and removed the iButtons and practiced either the semi-structured interviews or the observational forms. The day ended with the workshop attendees meeting at and touring the EcoComal factory.



Figure 4. Conference attendees visiting the EcoComal Factory, and taking a group photo on some important equipment

On the final day of the workshop, Charity gave presentations on data collection, management, analysis, and reporting. Lunch was done at the restaurant at the Hotel Antigua where the workshop participants worked on action planning documents to help them begin to design their

goals for their programs. After lunch, the action plans were shared and then Charity discussed data download from the iButtons.



Figure 5. Workshop participant group photo

The group was then led by Charity in downloading data from their own iButtons. After the data was downloaded, Charity led the group through data analysis using the SUMIT tool developed by UC Berkeley's, Ajay Pillarisetti. The day culminated in a certificate ceremony and many, many photos.

Stove Use Monitoring Fieldwork Preparation

Antigua, Guatemala May 6th - 7th

Post-workshop fieldwork coordination and intensive field team training occurred on the two days following the workshop. During that time, Stove Team, Berkeley Air, and EcoComal met to discuss implementation of the field study in the locations determined by Stove Team and EcoComal. Much information had been absorbed by the group during the workshop and a thorough discussion was had on what the research goals were and how to best design the study to answer the most pertinent questions. The final determination was to complete a before-and-after study, as originally discussed, combining stove use monitoring with iButtons and surveys to collect from households baseline demographic data, socio-economic status, as well as perceptions of the new stove. The perceptions module included an assessment of the new stove's impact on fuel use approximately the first month of operation.

In addition to finalizing study design and plans, the team responsible for the field study was given additional training beyond that completed during the workshop on iButton launching, installing and uninstalling, and downloading. The field team, Marco Guerra Herrera, Alan Garcia, and Luis Lopez, spent the afternoon at Hotel Posada La Merced in Antigua with Charity and Katie Laughlin going through the protocol step-by-step. For practice, iButtons were placed on a toaster and toaster usage was measured to simulate a field visit. All steps were completed as though the visit had actually happened in a home.

The Ecolancha III iButton placement was tested in multiple spots on the stove during the workshop but was found to be either too hot (chimney, under side of the stove, and fuel

opening) or too cold (side of the stove and “wings” of the stove). Further piloting of iButton placement on traditional and plancha stoves was done after Charity’s departure by Katie and Kim when they found a location at the middle, back of the Ecoplancha III stove to be suitable for iButton placement and a brick with the iButton place approximately 10 cm from the edge of the combustion zone for the traditional stove.

4. Study Sites and Stoves

The study was conducted from May 2016 – December 2016, which is the wet season, in two rural, Guatemalan communities near the town of Guanagazapa (Figure 1). The households in this area use primarily wood collected from nearby forests that is burned in traditional three stone fires or traditional plancha stoves.

The before-and-after study assessed the use and adoption of two improved cookstoves: the Ecocina and Ecoplancha III (Figure 2).

The Ecocina stove was designed by Dr. Larry Winiarski and uses a rocket elbow combustion chamber of low-fired field tile, insulated by pumice, and surrounded by a bucket of ferro-cement that keeps the stove exterior cool to the touch. The design of the top of the stove insures correct heat transfer to the pot or griddle. The cement surround is produced in a carefully designed mold. And an adjustable pot-skirt directs heat around any sized pot thus increasing heat transfer. A sheet metal griddle is included and is reinforced in the center to assure even heat throughout the cooking surface.

The Ecoplancha III is a biomass cookstove developed by Marco Tulio and produced at the EcoComal factory in Guatemala. It is a larger plancha stove consisting of a rocket elbow combustion chamber, a steel plancha with three pot holes equipped with multiple sizes of removable rings, and an external chimney. The stove is made of two pieces of concrete reinforced with ¼ inch smooth rebar, and includes two tile wings with metal reinforced frames.

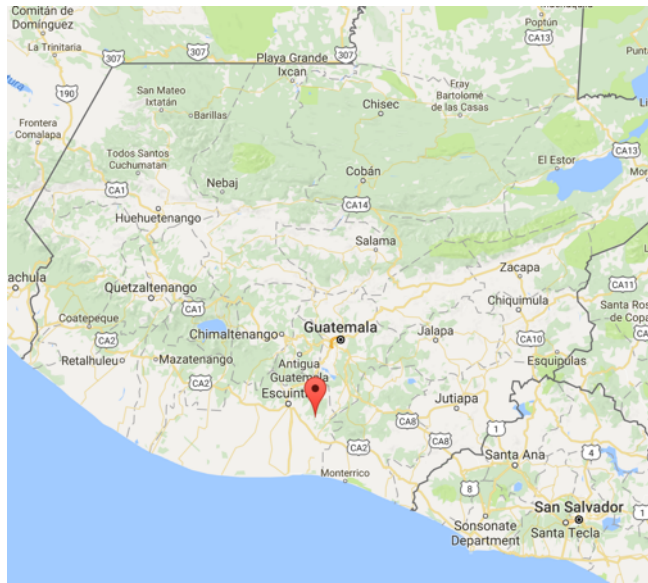


Figure 1: Map of Guatemala identifying Guanagazapa, the town nearest the study sites.



Figure 2: The Ecocina Cookstove and Ecoplancha III Cookstove

a. The Communities of San Ramon and Las Brisas

San Ramon, located approximately 20 miles from the municipality of Guanagazapa, Guatemala, consists of approximately 50 homes and is an extremely poor and isolated indigenous community. The primary language is Mam, a Mayan language, although most men and the younger generations also speak Spanish. Women dress in traditional Mayan textiles. The majority of the population is part of an informal economy, performing temporary labor harvesting coffee and sugar cane or selling weavings, tamales, or fruit. The community is heavily dependent on subsistence farming of beans and corn for survival. All families cook with solid fuels using a traditional-fire or traditional plancha stove (Figure 3). Previously located in the highlands of Guatemala, this Mam community relocated after the government formally redistributed marginalized lands to communities affected by the country's 36-year civil war. Out of the 50 homes, 40 were pre-selected to receive an Ecocina cookstove.





Figure 3: Examples of traditional open fires in San Ramon.

Las Brisas is less isolated than the community of San Ramón but located on the same road from Guanagazapa, roughly 10 miles closer to town. Las Brisas is a Spanish-speaking community and also subsists through farming, temporary labor, and an informal economy.

The community is comprised of approximately 100 homes. All families cook with solid fuels using a traditional-fire or traditional plancha stove (Figure 4). Out of the 100 homes, 40 were pre-selected to receive an Ecoplancha III cookstove. Due to study complications described on page 19, of those pre-selected, only 28 received intervention stoves.



Figure 4: Examples of traditional fires in Las Brisas.

5. Methods

In both communities, households were randomly selected after a brief screening process to determine the recipient's willingness and interest to participate, primary cooking fuel and stove type, cooking events per day, plans to travel or have visitors during the study timeframe, whether wood is purchased or collected, and whether a family shares a courtyard or cooking tasks with extended family. Out of the 40 households pre-selected to receive stoves in each

community, 38 ultimately received cookstoves in San Ramón and 28 received cookstoves in Las Brisas (see challenges and recommendations on page 19).

After selection, stove recipients welcomed the field team into their homes over several days to complete the consent process and baseline survey. iButtons were also placed on the open fires. The following visit, one month later, in late June, stoves were delivered, open fire iButtons were downloaded and re-launched, and the field team placed and launched iButtons on the Ecocina or Ecoplanchas. Recipients were also trained on proper stove use and function, and asked not to remove their open fire in order to continue to track use of the traditional stove. Additional follow-up visits we made in August, mid-September (November in Las Brisas) and early December. Surveys were administered during follow-up visits and during the final visit to assess changes in cooking behavior and user perceptions on fuel use.

a. Stove Use Monitors

The study used Maxim iButton Stove Use Monitors (SUMs) to log temperature data in the field. The iButtons deployed were the L buttons, which can operate within a temperature window up to 85° C and can log data for roughly 56 days. Temperature data was used as a proxy for stove-use, equating a “hot” stove to cooking/use and a “cold” stove to non-use. A machine learning algorithm (SUMSarizer, University of California – Berkeley) was used to identify cooking versus non-cooking and cooking events and duration were determined for each stove in each study home.

Over the course of the study in San Ramon, 36% of data was lost due to the following errors:

- Incorrect iButton launching
- IButton burn out
- IButton loss in the field
- Removal of traditional fires
- User tampering with iButtons

For the same reasons, over the course of the study in Las Brisas, 25% of data was lost.

Due to this loss, data could not be analyzed on a household basis but instead were combined and analyzed on a population level.

b. Qualitative Surveys

This study used qualitative surveys to ascertain stove use patterns, fuel procurement, and household demographic information, such as education, possessions, and decision-making. This information was collected in a baseline survey and again at the final visit. The final survey also included user preference and willingness to pay sections. Follow-up surveys during interim visits collected information on stove perceptions and use.

In San Ramon, only 34 out of 38 households were surveyed on the final visit due to the primary cooks not being available at the time of the surveys. Final surveys were conducted during the harvest season, reducing the family’s availability when the surveys were conducted.

6. Results

a. SUMS Results

Open Fire Displacement: In both San Ramón and Las Brisas, SUMs data revealed partial displacement of the traditional open fire. In San Ramón, SUMs data from both the traditional open fire and Ecocina cookstove indicates a 70-80% displacement of the traditional stove with roughly 70% of cooking being conducted on the Ecocina cookstove in terms of number of use events per day (Figure 5).

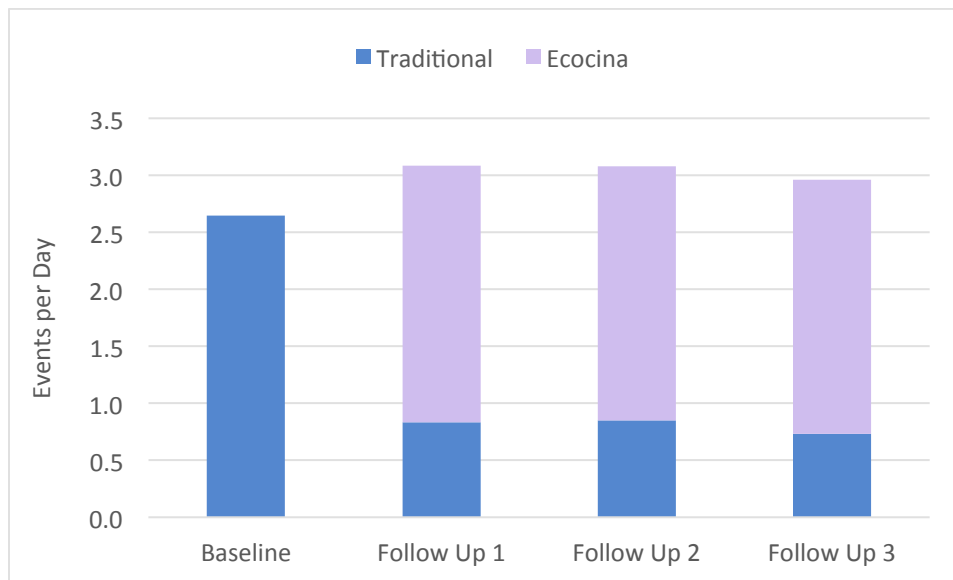


Figure 5: San Ramón open fire displacement illustrated in chart form. May 2016-December 2016.

In Las Brisas, SUMs data from both the traditional open fire and Ecoplancha III cookstove indicates a 56-60% displacement of the traditional fire with roughly 60-70% of cooking being conducted on the Ecoplancha III cookstove in terms of number of use events per day (Figure 6).

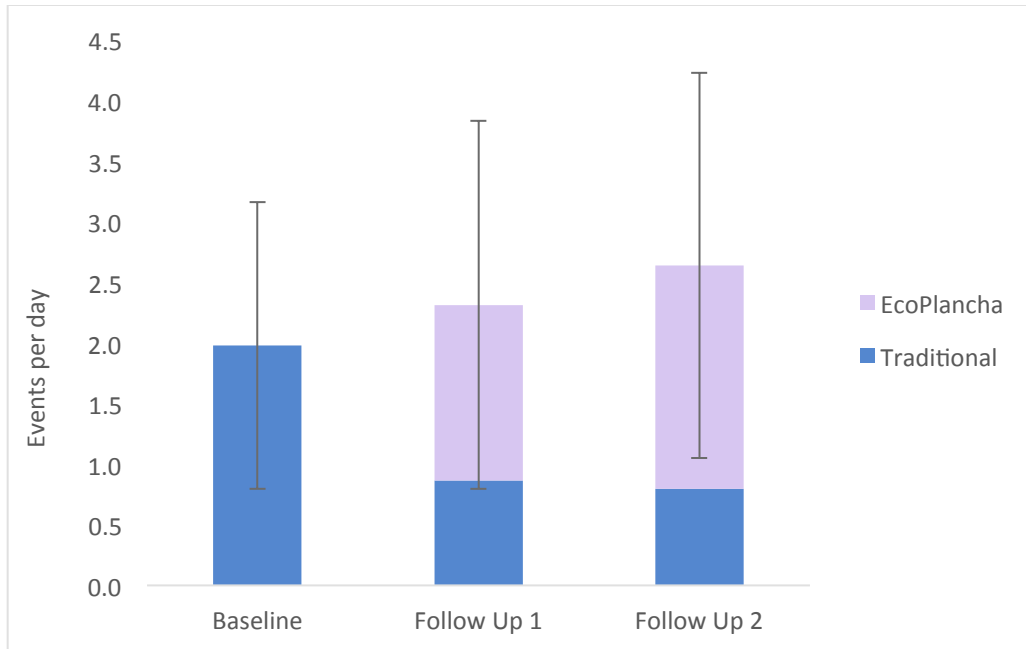


Figure 6: Las Brisas open fire displacement illustrated in chart form. May 2016-December 2016.

SUMs data from both sites implies, while displacement is occurring, there is a continued reliance on the traditional open fire, with stove stacking (i.e. both the traditional and EcoPlancha III stoves being used regularly) occurring in many homes.

Stove Stacking: Often when new stoves are introduced to a community, they do not completely displace the original cooking method but instead the users use the new stove for certain tasks and the original one for others. This is called stove stacking. Due to the significant SUMs data loss, a complete analysis of stove stacking was not possible, however, for a subset of households both traditional stove and new stove data is available during the final visit, allowing for a rudimentary assessment of stove stacking in the two study locations.

In San Ramon households which have data for both the traditional and Ecocina stoves during the final visit from October to December 2016 (N = 13), the Ecocina was used for an average of $76\% \pm 34\%$ events. Two households did not use their traditional stove during the final monitoring period, while the majority of participants used their traditional stove between 0 and 1 times per day (N = 8). Most users in this group used their Ecocina more than once per day (N = 11) (Figure 7).

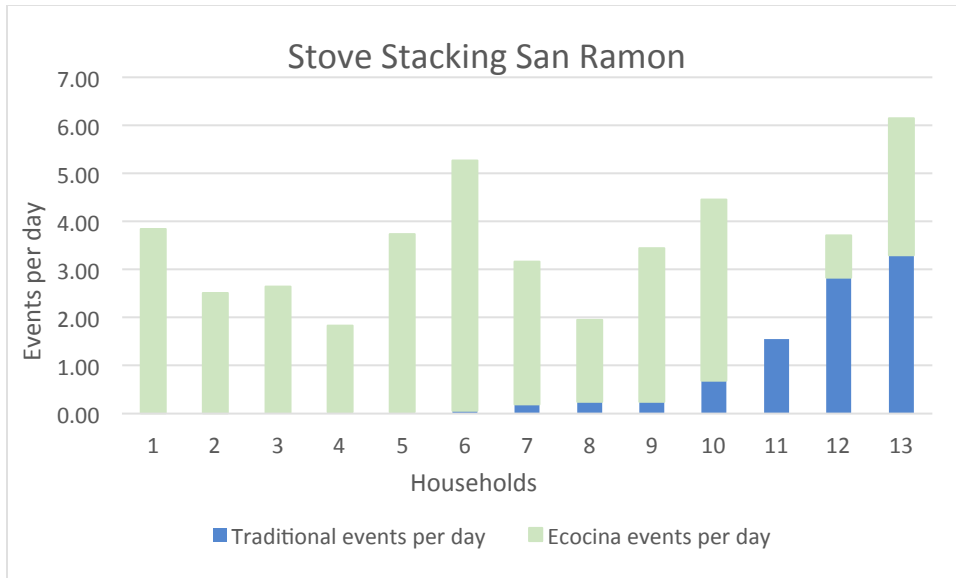


Figure 7: San Ramon stove stacking during the last visit from October 2016 – December 2016 in 13 households.

In Las Brisas, in the households which have data for both the traditional and Ecoplancha III stoves during the final visit from October to December 2016 (N = 19), the Ecoplancha III was used for an average of $64\% \pm 33\%$. Four households did not use their traditional stove during the final monitoring period, while the majority of participants used their traditional stove more than 1 time per day (N = 8). Most users in this group used their Ecoplancha III more than once per day (N = 17) (Figure 8).

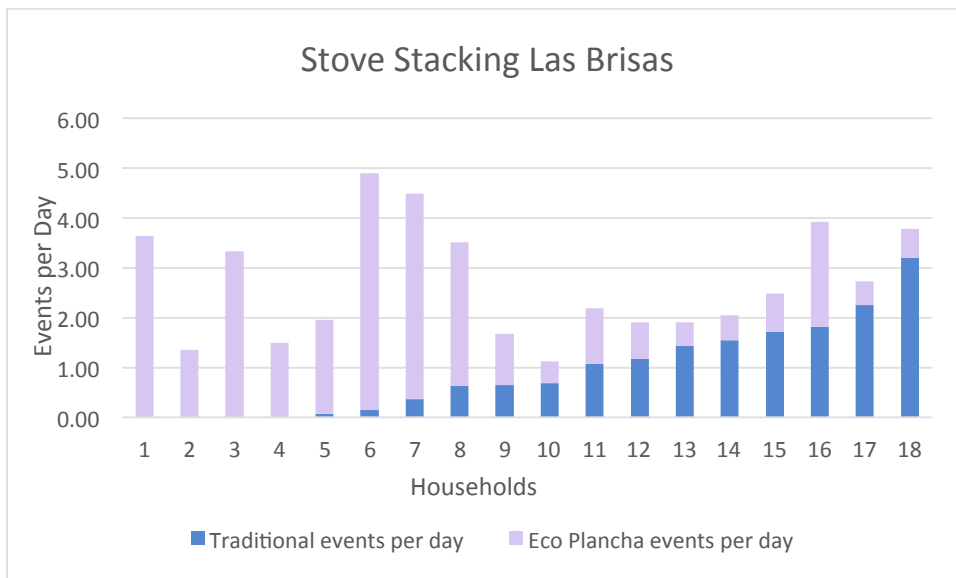


Figure 8: Las Brisas stove stacking during the last visit from ~October 2016 – August 2016 in 19 households.

Both sites had some households which relied solely on the new stove, shown in Table 1, but in both locations, most houses still used the traditional stove some. Very few participants (N =1) did not use their new stove at all.

Table 1. Stove use frequency in homes with both traditional and new stove data during the final visit of the study.

	San Ramon (N = 13)		Las Brisas (N = 19)	
	Traditional	Ecocina	Traditional	Ecoplancha III
Not used at all	2	1	5	0
Used 0-1 times per day	8	1	6	2
Used >1 times per day	3	11	8	17

b. Qualitative Survey Results

Family Size: In San Ramon, families range in size from 3 to 15 people. Table 2 presents family size compared to a stated stove preference and suggests that family size alone cannot be relied upon to determine potential uptake of the Ecocina. The same analysis was not done for Las Brisas, where families received the Ecoplancha III cookstove, a large, placha-style stove with the perceived capacity to cook more (see also Figure 9 for a graphic representation).

Table 2. Demographics and stove preference

Family Size	Ecocina Preference	Open Fire Preference
3	1	0
4	6	0
5	3	2
6	2	1
7	4	1
8	5	3
9	2	0
10	1	0
11	1	0
12	0	1
15	0	1

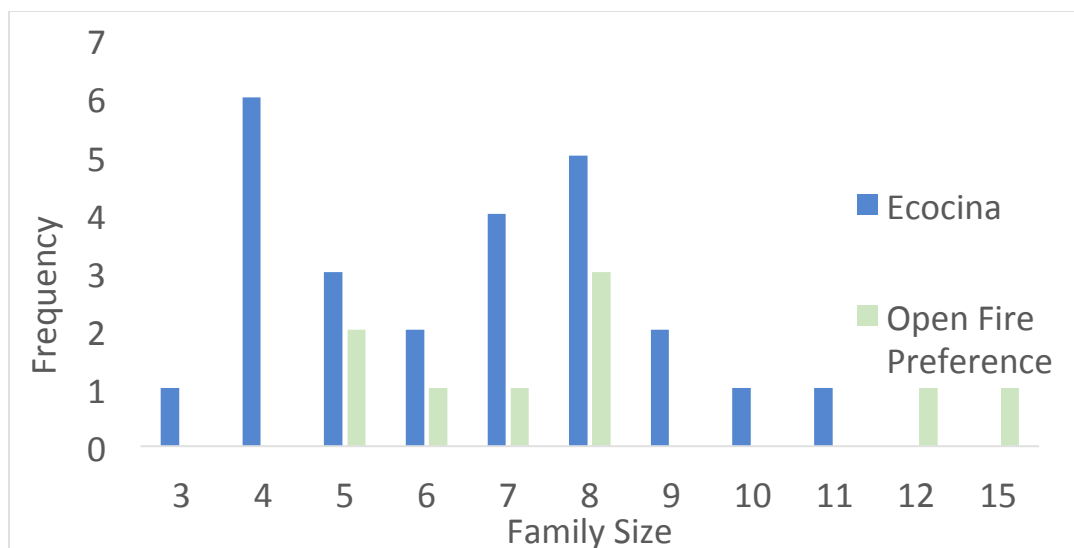


Figure 9: Stove preference by family size.

Purchasing vs. Collecting Wood: Only two families in San Ramón indicated purchasing wood during the study. Both families indicated a preference toward the Ecocina cookstove. SUMs data indicated decreased use of the traditional fire and increased use of the Ecocina cookstove over time for both families. In Las Brisas, two families indicated purchasing wood during the study. In qualitative surveys, both families indicated a preference for the open fire. According to the SUMs data for those households, usage of the Ecoplancha III decreased over time, however due to data loss for both stoves, the data is insufficient to draw any concrete conclusions.

Stove Preference: In San Ramon, 74% of households indicated a preference for the Ecocina and 26% indicated a preference for the traditional fire. In Las Brisas, 86% of households indicated a preference for the Ecoplancha III and 14% indicated a preference for the traditional fire.

Stove Stacking: 42% of survey respondents in San Ramon and 46% in Las Brisas indicated relying on secondary cooking devices between 1 and 7 days of the week. Figure 10 depicts the percent of respondents and the frequency of stove stacking per week as indicated in the qualitative surveys.

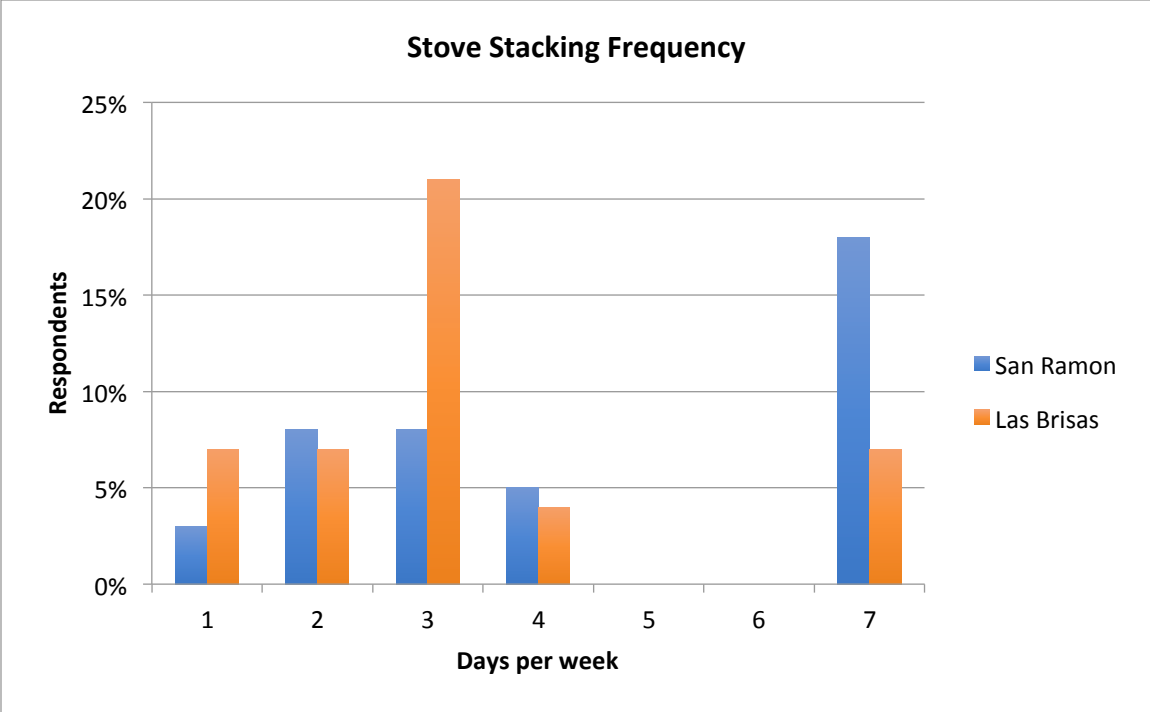


Figure 10: Stove stacking frequency in San Ramon and Las Brisas as indicated via qualitative surveys.

Simultaneous Use: Of the 34 participants surveyed in San Ramón, 47% indicated the simultaneous use of two stoves; 18% indicated they did not use two stoves at once, and 35% did not provide a response. Of the 28 participants in Las Brisas, 50% indicated the simultaneous use of two stoves; 14% indicated they did not use two stoves at once; and 36% did not provide a response. Table 3 presents the reasons for the simultaneous use of two cooking devices in each community.

Table 3: Survey respondents reasoning for the simultaneous use of two cooking devices

Reasons for Simultaneous Use	Percentage of Respondents (San Ramon)	Percentage of Respondents (Las Brisas)
Ability to cook two foods at once	56%	86%
Ability to cook for many people	25%	-
Ability to heat water and cook simultaneously	13%	-
Other: Not specified	6%	14%

Feedback: The following user feedback was provided about each stove.

User Feedback	Response (Ecocina)	Response (Ecoplancha III)
Biggest Challenge with the Improved Stove:	Does not produce enough heat (6%) Requires small pieces of wood (6%) Too much smoke (3%) Takes too long to cook (3%) No challenges (9%) Other: Not specified (41%) No response (32%)	No challenges (68%) Other: Maintenance (25%) Difficult to light (7%)
Like Most about the Improved Stove:	Uses less wood (38%) Cooks faster (30%) Conserves heat well (5%) Less smoke (5%) Makes tortillas well (3%)	Other: Not specified (39%) Less smoke (21%) Cooks faster (18%) Uses less wood (14%) Conserves heat well/gets very hot (4%) Cooks multiple dishes (4%)
Changes Would Make to the Improved Stove:	Make it larger (79%) Use larger pieces of wood (9%) None (9%) More burners (3%)	None (61%) Use larger pieces of wood (18%) Make it larger (14%) Retain heat for longer (4%) More portable (4%)

7. Challenges and Recommendations

The workshop and initiation of the field testing went very smoothly. That said, there is always room for improvement, and some unique challenges did arise, a few of which are summarized below.

Workshop

- The simultaneous translation was incredible. It is highly recommended to use this type of translation in future workshops. It facilitated greater group discussions, questions and answer sessions, and improved efficiency. With side-by-side translation, the workshop would have taken significantly longer.
- For the practice field visit, it is important that the participant receives a clear explanation of the visit's purpose and understands that it is merely for practice.
 - Groups for the household visits should not exceed 4-5 people.
 - Always try and find homes that have large kitchens, are friendly and hospitable, and are available during the time that the field visits are scheduled.

- Always call the day before and immediately before arriving to remind them of the time, the purpose of the visit, the number of people expected to visit, and the length of time for the visit.
- During the “Consent” presentation, the leader and the attendees should go through building a consent form together, so that the appropriate things are included, and the team feels comfortable saying what is on the form during the practice visit rather than practicing with a generic form.
- There was a substantial amount of content to cover in a short amount of time. People seemed saturated by the end of the workshop, when we covered data analysis and reporting, a technically complicated subject.
 - The first presentation discussing the background of “Adoption” should be turned into two presentations. It is too long for first thing. It can also be simplified.
 - Material will be condensed for future workshops. Some details on the theories of adoption can be simplified.
- More time for hands-on iButton launching and data handling would be valuable for the workshop participants.
- Workshop discussions were lively and inspiring. Prompts for the discussions were sometimes not well placed in the presentations, however. Re-assessing when and how these discussions are stimulated will allow the workshop to flow a bit better.

Field Study

Planning for the field study was well organized and executed by StoveTeam and EcoComal. The significant amount of work done on the ground before the workshop meant that things were well framed for the post-workshop field study. Nonetheless, there are always some lessons learned during workshop and study planning.

- At the San Ramon study site, the participant pool is small. StoveTeam was told that after recent economic hardship, the community had self-selected the study participants based on need. Having learned the importance of random selection during the workshop, StoveTeam questioned the efficacy of studying this self-selected group and the potential for bias. The StoveTeam, Berkeley Air, and EcoComal representatives had a lengthy discussion and considered finding alternative field sites. After further investigating the reasons behind the self-selection and explaining our needs for the study, it was decided that the project was fine to move forward and that the community would participate using random selection as initially explained to them.
- The iButtons used were the L buttons, which can only operate within a temperature window up to 85° C. This made placement tricky, especially on the traditional stove, which varies in size and shape significantly.
 - Using kSUMS for traditional stoves next time could avoid this problem.

There were several complicating factors during the study in both San Ramon and Las Brisas including:

- Determining the ideal placement of the iButtons on the open fires

- The weather
- Field team error
- Communications challenges with the municipality of Guanagazapa.

As noted above, the use of L buttons made placement a little tricky. An ideal placement was not identified for the Ecoplancha III during field-testing due to the high temperature off the chimney and the thermal mass of the stove. Ultimately, after additional field-testing, it was decided that the best placement on the Ecoplancha III would be behind the fire box toward the middle of the stove. This was despite the drawbacks the cement stove's thermal mass would have on evaluating cooking time. In some cases, the type of open fire did not provide many options for ideal SUMs placement either. Some open fires did not have space around the fire for placement in the brick, and some fires were enclosed with a u-shaped adobe ring, thus limiting the distance *away* from the fire that the iButton could be placed and still register heat fluctuations (Figure 11).

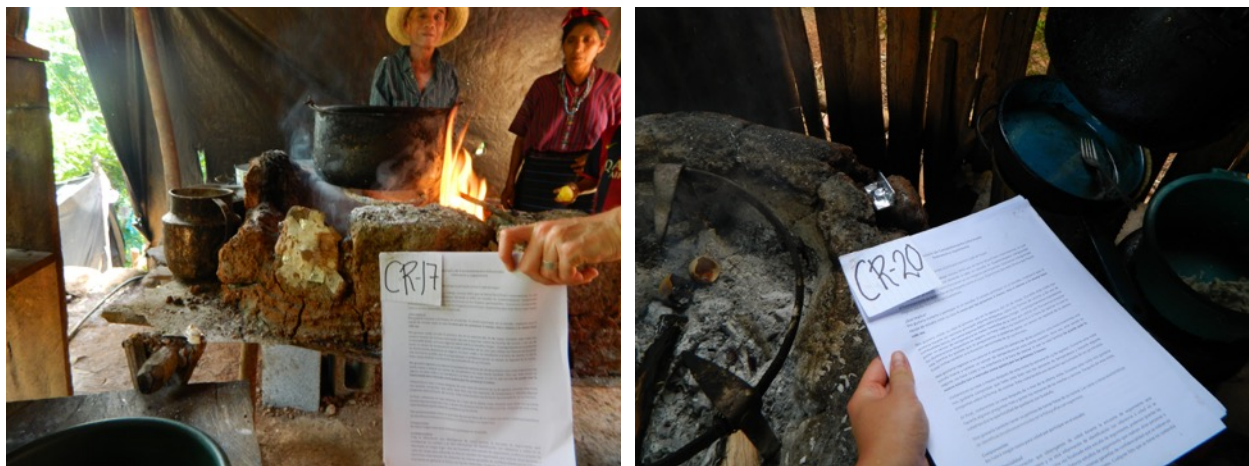


Figure 11: Placement of SUMs was challenging on the different types of open fires encountered in the field. In the photo on the left note the taped iButton in the center of the image. In the photo on the right, note the iButton in a bracket in the center of the image.

Also, because the study took place during the rainy season, the weather presented some challenges for completing work prior to downpours. In a few cases, in between visits, iButtons (and full kitchens) were washed away in rain- and windstorms. Field team error also resulted in lost data when iButtons were not launched correctly or replaced without insulation after high temperature readings.

Communications was also a major complicating factor, both between StoveTeam and the field team and The Field Coordinator and the Municipality of Guanagazapa. Challenges between StoveTeam and the field team mostly centered around uploading data to Dropbox such that it could be processed and reviewed prior to subsequent field visits; and a lack of communication about the challenges being encountered in the field. Given the complexity and technical nuance of applying SUMs in the field, more training and field-testing may have eliminated some of the challenges experienced by the field team.

With regard to challenges with the municipality, at the start of the study, the municipality of Guanagazapa agreed to partner with StoveTeam and EcoComal to provide stoves to Las Brisas. It was initially agreed that StoveTeam would cover half the cost of the Ecoplancha III stoves and the municipality would cover the balance. Some local politics got in the way of this arrangement and the municipality decided it would charge participants 100Q for the stove (and cover the balance). Additionally, access to Las Brisas was very difficult and required coordination with the municipality to aid in the transportation of stoves to the community. On the day of delivery, no transportation was provided so the stoves had to be stored at the municipality and another date coordinated with EcoComal (for proper training and installation). As a result, there was a longer delay than planned between installing iButtons on open fires and the delivery and installation of the Ecoplancha III stoves. The municipality then delivered the stoves without coordinating with EcoComal and did not ensure that all pre-selected homes received a stove (they instead offered the stoves to whomever wanted to pay 100Q). Despite this, the majority of pre-selected homes received a stove, with some families choosing to drop out as a result of the delays (and no longer having 100Q available to participate). This is the reason our study population decreased from 40 to 28 households.

Due to a lack of coordination with EcoComal, several families chose not to install the Ecoplancha III correctly for fear of ruining their metal roof. EcoComal and StoveTeam worked to encourage proper installation, but ultimately, many households chose not to vent the stoves properly. In retrospect, this should have been explained in the consent and selection process as a requirement of participation.

Despite agreeing to pay the balance of the stove costs to EcoComal, EcoComal reported that no payment was received from the municipality.

Finally, we lost two members of our field team to opportunities for permanent employment, which meant the re-training of staff.

8. Conclusions

Both quantitative and qualitative data were used to determine the frequency of use of the Ecocina and Ecoplancha III cookstoves compared to the traditional open fire in two communities near Guanagazapa, Guatemala.

Results from SUMs in San Ramon and Las Brisas indicate that the intervention stoves are indeed displacing use of the traditional open fire – by 70-80% and 56-60% respectively. Additionally, roughly 70% of cooking in San Ramon and 60-70% of cooking in Las Brisas is being conducted on the improved Ecocina and Ecoplancha III cookstoves, proving each community's readiness to adopt new cooking systems.

However, despite these strong indicators of use, both SUMs and survey data revealed continued reliance on traditional fires and stove stacking in multiple households. Given this,

additional research on cooking behaviors that link stoves used with specific foods and specific times of day, will help improve understanding of the drivers of traditional and improved stove use, and more effectively meet household energy needs to achieve greater health and environmental benefits.

Annex

Study Schedule May 12 – September 23, 2016

1. Practice (May 9, 10, 11) – Full Team
 - a. 5/9 - Talk with Marco, go to Guanagazapa to look at housing for boys
 - b. 5/10 – K2 work on various things, set-up systems, etc., in AM. Practice ibutton placement on open fires/poyos in town with team (Juan Carlos to look for some women) in PM.
 - c. 5/11 – Go back to families to pilot baseline with Team in PM
2. Visit 1: Go to the communities (May 12 and 13)
 - a. Explain the study (interviews, placement of the buttons, distribution of the stoves, etc)
 - b. Consent form for each family interested
 - c. Selection process (register in study)
3. Visit 2: Return to the communities (week of May 23) – *Guatemala Team Only*
 - a. Place ibuttons on each open fires (80+)/some ambient (5-10)
 - b. Launch ibuttons
 - c. Baseline survey
4. Visit 3: Return to communities (week of June 20) Full Team and OSU
 - a. Download and re-launch open fire/ambient ibuttons
 - b. Distribution/installation of the stoves
 - i. Ecoplancha 20, 21, 22 installed
 - ii. Ecocina 23, 24 distributed
 - c. Training on stove use
 - d. Place ibutton on stoves
 - e. Observational interview
5. Visit 4: Return to communities (week of July 18) – *Guatemala Team Only*
 - a. Download and re-launch open fire, stove, ambient ibuttons
 - b. Short interview on changes
6. Visit 4: Return to communities (week of August 15) – *Guatemala Team Only*
 - a. Download and re-launch open fire, stove, ambient ibuttons
 - b. Follow-up survey
7. Visit 5: Final Visit (week of September 19) – Full Team
 - a. Download and remove ibuttons from open fires, stoves and ambient
 - b. Final Interview
 - c. Thank you
 - d. Small gifts (t-shirts)
 - e. Possibly have Lynn Johnson take follow-up pictures



Cook Stoves & Indoor Air

Promoting Clean and Efficient Cooking in the Developing World



Measuring and understanding household stove use workshop

Antigua, Guatemala

Sponsored by U.S. Environmental Protection Agency (U.S. EPA) and Winrock International

Co-hosted by StoveTeam International and EcoComal

Draft Agenda

Monday, May 2nd –Thursday, May 5th 2016

Monday 2nd May

8:00am	Registration
8:30am	Welcome, introductions and workshop goals
Morning Session 1	Stove adoption
10:30am	Tea / Coffee Break
Morning Session 2	Identifying study outcomes
Morning Session 3	Stove use monitoring
12:30 – 1:30pm	Lunch and presentation
Afternoon Session 1	ISO Overview and update on progress
Afternoon Session 2	Demo: Launch and placement of SUMS
2:45pm	Tea / Coffee Break
Afternoon Session 3	Practice Session: SUMS placement

Tuesday 3rd May

8:00am	Reflections from day 1
Morning Session 1	Study design and sampling
Morning Session 2	Ethical considerations and sample consent
10:30am	Tea / Coffee Break
Morning Session 3	Quantitative data collection
12:15 – 1:15pm	Lunch and presentation
Afternoon Session	Field trip: Informed consent and SUMS placement in homes
4:30pm	Tea / Coffee wrap up and initial reflections from field

Wednesday 4th May

8:00am	Reflections from day 2 including feedback from field visit
Morning Session 1	Qualitative data collection
Morning Session 2	Mixed methods research
10:00am	Tea / Coffee Break
Morning Session 3	Field team management
Morning Session 4	Practice Session: Semi-structured interviews and review of data collection tools for field trip
12:15 - 1:15pm	Lunch and presentation
Afternoon Session	Field trip: SUMS collection and survey practice.
4:30pm	Tea / Coffee wrap up and initial reflections from field

Thursday 5th May

8:00am	Reflections from day 3 including feedback from field visit
Morning Session 1	Data collection and management
Morning Session 2	Practice Session: Downloading data from the field
10:30am	Tea / Coffee Break
Morning Session 3	Data analysis and reporting
12:00-1:00pm	Lunch and presentation
Afternoon Session 1	Practice Session: SUMIT analyser and review field survey data
Afternoon Session 2	Action planning
3:00pm	Tea / Coffee Break
Afternoon Session 3	Review and presentation of action plans
Closing of Workshop	Certificates and Group Photo