

Vanuatu Cookstove Distribution Project Preliminary Endline Survey Analysis

Abstract: The widespread use of traditional biomass cooking fires in the developing world results in the emission of black carbon, a powerful climate forcing pollutant, and causes significant health problems, particularly for women and children. Improved biomass burning cookstoves designed to use less wood and reduce indoor air pollution have been developed and are now available commercially in many countries. However, improved cookstoves can only result in positive health and environmental outcomes if they are used properly and consistently. This paper provides preliminary analysis of an improved cookstove distribution project in the Republic of Vanuatu. While significant barriers to adoption exist, this research indicates these improved cookstoves are being adopted for use alongside traditional cooking methods.

Introduction – Biomass Cooking Around the World and In Vanuatu

As of 2011, roughly 2.7 billion people in the world depended upon some form of biomass (animal dung, crop residue or wood) as their primary source of cooking fuel (International Energy Agency, 2011). In the South Pacific island nation of Vanuatu, 96% of rural households use wood and coconut shells as their main source of cooking energy (Vanuatu Census, 2009). With more than 75% of the country's population living in rural areas, nearly three out of every four households use and depend upon biomass for cooking.

Different types of rudimentary cookstoves are used by different cultures throughout the developing world. In Vanuatu, the most common type of stove is the "two-stone fire" where cooking pots are supported over an open fire. One thing traditional cookstoves have in common is that they often provide incomplete and inefficient combustion of the biomass, resulting in negative environmental, health and economic impacts. The adverse health impacts of cooking are often felt most by women and children as they spend more time near the fires while cooking and working in kitchens.

The Republic of Vanuatu

The Republic of Vanuatu is an archipelago of 83 islands situated in the south west Pacific Ocean. It lies over 1,000 miles east of the northern coast of Australia and 300 miles west of Fiji. Its roughly 240,000 inhabitants are spread out over some 60 islands in the chain. More than 75% of the population lives in rural areas where two thirds (66%) of the people over the age of 15 work in agriculture and fishing (Vanuatu National Census, 2009). While the adoption of technologies including televisions, DVD players, and mobile phones has changed some aspects of rural life, a part of life that remains very traditional is cooking.

Cooking in Vanuatu

Biomass fuel is generally used in one of two ways in Vanuatu. The most common use is in open fires, consisting of two pieces of scrap reinforcing steel bars, or rebar, placed in parallel across two large stones. These are generally located on the ground and, less frequently, are placed on a raised table made of corrugated iron sheeting. Both are typically located within an enclosed, or semi-enclosed, cook house which is used as a kitchen, dining room, and an area to host guests. As such, people spend a lot of time near the open fires, leading to potentially high levels of exposure to smoke and particulate matter for entire families, especially women and young children (Figure 1). These cook houses are typically constructed from bamboo, wood and thatch. The walls are either woven bamboo slats, or whole pieces of

bamboo tied together. Both result in relatively porous walls which provide more ventilation than a concrete or block house.



Figure 1: A young boy lights a traditional two stone fire on Ambae. Note the size of the wood and the construction of the walls (Photo: Dennis Mello).

Another traditional form of cooking takes place in earthen ovens. Stones are heated by building a large fire in a pit and placing the stones on top (Figure 2). After the fire burns down the stones are taken out and food wrapped in banana leaves, most commonly *laplap*, is put in their place.¹ The stones are placed on top of the *laplap* and banana leaves or burlap sacks are used as a cover to hold in the heat and steam. As this is a time intensive process, it is generally done once a week on Sundays. Earthen ovens require large amounts of firewood and are one style of cooking that ICS are unable to replicate.



Figure 2: Heating stones for use in the earthen oven (Photo: Dennis Mello).

This report presents preliminary endline findings and analysis of the Vanuatu Cookstove Distribution Project, a collaborative effort between the Denver LoDo Rotary Club, Peace Corps Vanuatu, and Green Power. This research has been designed in partnership with the Denver LoDo Rotary Club stove distribution pilot project in order to determine if the stoves currently being imported into Vanuatu are appropriate for the local context. It aims to measure adoption rates of the stoves and users' impressions of stove performance over time. Further, it attempts to measure factors that lead to adoption (or non-adoption) of the new stoves.

¹ Lap-lap is a traditional dish throughout Vanuatu which is made by baking mashed root crops or bananas wrapped in banana leaves.

Methodology

The project was designed so as to distribute stoves in two rounds over the course of one year. The villages of Vuimberugu (Ambae Island), Niku and Baia (Epi Island) received their ICS in the first round (October 2013). Households in Quatemele (Ambae) and Moriu (Epi) received their ICS in the second round, approximately one year later (November 2014). These assignments were not randomized but were chosen based on the location of the Peace Corps Volunteers.

The use of a control group and two rounds of distribution allows for a difference in differences analysis of adoption rates and other changes in cooking behaviors. As can be seen in table 1 below, 60 households received stoves in the first round and 38 received stoves in the second round, for a total of 98 households.

Table 1: Project Distribution Design

Number of Households in Each Distribution Round						
	Ambae		Epi			Total
	Vuimberugu	Quatemele	Niku	Baia	Moriu	
First Round	25		28	7	-	60
Second Round	-	12	-	-	26	38

Baseline surveys were conducted in Vanuatu primarily between September and December 2012, with a handful coming in the early months of 2013. Due to delays in the procurement of the stoves, initial distribution was delayed until October 2013. Endline surveys were completed between July and September 2014. This means that on Ambae, participants had their stoves between 10 and 11 months by the time they took the endline surveys. On Epi, participants had between 9 and 10 months.

Number of Surveys Completed in Each Distribution Round							
		Ambae		Epi			Total
		Vuimberugu	Quatemele	Niku	Baia	Moriu	
Baseline Surveys	Sept 2012 – Feb 2013	25	12	28	7	26	98
Endline Surveys	Jul – Sept 2014	21	11	19	7	22	80

Baseline surveys were given to 98 households (60 intervention / 38 control), while at endline, only 80 households (47 intervention / 33 control) were able to be interviewed. This was due to various factors, including cases where households had left the island or where they were unable to be reached during the time available for endline surveys.

In August 2012, community meetings explaining the aims of the project were held in *nakamals* (community centers) and churches. Participants were told that the Denver LoDo Rotary Club was distributing the ICS because they have been shown to save firewood and produce less smoke than traditional open fires. Each household that wished to take part would receive one ICS which would be theirs to keep. No payments were accepted and no conditions were placed on ownership of the stoves. After each community agreed to take part, individual households were approached to gain their consent to participate in surveys about their cooking habits and stove usage. These surveys form the basis of this research. It was made clear to all households that they were free to decline to participate in the research without fear of losing their stoves.

The survey timeline was designed to allow for an analysis of how households adjust their cooking habits in response to the presence of the new technology. As it was possible that cooking habits would have changed in the absence of the ICS distribution project, nearby villages were included to provide a comparison group. In an effort to minimize any adverse impacts resulting from being excluded from the initial distribution project, a second round of stove distribution to neighboring villages was included from the start. This also makes it possible for future analysis into potential differences in adoption rates in the different rounds.² In order to fully take advantage of the multiple round design of the study, an additional round of surveys would need to be completed in the future. The merits of these further studies as a result of a change in stoves being imported are explained below in the 'next steps'.

Preliminary Findings

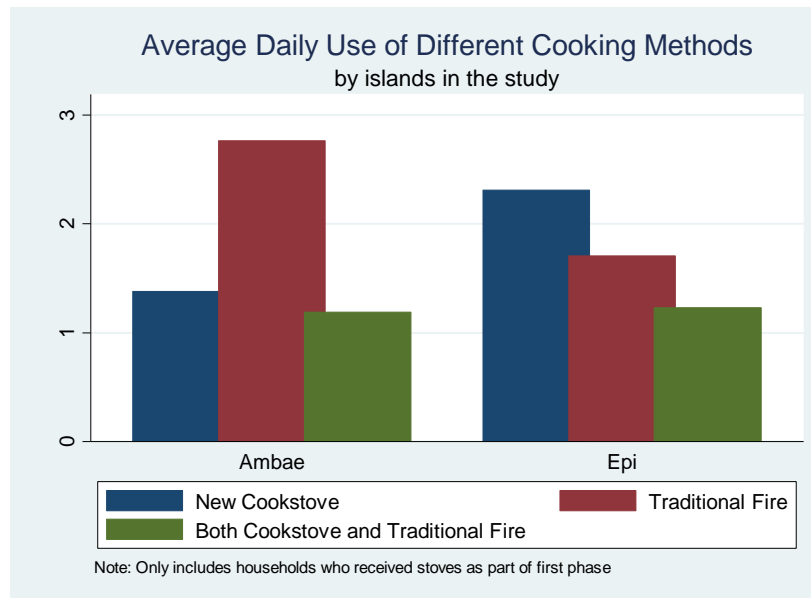
Based upon an initial analysis of the endline survey data, some of which is presented below, the improved cookstoves distributed during the first round of this program have seen some success in integrating into households' everyday cooking habits. While the improved cookstoves have not replaced traditional methods of cooking, such as the open fire or earthen oven, 96% of households reported using them at least once per day. It appears that the improved cookstoves have begun to find a niche in the 'fuel mix' of individual households on both Ambae and Epi.

Baseline surveys taken prior to the initial stove distribution showed that households cooked over fire an average of 2.5-2.7 times per day, with 94% of households reporting that they used their two stone fires every time they cooked, with no statistical difference between control and intervention groups. Endline surveys showed significant reductions in the frequency of reliance on two stone fires overall alongside the expected increase in the use of the new cook stoves.

While fewer households on Epi reported seeing the expected benefits of the improved cookstoves compared to households on Ambae, households on Epi use their stoves more frequently and had a larger decrease in their use of traditional two stone fires. On average, households on Epi reported using their new stoves 2.3 times per day compared to just 1.4 times per day on Ambae. These findings require further investigation to determine the reasons for the significant differences between the two islands..

The graph below shows that households on both islands have adopted the new cookstoves and are using them alone and alongside traditional open fire stoves.

² There could be some anticipation effect where households in the Round 2 villages decide not to adopt a new technology, i.e. propane gas stove, in anticipation of receiving their free ICS. Not sure how big of an effect, if any this might have since the barrier to adoption of gas stoves is really availability and price. If a household found themselves with the money and found a way to easily buy, and replace, gas bottles, the promise of a new wood-burning ICS would likely not have a large effect. However, it may discourage them from buying their own ICS through another outlet such as a local shop.



Further support for the idea that the stoves are being adopted is seen in the response to the question of if they would recommend that their family and friends buy a stove. An overwhelming majority (96%) of households said they would, although many questioned where their friends and family would be able to purchase one. This finding, along with the households self-reported willingness to pay between \$21 and \$28 USD indicates that there is a demand for these stoves if they could be made available for purchase locally. Further investigation would be needed to determine if they would be able to pay full market value or if they would need some subsidy or financing option.

Benefits and Drawbacks of Improved Cookstoves

Households on both Ambae and Epi reported the expected benefits of the improved cookstoves, including emitting less smoke, using less firewood, and cooking faster than traditional open wood fires. Although as mentioned above there was some difference between the islands (shown in tables below) both groups reported the benefits.

In general, the most common area for improvement mentioned by respondents was in the size of the stove being too small. This factor could help to explain why households are using their new cookstoves alongside traditional open fires. Families often need to have more than one pot of food cooking at the same time, leading to the need to use both old and new stoves at the same time.

Interestingly, the design of the stoves being sold in Vanuatu changed between baseline and endline, so that the stoves distributed in the second round were able to accommodate much larger cooking pots. This change in the design of the stoves offers an interesting opportunity for further research on the adoption and use of the stoves. It is possible that this change in design will increase households' use of the cookstoves as they would be able to be used in more cooking scenarios.

Potential Health and Safety Impacts

While this project was not able to measure true health impacts of the use of the stoves, previous research on improved cookstoves has shown that regular and proper use of the cookstoves can reduce indoor air pollution, with significant health impacts for households. Based upon the fact that households are using the cookstoves in their regular cooking mix, there is a potential that indoor air pollution is

being decreased, which would have positive health impacts. But this remains unknown without further study.

In this project we did ask respondents to self-report on quality of life factors such as eye irritation, coughing, and headaches after cooking. There was no statistical difference between those who received stoves during the first phase (intervention) and those who did not (control). Two carbon monoxide detectors, which were meant to be used as a proxy measure for indoor air pollution, were used in some of the baseline households, but were lost during the transition of volunteers working with this project.

Additional survey questions aimed to look at the safety of the stoves by looking at the number of burns and the number of times the stoves had tipped over during the previous 12 months. No statistical change in the number of children burned by stoves, minor drop in the incidences of cooks being burned while cooking in previous 12 months. On Epi, endline surveys with the intervention group showed that none of them had had any tipovers in the previous 12 months. This result could be due to data entry errors or the question being asked in a different way than during baseline. It could also indicate that the new cookstoves are substantially less likely to tipover than traditional stoves. Further research is needed to test this.

Successes and Challenges of Working with Peace Corps Volunteers

This success of this project relied heavily upon the effort and support of Peace Corps Volunteers and staff in Vanuatu. While there were challenges given the remoteness of the villages and delays in the procurement of the stoves, the project could not have succeeded, and certainly benefited from the volunteers' close relationship and knowledge of the communities.

The largest challenge with working with Peace Corps Volunteers was a result of the stoves being delayed and having to complete the project with different volunteers than those who began. The initial design of the project would have seen the same volunteers conduct the baseline and endline surveys, as well as training on the use of the stoves. However, by the time the stoves were delivered, the original volunteers were completing their service. Fortunately we were able to recruit new PCV who were stationed in nearby villages to help complete the project. Unfortunately, we were unable to give them as thorough training on the surveys as the original PCVs. This led to some questions being misunderstood and some being left out.

Despite these challenges, the partnership with Peace Corps Vanuatu was instrumental to the success of the project. In the future, it may be beneficial to have projects more fully developed and prepared by the time the volunteers are in pre-service training, so that they can have two full years to work on whichever project it is. This would require working with the Peace Corps post in country further in advance.

Recommendations and Next Steps

These preliminary results show that the cookstoves have been adopted and were being used regularly at the time the endline surveys were completed. The results also show the limitations of the size of the first cookstoves distributed, and the lack of availability in the communities. As mentioned above, the fact that different cookstoves (which appear able to accommodate larger cooking pots) were distributed in the second phase of the project opens up the possibility for a follow up survey which could compare use and adoption between the two stoves. Follow on surveys could also look at how the stoves survived the recent cyclone, and if that altered households' cooking habits.

Further, these preliminary findings could be shared with David Stein and Green Power to let them know there is a demand for these cookstoves outside of the capital. However, given the recent destruction

wrought by Tropical Cyclone Pam, households' priorities and needs are going to be substantially different than a few months ago when the endline surveys were taken. The cyclone will also alter the current PCVs priorities for their work in Vanuatu. However, if there were a PCV who was interested in working on the project within the next year or 18 months, it would be interesting to conduct a version of the survey to determine usage and comparisons between the different types.

Background Information and Survey Data Results:

In the first round, 60 stoves were distributed to the 'intervention' communities of Vuimberugu, Niku and Baia. In the second round, 38 stoves were distributed to the households in the 'control' communities of Quatemele and Moriu.

All 47 households in intervention group still owned their new cookstoves, and each reported having received some type of training on the use of the stove through the project. The vast majority, 98% (46 of 47) received training from their Peace Corps volunteer during a home visit or community workshop shortly after stoves were distributed.

Satisfied overall?

Preliminary analysis of the adoption of the stoves based on endline survey responses of the 47 households who received stoves in the first round are presented below. Overall, households valued their stoves and found them a useful addition to the mix of cooking options used in their homes. The findings indicate that while the improved cook stoves will not completely replace other forms of cooking, they were valued and used quite often.

Recommend to Friends?

When asked if they were satisfied with their new stoves, 45 of 46 respondents (98%) said they were. The one household that was not satisfied was a married couple in their late 70's who cooked for themselves and was not interested in changing. A similar percentage of households, 96% (45 of 47), said they would recommend the improved cook stove to their friends and family. Some, however, questioned where their friends and family would be able to purchase them as they are not available in stores on the islands.

Overall impressions

When asked about the overall feeling of their stoves, the top three comments were that they liked that the stove was easy to use/quick (10 responses), that it used less wood (11 responses), and that it produced less smoke (8 responses). These are often the main benefits of the stoves that are promoted by their proponents and manufacturers.

Similar responses came when asked what they liked most about the stoves, with the top three responses again begin that it was quick (16 responses), used less firewood (16 responses), and that there was less smoke than traditional stoves (9 responses).

What would you change?

Overwhelmingly the common suggestion for improving the stove was the size. Of the 34 households who said they would change something, 28 of 34 (84%) said it was too small or that they would need two of them to be useful.

When asked this question in another way, what they disliked about the stove, 21 of 22 people who answered commented on the small size of the stove.

Comparing improved cook stoves with traditional open fires

Households were asked a series of questions comparing their improved cook stoves ('new stove') with traditional open fires ('Fire'). The tables below show the frequency of responses by island for each of the questions.

How does the cooking time compare between the stoves?

	New stove faster	No difference	Fire faster	Total
Ambae	11 (52%)	7 (33%)	3 (14%)	21
Epi	11 (42%)	1 (4%)	10 (38%)	26
Total	22 (47%)	8 (17%)	13 (28%)	47

**Percentages shown are calculated for each row*

HH on Epi more likely to respond that fire is faster

How does the smoke compare between the stoves?

	New stove emits less smoke	No difference	Fire emits less smoke	Total
Ambae	21 (100%)	0 (0%)	0 (0%)	21
Epi	19 (73%)	2 (8%)	3 (12%)	26
Total	40 (85%)	2 (4%)	3 (6%)	47

**Percentages shown are calculated for each row*

How does the wood consumption compare between the stoves?

	New stove consumes less wood	No difference	Fire consumes less wood	Total
Ambae	21 (100%)	0 (0%)	0 (0%)	21
Epi	16 (62%)	3 (12%)	5 (19%)	26
Total	37 (79%)	3 (6%)	5 (11%)	47

**Percentages shown are calculated for each row*

100% of respondents on Ambae saw less firewood used in new stove versus an open fire. On Epi, 8 of 26 (31%) households saw fire as good as or better than new stove. There is an opportunity for additional training and instruction to see if they could reduce firewood usage in new stoves.

How does the taste compare between the stoves?

	New stove food tastes better	No difference	Fire cooked food tastes better	Total
Ambae	3 (14%)	18 (86%)	0 (0%)	21
Epi	3 (16%)	19 (73%)	3 (12%)	26
Total	6 (13%)	37 (79%)	3 (6%)	47

**Percentages shown are calculated for each row*

How does the ease of use compare between the stoves?

	New stove easier	No difference	Fire easier	Total
Ambae	10 (48%)	11 (52%)	0 (0%)	21
Epi	7 (27%)	10 (38%)	5 (19%)	26
Total	17 (36%)	21 (45%)	5 (11%)	47

**Percentages shown are calculated for each row*

Again a difference between the two islands, perhaps due to training/use - on Epi, 5/26 households said fire was easier

How many times per day do you use the new stove?

	Never	Once per Day	Twice per day	Three times or more per day	Total
Ambae	0	13 (62%)	8 (38%)	0	21
Epi	2 (8%)	3 (12%)	7 (27%)	13 (50%)	26
Total	2 (4%)	16 (34%)	15 (32%)	13 (28%)	47

**Percentages shown are calculated for each row*

Interestingly, and somewhat contrary to expectations based on their comparisons of the new stoves to traditional wood fires, households on Epi used their stoves nearly one more time per day than households on Ambae. This difference is statistically significant at 99%.

How many times per day do you cook over traditional fire?

	Never	Once per Day	Twice per day	Three times or more per day	Total
Ambae	0	0	6 (29%)	14 (67%)	21
Epi	2 (8%)	10 (42%)	5 (21%)	7 (29%)	26
Total	2 (4%)	10 (22%)	11 (24%)	21 (47%)	47

**Percentages shown are calculated for each row*

Households on Ambae cooked over traditional fires an average of one more per day than those on Epi (2.76 times per day versus 1.71 times per day). This difference is statistically significant at 99.9%

How many times per day do you use both stoves together?

	Never	Once per Day	Twice per day	Three times or more per day	Total
Ambae	0	17 (81%)	4 (19%)	0	21
Epi	5 (19%)	14 (54%)	3 (12%)	4 (15%)	26
Total	5 (11%)	31 (66%)	7 (15%)	4 (9%)	47

**Percentages shown are calculated for each row*

It was quite common to use both stoves together on both Ambae and Epi, with 81% of all households saying that they used both stoves together at least once per day.

Why don't you use the new stove every time?

When asked about their reasons for not using the new stove every time, households gave multiple reasons including: the stove was too small, they wanted to cook in an earthen oven, and the need to split wood into small pieces (whereas wood collected in the forest was quite large).

How much would you be willing to pay for this stove?

When asked how much they would be willing to pay, households on Epi responded they would be willing to pay an average of 3093 vatu (\$28) with a standard variation of 1,306 vatu (\$12). Households on Ambae reported being will to pay 2,219 vatu (\$21) with a standard deviation of 370 vatu (\$3.43).