



USAID | GHANA
FROM THE AMERICAN PEOPLE

SUSTAINABLE FISHERIES MANAGEMENT PROJECT (SFMP)

Evaluation Report on Morrison Stoves.



MARCH 2016

THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY



SNV SMART
DEVELOPMENT
WORKS

This publication is available electronically on the Coastal Resources Center's website at http://www.crc.uri.edu/projects_page/ghanasfmp/

For more information on the Ghana Sustainable Fisheries Management Project, contact:

USAID/Ghana Sustainable Fisheries Management Project

Coastal Resources Center

Graduate School of Oceanography

University of Rhode Island

220 South Ferry Rd.

Narragansett, RI 02882 USA

Tel: 401-874-6224 Fax: 401-874-6920 Email: info@crc.uri.edu

Citation: Avega, B., Nsiah, A., Kwarteng, E. (2016). Evaluation Report on Morrison Stoves. The USAID/Ghana Sustainable Fisheries Management Project (SFMP). Narragansett, RI: Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island and SNV Netherlands Development Organisation. GH 2014_ACT077_SNV. 28 pp.

Authority/Disclaimer:

Prepared for USAID/Ghana under Cooperative Agreement (AID-641-A-15-00001) awarded on October 22, 2014 to the University of Rhode Island and entitled; the USAID/Ghana Sustainable Fisheries Management Project (SFMP).

This document is made possible by the support of the American People through the United States Agency for International Development (USAID). The views expressed and opinions contained in this report are those of the SFMP team and are not intended as statements of policy of either USAID or the cooperating organizations. As such, the contents of this report are the sole responsibility of the SFMP Project team and do not necessarily reflect the views of USAID or the United States Government.

Cover photo: Meeting with beneficiaries at Gomoa Feteh (Benedicta Avega)

Detailed Partner Contact Information:

USAID/Ghana Sustainable Fisheries Management Project (SFMP)
10 Obodai St., Mempeasem, East Legon, Accra, Ghana

Telephone: +233 0302 542497 Fax: +233 0302 542498

Maurice Knight	Chief of Party maurice@crc.uri.edu
Kofi Agbogah	Senior Fisheries Advisor kagbogah@henmpoano.org
Nii Odenkey Abbey	Communications Officer nii.sfmp@crcuri.org
Bakari Nyari	Monitoring and Evaluation Specialist hardinyari.sfmp@crcuri.org
Brian Crawford	Project Manager, CRC brian@crc.uri.edu
Justice Odoi	USAID Administrative Officer Representative Jodoi@usaid.gov

Kofi.Agbogah
kagbogah@henmpoano.org
Stephen Kankam
skankam@henmpoano.org
Hen Mpoano
38 J. Cross Cole St. Windy Ridge
Takoradi, Ghana
233 312 020 701

Andre de Jager
adejager@snvworld.org
SNV Netherlands Development Organisation
#161, 10 Maseru Road,
E. Legon, Accra, Ghana
233 30 701 2440

Donkris Mevuta
Kyei Yamoah
info@fonghana.org
Friends of the Nation
Parks and Gardens
Adiembra-Sekondi, Ghana
233 312 046 180

Peter Owusu Donkor
Spatial Solutions
powusu-donkor@spatialdimension.net
#3 Third Nautical Close,
Nungua, Accra, Ghana
233 020 463 4488

Thomas Buck
tom@ssg-advisors.com
SSG Advisors
182 Main Street
Burlington, VT 05401
(802) 735-1162

Victoria C. Koomson
cewefia@gmail.com
CEWEFIA
B342 Bronyibima Estate
Elmina, Ghana
233 024 427 8377

Lydia Sasu
daawomen@daawomen.org
DAA
Darkuman Junction, Kaneshie Odokor
Highway
Accra, Ghana
233 302 315894

Gifty Asmah
giftyasmah@Daasgift.org
Daasgift Quality Foundation
Headmaster residence, Sekondi College
Sekondi, Western Region, Ghana
233 243 326 178

For additional information on partner activities:

CRC/URI:	http://www.crc.uri.edu
CEWEFIA:	http://cewefia.weebly.com/
DAA:	http://womenthrive.org/development-action-association-daa
Daasgift:	https://www.facebook.com/pages/Daasgift-Quality-Foundation-ENGO/135372649846101
Friends of the Nation:	http://www.fonghana.org
Hen Mpoano:	http://www.henmpoano.org
SNV:	http://www.snvworld.org/en/countries/ghana
SSG Advisors:	http://ssg-advisors.com/
Spatial Solutions:	http://www.spatialsolutions.co/id1.html

ACRONYMS

AWEP	Association of Women for the Preservation of the Environment
MES	Morrison Energy Services
SNV	SNV Netherlands Development Organisation
SFMP	Sustainable Fisheries Management Project
USAID	United States Agency for International Development

TABLE OF CONTENTS

ACRONYMS.....	ii
TABLE OF CONTENTS.....	iv
LIST OF FIGURES	v
LIST OF TABLES	v
EXECUTIVE SUMMARY	1
INTRODUCTION	2
1.1 Objective.....	3
1.2 Brief	3
2.0 METHODOLOGY	4
3.0 EVALUATION PART 1: BENEFICIARY SATISFACTION ANALYSIS.....	4
3.1 Understanding the Target Group	5
3.2 Use of Stoves	5
3.3 Beneficiary Satisfaction	6
3.4 Resource Efficiency	7
3.5 Stove Financing	8
3.6 Stove Quality	8
4.0 EVALUATION PART TWO: ENERGY ASSESSMENT ON STOVES	9
4.1 Comparative Assessment between the Chorkor, Morrison Brick and Morrison Clay stoves.....	9
4.2 Test 1.....	9
4.3 Test 2.....	11
4.4 Results and Discussion	13
4.5 Smoking Time.....	13
4.6 Better Drying	14
4.7 Specific Energy (fuelwood) Consumption (SEC).....	14
4.8 Efficiency improvement.....	14
5.0 CONCLUSION.....	14
6.0 RECOMMENDATION	14
APPENDIX 1: List of Stove Beneficiaries and Associated Information	16

LIST OF FIGURES

Figure 1: Emmanuel Kwarteng (SNV Staff) interviewing Esi Akyineba, a demonstration stove host at Winneba	4
Figure 2: Ages of Respondents	5
Figure 3: Most Valued Benefits of Stove	6
Figure 4: Beneficiary Satisfaction	7
Figure 5: Resource Efficiency	7
Figure 6: Sharon Ghartey by her newly built improves stove	8

LIST OF TABLES

Table 1: Test 1 Raw Data.....	10
Table 2: Test 1 Analysis	11
Table 3: Test 2 Raw Data.....	11
Table 4: Test 2 Analysis	13
Table 5: Summary.....	13

EXECUTIVE SUMMARY

Fish is an important source of food and income to many people in the developing world. In Africa, some 5 percent of the population, about 35 million people, depend wholly or partly on the fisheries sector, mostly artisanal fisheries, for their livelihood. The Ghana Fisheries and Aquaculture Development Plan for 2011 – 2016 stated that the country has access to significant and valuable stocks of fish; total domestic production, including aquaculture, is roughly 440,000 tons each year.

The introduction of improved fish smoking technologies has become necessary for value addition; to increase yields and subsequently improve the livelihoods of fish processors. The introduction of the Chorkor fish smoking stove was very critical to increasing smoked fish production towards the reduction of post-harvest fish losses in Ghana. Thus fish processors were able to smoke more fish within a smoking cycle than earlier.

Years later, another improved fish smoking stove; the Morrison Fish smoking stove was designed and piloted in New Takoradi in the Western Region and along the Eastern coasts of Ghana, with the support of a number of NGOs including Daasgift Quality Foundation, CHF and SNV.

SNV under the Improved Fish Smoking Project has installed 285 Morrison stoves in parts of the eastern coastal fishing communities of Ghana, specifically the Keta and Ada East Districts. The beneficiaries confirmed the energy efficiency potential of the stove and provided additional information on benefits, such as; cooks faster, emits less smoke, gives an appealing fish outlook and dries the fish better. The Energy efficiency potential of the stove was one main characteristic that drove the promotion of the stoves because of the conspicuous savings on wood fuel, which translates into reducing the rate of deforestation to an extent.

Based on the successes Under SNV's previous Improved Fish Smoking project, SNV introduced and promoted the improved Morrison fish smoking stoves to the new Sustainable Fisheries Management Project as a potentially scalable support programme towards improving the livelihood of fish processors.

Based on SNV's proposal, the Morrison stove was adopted and piloted under the USAID/Ghana Sustainable Fisheries Management Project in five communities in the Central Region; namely Winneba, Apam, Senya Bereku, Gomoa Feteah and Ankaful. A total of 48 Morrison stoves have been installed since 2014.

An evaluation survey was carried out early March 2016 to evaluate the energy efficiency and the satisfaction of beneficiaries of the 48 stoves piloted. Questionnaires, focus group discussion and energy audits were employed to meet the objectives of the survey.

A sample size of 35 fish processors who were supported with the Morrison stove were selected for the survey across four communities, with the exception of Ankaful, because the stoves were under construction during the evaluation period. All respondents were females. Of the 48 stoves, 11 stoves were installed at Apam, 13 at Winneba, 11 at Senya Bereku, 6 at Gomoa Feteah and 7 at Ankaful.

The survey showed that 96% of the respondents had a chorkor stove before the adoption of the Morrison stove. 41% of the respondents still use their Chorkor stoves in addition to their Morrison stoves. 48% of the respondents prefer the Morrison stove to the Chorkor, because it smokes faster; gives a good finishing, look and texture; production cost is reduced as a result of using less firewood; and it reduces the occurrence of smoke in the working environment.

All the same, the respondents also had a number of challenges with the stove; paramount being the small capacity of the stove as compared to the chorkor stove and the small opening of the fire chamber. Some of the respondents, especially the hosts of the demonstration stoves, also mentioned that, the small mesh sizes slowed down the smoking process for large fishes.

Generally the construction of the stoves was well carried out to standard. Most of the beneficiaries had received their full set of stove (16 trays, double unit stove base, 2 chimneys and 2 lids). 5 respondents in Winneba had not been supplied with chimneys and 8 stoves at Senya Bereku were not built to standard. These stoves are currently being repaired and the chimneys have since been supplied.

Out of the 35 respondents, 34 acquired loans from Microfin Rural Bank to purchase stove out of which 6 respondents defaulted in repaying loans. 43% of the respondents indicated that the current 50% subsidized amount of GHC1000 for brick stoves and GHC750 for clay cemented stoves is a fair price for the stove.

For energy efficiency, it is interesting to note that, the clay cemented Morrison stove is more efficient than the brick Morrison stove; and both of them are more efficient than the Chorkor stove. The clay cemented stove is 49.7% more efficient than the Chorkor stove whereas the brick stove is 43.1% more efficient than the Chorkor stove.

INTRODUCTION

In Ghana, various traditional methods are employed to preserve and process fish for consumption and storage. These include smoking, drying, salting, frying and fermenting and various combinations of these. Smoking is the most widely practiced method. Practically, all species of fish available in the country can be smoked and it has been estimated that 70-80 percent of the domestic marine and freshwater catch is consumed in smoked form.

Fish smoking in Ghana is traditionally carried out by women in coastal towns and villages, along river banks and on the shores of Lake Volta. In most fishing communities, the main economic activity of women is fish processing.

Until the end of the 1960s, the ovens most used for smoking fish in Ghana were cylindrical or rectangular and made of mud or metal. Using these ovens, had considerable disadvantages, the ovens had a low capacity, were inefficient in fuel usage and could not cope with the large volumes of fresh fish landed during bumper fish seasons. This contributed to high post-harvest losses and, since the fish season also coincided with the rainy season, the fish could not be sun-dried.

In the early 1950s, awareness of the shortcomings of traditional ovens had stimulated development work on new and improved smoking ovens, such as the Adjetey, Altona, Ivory Coast and Nyegesi models. For various reasons, however, none of these was accepted when introduced in Ghana.

In the light of lessons learned from the constraints and disadvantages associated with these earlier ovens, an improved traditional fish smoking oven, the Chorkor, was developed and introduced in 1969. This innovative model, developed by the Food and Agriculture Organization of the United Nations (FAO) and the Food Research Institute of the Council of Scientific and Industrial Research (CSIR) in Ghana, has since demonstrated the potential of traditional technologies in meeting current challenges (FAO, 1997).

Although initially developed for use in Ghana, the Chorkor oven has now received wide acceptance in most western, central and eastern African countries through a number of initiatives supported by multilateral and bilateral sources. To date, Cameroon, Ethiopia, the

Gambia, Kenya, Lesotho, Nigeria, Sierra Leone, Tanzania (including Zanzibar), Uganda and Zambia have demonstrated enthusiasm for and commitment to adopting this simple and cost-effective technology (<http://www.tcdc2.undp.org>).

Decades later, another improved stove, Morrison stove was designed. The Morrison stove was designed by Mr. Albert Kojo Morrison a stove artisan who lives in Kasoa in the Central Region of Ghana. The fish smoking stove was first piloted and used at New Takoradi in the Western Region with the support of Daasgift Quality Foundation and CHF International, in 2008.

Between 2014 and 2015 the stoves were promoted in parts of the Volta and Greater Accra coastal communities with the support of SNV Ghana through a Netherlands Government funded Improved Fish Smoking project and presently through the USAID funded Sustainable Fisheries Management Project. The improved stove reduces wood fuel use and produces less smoke, thus protects the women from smoke related diseases. The stove is reported to be 40% more fuel wood energy efficient than the Chorkor stove.

The USAID/Ghana Sustainable Fisheries Management Project being implemented by the Coastal Resource Center of the University of Rhode Island with the assistance of a consortium of local partners in Ghana including SNV Ghana, aims at rebuilding the small pelagic stocks in the Ghanaian coastal waters through varied interventions.

The Post-harvest component of the project, focused on fish processing is one of the sectors receiving much attention through the project. As part of activities carried out in year 1 under the project, 50 Morrison stoves were constructed in 5 communities in the Central Region.

To ensure that the beneficiaries are satisfied with the stoves, an evaluation survey was carried out on the stoves and the beneficiaries' level of satisfaction with the stoves. This report presents detailed information on the evaluation survey.

1.1 Objective

The evaluation survey was aimed at:

- Assessing the satisfaction of the stove users and
- Assessing the energy savings of the Morrison stove vis-avis the Chorkor stove

1.2 Brief

Between 29th February and 4th March, 2016, the SNV post-harvest team undertook a monitoring trip to four beneficiary communities in the Central region.

In year 1 of the project, SNV started the construction of 50 Morrison stoves in the Central Region. These stoves were supposed to be built in Apam and Winneba but was further extended to other communities such as Senya Bereku, Gomoa Feteah and Ankaful. Before the construction of the 50 stoves, 7 stoves were constructed in Winneba and Apam for demonstration purposes.

So far 41 stoves have been fully completed and is construction of the remaining 9 is currently ongoing.

Two stove companies were contracted for this activity- Morrison Energy Services and Association of Women for the Preservation of the Environment (AWEP). Morrison Energy was contracted to construct 30 stoves whereas AWEP was contracted to construct 20 stoves.

Morrison Energy has so far completed all 30 stoves at Winneba, Apam, Gomoa Feteah and Ankaful whereas AWEP has constructed 11 stoves out of the 20 at Senya Bereku.

2.0 METHODOLOGY

The survey was carried out in four out of the five communities as a result of time factor and more importantly the stoves at Ankaful were under construction during the evaluation period. Thus the surveys were conducted at Winneba, Apam, Gomoa Fete and Senya Bereku.

Standard questionnaires, personal observations, focus group discussions and energy audits were used to collect the needed data for the survey.

The survey was in two forms; the beneficiary satisfaction survey, which involved questionnaires and focus group discussions and energy audits on three stoves; the Morrison brick, the Morrison clay cemented and the Chorkor stove.

All beneficiaries of the Morrison stoves including the seven pilot stove hosts formed a population size of 48. For the customer satisfaction survey, a sample size of 35 beneficiaries were selected at random in Apam, Winneba, Senya Bereku and Gomoa Fete. In addition to the questionnaires, two focus group discussions were held in two communities; Apam and Senya Bereku. This is to augment information gathered from the individual interviews.

For the energy audits, three fish smoking stoves were selected at random; the Chorkor, Morrison brick and Morrison clay cemented. The controlled cooking test process was used. Two smoking sessions were carried out on all three stoves.

Analysis for both aspects of the survey is represented in the following sections of this report.



Figure 1: Emmanuel Kwarteng (SNV Staff) interviewing Esi Akyineba, a demonstration stove host at Winneba

3.0 EVALUATION PART 1: BENEFICIARY SATISFACTION ANALYSIS

Even though 32 people out of the 35 sample population size were interviewed, the results still have limited representation because only 38% of respondents had used the stove between the period 4-6 months and 41% had not yet used the stove due to unavailability of fish in the lean season. The remaining 21% had used it a month and below, this may affect respondents' judgments and therefore quality of data.

Due to minimum use period of the stove some respondents could not answer properly some questions that needed specifics, which may also affect data quality.

3.1 Understanding the Target Group

Women are the key users of the Morrison improved fish smoking stoves (Morrison stove) as such 100% of respondents were females.

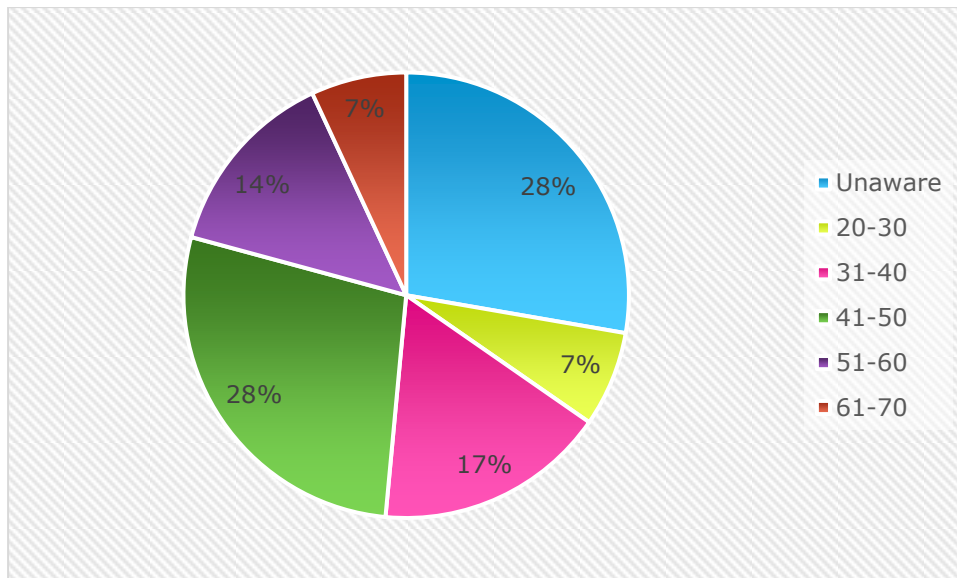


Figure 2: Ages of Respondents

28% of respondents were unaware of their ages, 21% were within the age range of 51-70 years followed by 45% being in the middle age; 31-50 years, while young women within 20-30 were the least at 7%. This informs that most stove users are within the middle age group.

All the respondents were fish smokers and all of them but two were using their own chorkor stoves. The two respondents, located at Gomoa Feteh rent chorkor stoves to others for smoking their fish.

3.2 Use of Stoves

Out of the 48 stoves that have been constructed, 13 were located in Winneba, 11 in Apam, 11 in Senya Bereku 6 in Gomoa Feteh and 7 at Ankaful. Those in Gomoa Feteh were the latest to receive the stove and had used it at least 3 weeks, whereas the stoves at Ankaful were being constructed during the survey period.

38% of respondents had used the stove between the periods; 4-6 months and 41% had not yet used the stove due to unavailability of fish in the lean season. The remaining 21% had used it a month and below. All respondents own at least one improved brick or clay Morrison stove and they smoke on average 5 days a week depending on fish availability.

The survey showed that 96% of the respondents had a chorkor stove before adopting the new improved stove. 41% of respondents are still using the Chorkor stoves. They explained that the chorkor stove serves as a support to the Morrison stove especially during the bumper season when there is more fish to be smoked. Whereas 28% of the respondents are using just the improved stoves. However 48% of stove users indicated they preferred the improved stove to the chorkor stove.

The survey indicated that 17% preferred the chorkor stove to the improved. The reasons given on why the Chorkor stoves were preferred to the Morrison stove, included;

- Preference for wide fuelwood inlet to enhance fitting in large sizes of wood, which is something the
- The small tray net sizes of the Morrison stove slows down the smoking process
- Less capacity
- For respondents who preferred the Morrison stove, reasons were centred on;
- The ability of stove to utilise 50% less fuelwood as compared to former stove,
- The ability of stove to smoke fish faster thereby reducing processing period,
- Reduced smoke emission
- The ability of stove to cook and smoke the fish in one session
- Reduced insect infestation
- Reduced frequency in interchanging trays

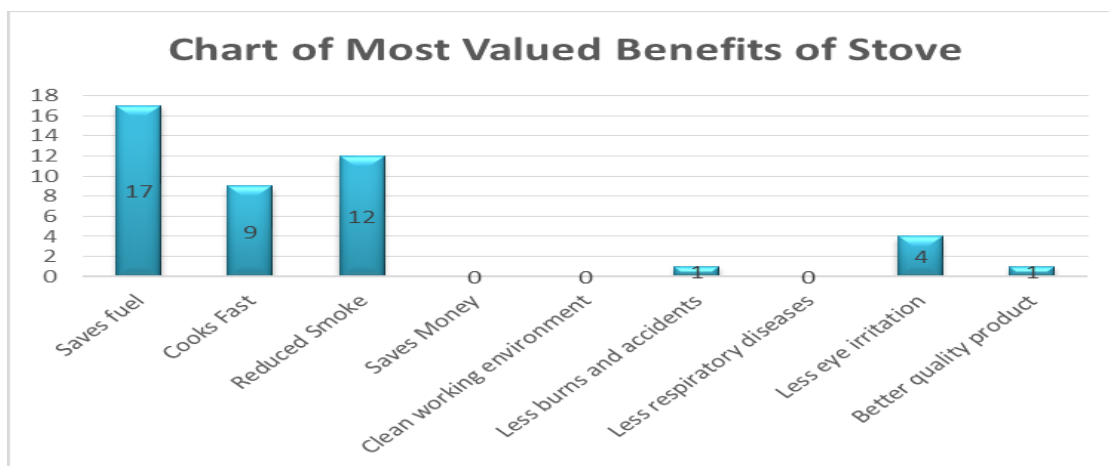


Figure 3: Most Valued Benefits of Stove

The above chart shows reduced smoke emission and low fuel consumption as the most valued benefits of stove. This reflects the effectiveness of the stove in responding to the satisfaction needs of the consumers.

On the components of the Morrison stove; such as the chimney; cover/lid; the trays, the base and the fire place entrance, respondents commented on work related to installing the chimney during processing. It was observed that some of the processors avoided the use of the chimney.

Users will have to be well educated on the motive behind stove design and get a clear understanding why they are to use stove as instructed. For instance a user should understand why wood inlet does not necessarily need to be large. However it was evident that the sizes of wood used for smoking, for most respondents were large sizes of wood and would require some extra efforts and possibly cost implications (paying labor to split the wood) to enable wood sizes fit into entrance of stove. A stove user should therefore have enough motivation to want to use the improved stove.

3.3 Beneficiary Satisfaction

Out of 29 respondents who had used the stove, 54% indicated that, the stove meets their processing need and therefore preferred it to the Chorkor. However 62% of stove owners including some owners who had not yet used the stove indicated that they will recommend the Morrison stove to others and were satisfied with their decision to purchase the stove. Reasons being that, the fish output is attractive and saves fuel. 59% of respondents expressed high possibilities of purchasing more improved stoves and 45% are willing to replace their Chorkor stove.

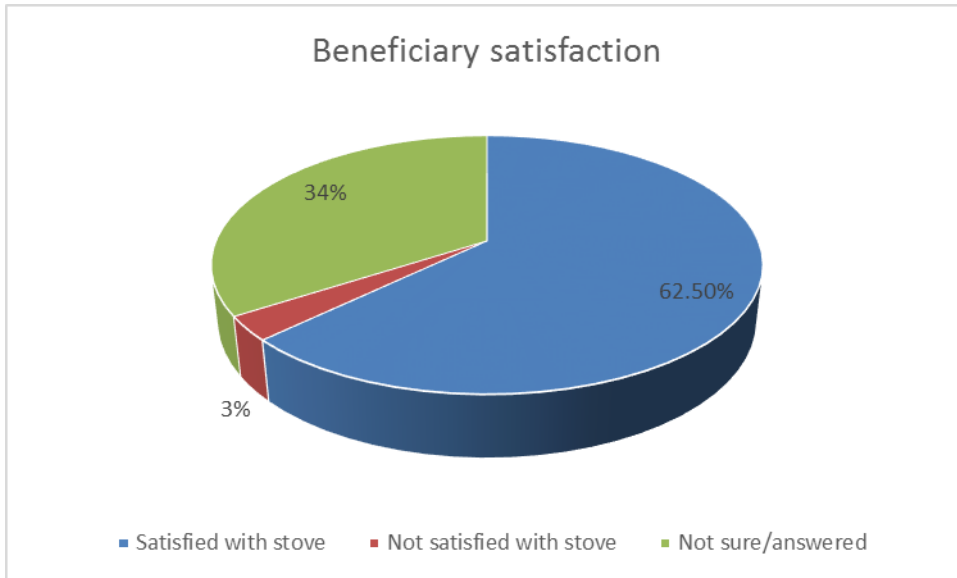


Figure 4: Beneficiary Satisfaction

The respondents informed that, when they have more fish the Morrison stove is used and the chorkor serves as support to the Morrison stove, especially because it gives an attractive out look to the smoked fish. The respondents requested for more trays to make the stove much more beneficial to them.

3.4 Resource Efficiency

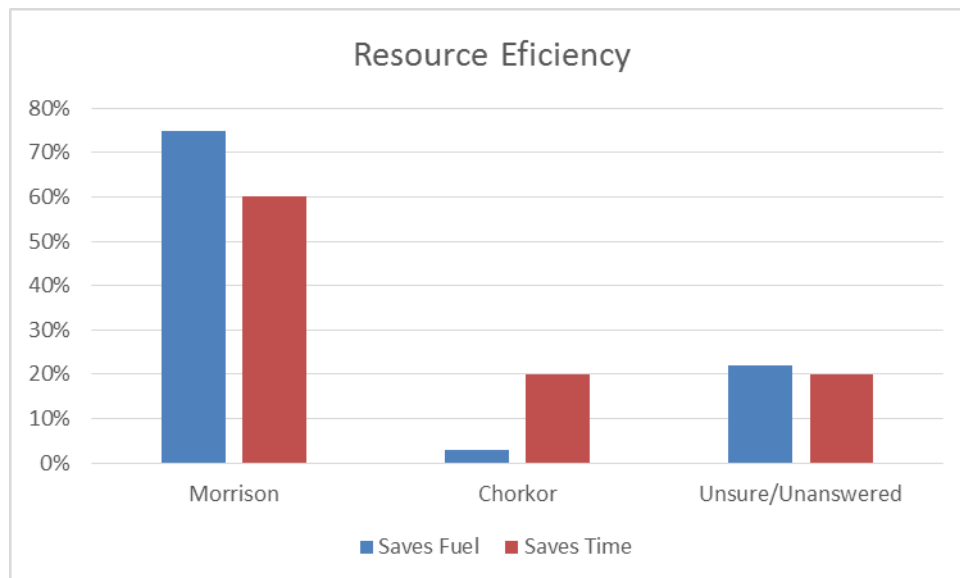


Figure 5: Resource Efficiency

75% of respondents indicated that they have identified improvement in their resource use; explaining further that production cost is reduced because they need half of the usual amount of fuelwood they would have used for the Chorkor for smoking fish on the Morrison stove. 60% of the respondents informed that the Morrison stove smokes fish faster than the Chorkor whereas 20% of the respondents confirmed that the Chorkor smokes faster than the Morrison, another 20% were unsure. From their responses it was deduced that, on average the Chorkor smoker takes at least 2hrs and 30mins for a soft smoking process to complete whereas the Morrison stove takes about 2hrs. Also the Chorkor stove uses twice as much fuel needed by the Morrison stove for a normal smoking session.

It was difficult to get information on profit margins as the respondents could not give accurate values. One respondent (Florence Nartey, Winneba) however informed that she increased the price of their fish on the market and it sold out within a short time thus was maintaining the new price. The cost difference was GHC 20.00 per basket of fish.

3.5 Stove Financing

34 respondents acquired loan from Microfin Rural Bank to purchase stove out of which 6 respondents had challenges with repaying loans. From the survey it was evident that with the unavailability of fish in the lean season it was difficult for processors to stay in business to be able to repay loans, the respondents suggested that the MFI's should tally repayment plans to their production seasons, taking into consideration the lean and bumper seasons. 1 beneficiary is making payment directly to the stove company. The repayment period is 6 months.

Realistic prices proposed by respondents were GHC 750 for clay stoves and GHC 1000 for brick stoves. In effect most respondents were comfortable with how much they paid for the stove.

3.6 Stove Quality

The installation of the stoves was carried out by two companies; Morrison Energy Services (MES) the originator of the Morrison stove and Association of Women for the Preservation of the Environment (AWEP). MES worked in Winneba, Apam, Gomoa Feteh and Ankaful, whereas AWEP worked in Senya Bereku.

At Winneba, Apam and Gomoa Feteh, the beneficiaries were happy and content with the stoves. They were constructed in time and there were no challenges with the stove quality. The final five stoves constructed at Winneba did not have chimneys, which Morrison acknowledged and explained that he was fabricating a new batch of chimneys which will be supplied.

8 stoves at Senya Bereku were not built to standard and had to be rectified to ensure quality provision of service to the beneficiaries. This affected repayment of loans because the beneficiaries were not satisfied with the quality of stove provided for them.

The above stated issues with quality is currently being rectified.



Figure 6: Sharon Ghartey by her newly built improves stove

4.0 EVALUATION PART TWO: ENERGY ASSESSMENT ON STOVES

4.1 Comparative Assessment between the Chorkor, Morrison Brick and Morrison Clay stoves

The controlled cooking test (CCT) method of testing was employed for the assessment of the Morrison Brick, Morrison Clay and the Chorkor stoves. With CCT, a real smoking process is carried out with assistance from the stove users just as in their normal smoking process. What we seek to achieve is the percentage improvements on the traditional stove.

Soft smoking method of smoking was applied in both cases and the information collected included: (1) fuel consumption; (2) time to complete smoking; (3) smoke production; (4) convenience of using the stove. The fuel consumption and time to smoke the fish were measured, the smoke production and the convenience of using the stoves were assessed by questionnaire and observation.

It is important to note that the Morrison stove that was selected for the audit is one of the demonstration stoves that were installed. The trays designed for these stoves had smaller net sizes for smoking anchovies. One main issue that came up during the questionnaire administration was the fact that, the demonstration stoves slows down the smoking process and the hosts attributed this to the small net sizes of the trays. Thus this stove was selected to ascertain their feedback.

Therefore one limitation of this audit was the fact that the tray net sizes was not the same, for both the Chorkor and the Morrison; that of the Morrison was smaller than the Chorkor.

4.2 Test 1

Table 1 provides the data obtained from test 1 for the Morrison Brick, Morrison Clay and the Chorkor stove using the sardinella as the test object. The fish was obtained from the cold store in all cases.

Table 1: Test 1 Raw Data

Parameter	Morrison Brick	Morrison Clay	Chorkor Stove	How is it obtained
Type of fish	Sardinella	Sardinella	Sardinella	
Source of fish	Cold store	Cold store	Cold store	
Type of fuel	Fuelwood	Fuelwood	Fuelwood	
Weight of Fuel	33.05	23.9	34.7	kg
Cost of Fuel	10.82	7.82	11.36	GHc
Total weight of fish	41.61	43.76	45.36	Weight confirmed by measurements (Kg)
Cost of fish	241.90	254.40	263.70	(GH¢)
Start time	11:31	10:27	10:26	Watch
Finish time	15:16	13:33	13:15	Watch
Total weight of smoked fish	23.37	23.92	26.42	Weighed (Kg)
Weight of fuel left	16.00	6.25	2.80	Weighed (Kg)

Table 2 provides the test analysis from test 1. The results captures information on fuel consumption, smoking time, and specific energy consumption for both stoves.

Table 2: Test 1 Analysis

Parameter	Morrison Brick	Morrison Clay	Chorkor Stove	How is it obtained
Processing time per batch	3:45	3:06	2:49	Minutes
Weight of fuel used	17.05	17.65	31.9	Kg
Weight loss in smoked fish	18.24	19.84	18.94	Kg
Cost of fuel used	5.58	5.78	10.44	GH¢
Percentage weight loss in fish	43.8	45.3	41.75	%
Specific fuelwood consumption	0.40975727	0.4033	0.7033	kJ energy consumed/kg raw product
Specific fuelwood consumption	0.7296	0.7379	1.2074	kg fuelwood/kg final product

4.3 Test 2

Table 3 provides the test data for test 2 obtained through a comparative energy assessment between the Morrison Brick, Morrison Clay and the Chorkor stove using the sardinella as the test object. The fish used were obtained from the cold store in all cases.

Table 3: Test 2 Raw Data

Parameter	Morrison Brick	Morrison Clay	Chorkor	How is it obtained
Type of fish	Sardinella	Sardinella	Sardinella	
Source of fish	Cold store	Cold store	Cold store	
Type of fuel	Fuelwood	Fuelwood	Sawdust	
Weight of Fuel (before)	19.35	19.15	34.35	kg
Cost of Fuel	7.97	7.89	14.15	GH¢
Total weight of fish	45.21	44.11	44.56	Weight confirmed by measurements (Kg)
Cost of fish	256.64	250.40	252.95	(GH¢)
Start time	10:40	10:40	10:42	Watch
Finish time	12:48	13:12	13:12	Watch
Total weight of	25.52	23.87	25.43	Weighed (Kg)

smoked fish				
Weight of fuel (after)	5.15	9.80	7.95	Weighed (Kg)

Table 4 provides a test analysis from test 2 capturing fuel consumption, smoking time, and specific energy consumption.

Table 4: Test 2 Analysis

Parameter	Morrison Brick	Morrison Clay	Chorkor Stove	How is it obtained
Processing time per batch	2:08	2:32	2:30	Minutes
Weight of fuel used	14	9.35	26.4	Kg
Weight loss in smoked fish	19.69	20.24	19.13	
Cost of fuel used	5.77	3.85	10.87	GH¢
Percentage weight loss in fish	43.55	45.89	42.93	
Specific Energy consumption	0.3097	0.2120	0.5925	kJ energy consumed/kg raw product
Specific fuelwood consumption	0.5486	0.3917	1.0381	kg fuelwood/kg final product

4.4 Results and Discussion

This section averages the analysis from the 2 test conducted and summarizes the results in table 5 below. The results from the summary table is discussed below.

Table 5: Summary

Parameters	Morrison Brick	Morrison Clay	Chorkor
SFC Kg Fuelwood /kg smoked fish)	0.6391	0.5648	1.1228
Percentage Weight loss due to smoking (%)	43.7	45.6	42.3
Smoking Time (minutes)	2:56	2:49	2:39
Cost of fuelwood used per batch (GHC)	5.67	4.81	10.66
Money savings per batch (GHC)	4.98	5.84	
Efficiency Improvements	43.1	49.7	

4.5 Smoking Time

The Morrison Brick, Morrison Clay and the Chorkor Stoves use an average of 176 minutes, 169 minutes and 159 respectively to complete one soft smoking cycle. This implies that the Chorkor stove cooks 17 minutes faster than the Morrison Brick and 10 minutes faster than the Morrison Clay.

(The limitation here is that, the tray net sizes varied, the Morrison tray nets were smaller in size than the chorkor tray nets, thus confirming what the beneficiaries of the demonstration stoves informed on longer smoking period for Morrison stove).

4.6 Better Drying

In all cases, the drying capacities are quite similar. The Morrison Brick reduced the fish weight by an average of 43.7%, the Morrison Clay reduced fish weight by 45.6% and finally Chorkor reduce fish weight by 42.3%. It can therefore be concluded that, the Morrison Clay stove dries fish better than the Morrison Brick and Chorkor. The ability to dry fish of the stove reflects in the shelf life of the fish.

4.7 Specific Energy (fuelwood) Consumption (SEC)

The average SEC of smoked fish using the Morrison Brick stove for soft smoking is 0.64, the Morrison Clay is 0.56 and the Chorkor stove is 1.12. This implies, per every kilogram of fish smoked, the Morrison Brick, Morrison clay, and Chorkor Stove requires 0.64kg, 0.56kg, 1.12kg of fuelwood to complete soft smoking respectively.

4.8 Efficiency improvement

Comparing the specific energy consumption of the Morrison Brick, Morrison Clay to the Chorkor, it can be ascertained that, the efficiency improvement of the Morrison Brick stove is about **43.1%** and Morrison Clay is about **49.7%** respectively. This implies that, the Morrison Clay technology is more fuel efficient and conserve 49.7% the fuel a Chorkor stove will consume. This percentage improvement qualifies for the Energising Development programme for Energy Access (Endev programme) criteria for selecting stoves for promotion.

5.0 CONCLUSION

As a result of budget and time limitation the team was only able to visit four communities out of the five. Ankaful was visited on a follow up mission.

The evaluation team was made up of representatives from SNV, Microfin Rural Bank and the two stove companies, thus it was easier to engage the respondents across all the phases of the support programme.

In conclusion respondents were happy with the improved stove and actually gave some ideas on the areas they expect further improvements to meet. This includes stove capacity, faster smoking time and the production of good quality fish. They suggested that, additional trays should be added and the wood for making the trays should be well dried to avoid deformation and breakage over time.

The respondents were generally not appreciative of the financing mechanism because of the interest margin being paid, the payment period and the amount of time they needed to spend for the training prior to loan allocation. The fascinating aspect was the fact that most of them had finished paying the loan and were requesting for another allocation for their businesses, even at Senya Bereku.

Quality issues are currently being sorted out and generally more fish processors requested to be included in the support programme.

On the whole, fish processors have come to accept and demand for improved technologies to improve upon their production capacity towards improving their livelihoods.

6.0 RECOMMENDATION

1. This evaluation should be carried out again after 6 months to validate the current findings
2. Beneficiaries need to be trained and coached on business management especially profit calculation in order to evaluate added value with regards to increased income.
3. Beneficiaries need to be trained and coached on how to use and maintain the stoves.

4. Apart from training, there is a need for continuous coaching and monitoring to ensure that the support provided to the beneficiaries achieves its objective.
5. There is a need to explore other financing opportunities with far less interest rates and also build a savings culture in the beneficiaries.
6. The need for training in healthy processing and improved storage techniques.
7. Stove companies must be business oriented, they need capacity building. It is also important to introduce companies who will see the promotion activity as a business venture.

APPENDIX 1: List of Stove Beneficiaries and Associated Information

NO.	District	Community	Beneficiary Name	Type of stove	Longitude	Latitude	Elevation	Accuracy (m)
1	Effutu Municipal	Winneba	Mary Asable	Morrison Clay	W 000.61779	N 05.34426	14.7	3.3
2	Effutu Municipal	Wenniba	Esi Akyeneba	Morrison Brick	W 000.61838	N 05.34360	13.6	5.3
3	Effutu Municipal	Wenniba	Leticia Dampson	Morrison Clay	W 000.61827	N 05.34243	17.2	5.3
6	Effutu Municipal	Wenniba-Akosua Village	Victoria	Morrison Brick	W 000.63923	N 05.32863	6.6	3.3
7	Effutu Municipal	Wenniba-Woarawobeba	Stella Quartey	Morrison Clay	W 000.58246	N 05. 36022	11	3.1
8	Effutu Municipal	Winneba	Challenging Heights	1 Brick stove & 2 Clay	W 000.61901	N 05.33748	14.2	4.1
9	Effutu Municipal	Winneba	Esi Ankrah	Clay cemented	W 000.62015	N05.33997	23	4.1
10	Effutu Municipal	Winneba	Efua Mansah	Clay cemented	W 000.63170	N05.33405	10.5	7.6
11	Effutu Municipal	Winneba	Aba Ahinsimaa	Clay cemented	W 000.62064	N 05.33690	24	4.2
12	Awutu Senya West	Senya Bereku	Beatrice Sackey	Morrison Brick	W 000.49030'	N 05.38583'	26.7	4.6
13	Awutu Senya	Senya Bereku	Ama Ammoh	Morrison	W 000.49019	N 05.38725'	22.9	3.4

NO.	District	Community	Beneficiary Name	Type of stove	Longitude	Latitude	Elevation	Accuracy (m)
	West			Brick				
14	Awutu Senya West	Senya Bereku	Janet Arkoh	Morrison clay	W 000.49442	N 05.38801'	37.9	6.4
15	Awutu Senya West	Senya Bereku	Ama Ntoanan	Morrison clay	W 000.49445'	N 05.38759	36.2	6
16	Awutu Senya West	Senya Bereku	Mary Annor	Morrison Brick	W 000.49086	N 05.39024	21.4	5.5
17	Awutu Senya West	Senya Bereku	Ama Nyarkuma	Morrison Brick	W 000.49338	N 05.38637	33.2	3.8
18	Awutu Senya West	Senya Bereku	Efua Saabah	Morrison Brick	W 000.49337	N 05.38638	31.6	3.8
19	Awutu Senya West	Senya Bereku	Victoria Abio	Morrison Brick	W 000.49302	N 05.38924	41.8	5.7
20	Awutu Senya West	Senya Bereku	Erica Binney	Morrison Clay	W 000.49685	N 05.38687	46.7	4.2
21	Awutu Senya West	Senya Bereku	Aba Prebah	Clay cemented	W 000.49833	N 05.38404	43.4	3.6
22	Awutu Senya West	Senya Bereku	Giftty Ano	Brick stove	W 000.49448	N 05.38553	32.5	4.3
23	Gomoa West	Apam	Akua Kontiwa (Konkohema)	Morrison Clay	W 000.73177	N 05.28812	11.3	4
24	Gomoa West	Apam	Grace Bondzi	Morrison Brick	W 000.72862	N 05.28689	12.2	4.2
25	Gomoa West	Apam	Zuyeratu Yakubu	Morrison	W 000.74283	N 05.29412	13.2	4.1

NO.	District	Community	Beneficiary Name	Type of stove	Longitude	Latitude	Elevation	Accuracy (m)
				Clay				
26	Gomoa West	Apam	Joyce Danso	Morrison Clay	W 000.74283	N 05.29416	13.2	3.9
27	Gomoa West	Apam	Esi Annan	Morrison Clay	W 000.73899	N 05.28932	10.6	3.9
28	Gomoa West	Apam	Mary Eshun	Morrison Clay	W 000.74084	N 05.28984	9.9	3.5
29	Gomoa West	Apam	Boafo	Morrison Clay	W 000.74135	N 05.28935	12.4	4
30	Gomoa West	Apam	Emelia Asane	Morrison Clay	W 000.72802	N 05.28669	27.6	5.5
31	Gomoa West	Apam	Akua Kyemfua	Morrison Clay	W 000.44.070	N 05.170247	9.1	3.3
32	Gomoa West	Apam	Abena Kreba	Morrison Clay	W 000.44.072	N 05.17.247	10.9	3.4
33	Gomoa West	Apam	Mary Oko	Morrison Clay	W 000.44.139	N 05.170.240	15.1	4.5
34	Gomoa East	Gomoa Feteah	Afua Adadzwa	Brick stove	W 000. 46643	N 05.42159	38.4	5.5
35	Gomoa East	Gomoa Feteah	Rose Mensah	Brick stove	W 000.46686	N 05.42447	27.1	3.5
36	Gomoa East	Gomoa Feteah	Ama Tawiah	Brick stove	W 000.47038	N 05.42197	49.7	7.9
37	Gomoa East	Gomoa Feteah	Sharon Ghartey	Clay cemented	W 000.46699	N 05.41985	38.4	6.3
38	Gomoa East	Gomoa Feteah	Helena Eyison	Brick stove	W 000.46865	N 05.42198	51.2	3.2

NO.	District	Community	Beneficiary Name	Type of stove	Longitude	Latitude	Elevation	Accuracy (m)
39	Gomoa East	Gomoa Feteh	Gladys Afful	Brick stove	W 000.47556	N 05.42182	54.4	4.2
40	Cape Coast Metropolitan Assembly	Ankaful	Mary Hayden	4 clay stove				
41	Cape Coast Metropolitan Assembly	Ankaful	Baaba	2 clay stove				
42	Cape Coast Metropolitan Assembly	Ankaful	Cecilia Aikins	1 clay stove				

**IMPROVED STOVE EVALUATION SURVEY
QUESTIONNAIRE FOR FISH PROCESSORS**

Date of Interview			
Community & Actual location			
District:			Region :
GPS Coordinates for the stove location	Long:	Lat:	
	Accuracy:	Elevation:	
Name of Beneficiary			
Telephone Number			
Age:			No of dependents:

SECTION A: STOVE USAGE

A1	How long have you been using the Improved stove	Six months [] Five months [] Four months [] Three months []	Two months [] One month [] less than a month [] Not used it yet []
	How many improved stoves do you own		
A2	Which fish smoking stove were you using before the new one.	Round metal/mud traditional stove [] Chorkor stove [] Frismo stove [] Other (specify):	
A3	Are you still using the old stoves	Yes [] No []	
A4	Comparing the new stove to the old one, which one will you prefer for your processing activity and Why?	Former stove [] Morrison stove [] Why?	
A4	How often do you use the stove	7 days a week [] 6 days a week []	3 days a week [] twice a week []

A1	How long have you been using the Improved stove	Six months []	Two months []
		Five months []	One month []
		Four months []	less than a month []
		Three months []	Not used it yet []
		5 days a week []	once a week []
		4 days a week []	don't use it []

A5	Do you have any challenges with the use of the improved stoves	Yes []	No []
A6	If yes; what are these challenges	Laborious to use [] Less capacity [] Needs continuous maintenance [] Resource (Time & Cost) intensive [] Other (specify):	
A7	If no; how beneficial is the stove to you?	Saves fuel [] less burns and accidents [] Cooks fast [] less respiratory diseases [] Reduced smoke [] less eye irritation [] Saves money [] better quality product [] Clean working environment [] Other (specify)	

A10	Can you give me your opinion about the different components of the stove?	Chimney: Trays: Fire place: Base: Cover/Lid: Other (specify):
-----	---	--

SECTION B: BENEFICIARY SATISFACTION

B1	Would you say this stove meet your processing need to your satisfaction.	Yes [] No []
B2	If No, what characters would you wish for the stove to have to make it more comfortable for your use / Any possible improvement suggestions?	
B3	If Yes, will you recommend the stove to others and why?	Yes [] No [] Why?

B4	Are you satisfied with your decision to purchase this stove?	Yes [] No []
B5	Based on your experience with the stove, are you likely to purchase more.	Yes [] No []
B6	Would you like to replace your former stoves with the improved one or you will like to use both stoves together.	I will replace the former stoves [] I will use both together [] The improved one will be a support to the former [] The former will be a support to the improved one []
B13	What benefits does the former stove have over the improved stove	Can take large fish capacity at a time [] It smokes fish faster [] Easy to work with [] Other (specify):

SECTION C: RESOURCE EFFICIENCY

C1	Have you noticed any improvements in your resource use, with the use of the improved stove	Yes [] No[]
C3	If yes, what are some of these improvements	Use less firewood [] Smoking process is faster [] Time saving [] Less smoky environment [] Increased profit [] Other (specify):
C4	How much (quantity & cost) firewood were you using on average, for a smoking cycle on the former stove	GHC: Quantity:
C5	How much (quantity & cost) firewood do you use on average with the improved stove for a smoking cycle	GHC: Quantity:
C6	How much fish (Quantity & Cost) do you smoke on average per smoking cycle; for the quantity of firewood stated above	GHC: Quantity:
C7	How much time do you use on average for a smoking cycle, when using the former stove	Less than 3hrs [] 6 - 7hrs [] 3 – 4hrs [] 7 - 8hrs [] 4 – 5hrs [] 8 - 9hrs [] 5 – 6hrs [] Above 9hrs []
C8	How much time do you use on average for a smoking cycle, when using the improved stove	Less than 3hrs [] 6 - 7hrs [] 3 – 4hrs [] 7 - 8hrs [] 4 – 5hrs [] 8 - 9hrs [] 5 – 6hrs [] Above 9hrs []
C9	What was your average profit per week when you were using the former stove	Below GHC50 [] GHC150 – GHC199 [] GHC50 –GHC99 [] GHc200 – GHC 249 [] GHC100 – GHC149 [] GHC250 – GHC300 [] Other (specify):
C10	What is your average profit per week when you use the improved stove	GHC20 – GHC49 [] GHC150 – GHC199 [] GHC50 –GHC99 [] GHc200 – GHC 249 [] GHC100 – GHC149 [] GHC250 – GHC300 []

C1	Have you noticed any improvements in your resource use, with the use of the improved stove	Yes [] No[]
		Other (specify):

SECTION D: FINANCING

D1	At what cost price did you purchase the stove?	GHC
D2	What payment method did you use?	Cash [] Loan [] Savings [] Other:
D2	Did you have any challenges with the financing medium and repayment?	Yes [] No []
D3	If yes, what challenges	
D4	Would you propose another financing medium as more preferable to you	
D5	What will be a realistic stove price for you	

SECTION E: SATISFACTORY CONSTRUCTION PROCESS

E1	Do you like the team who constructed the stove for you	Yes [] No []
E2	What are the challenges you had with the construction team	Delayed construction [] Poor interpersonal relations [] Other:
E3	What characters will you propose an ideal team to have	

GENERAL OBSERVATION ON STOVE QUALITY (TICK YES \checkmark / NO X)

Specifications (Brick stoves)		Specifications (Clay cemented stoves)	
Brick base according to standard dimensions		Clay base according to standard dimensions	
Brick base in good condition		Cemented clay base	
Number of trays up to 8		Number of trays up to 8	
Trays are according to standard dimensions		Trays are according to standard dimensions	
Trays in good condition		Trays in good condition	

PERSONAL OBSERVATION

Beneficiary Preference:

Stove quality: