

TANZANIA ALTERNATIVE COOKING FUELS AND TRAINING PROGRAMME 2018



PROGRAMME FINAL REPORT

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EXECUTIVE SUMMARY

At present over 90% of households across all three refugee camps in the Kigoma Region of Tanzania use firewood for cooking, which is being collected from the forests within, and around, the refugee camps leading to deforestation. The burden of collecting firewood also disproportionately affects women and children, who have to travel considerable distances from their homes in order to provide the necessary fuel for cooking, exposing themselves to increased risks of Sexual and Gender Based Violence (SGBV). It is from these concerns that UNHCR and partners in Kigoma Region embarked on a pilot programme to provide the PoCs with alternative cooking energy as well as launching energy saving initiatives in Nyarugusu, Nduta and Mtendeli Refugee Camps. DRC, GNTZ, REDESO, CEMDO and UNHCR were involved in the implementation of this programme which had three main components, namely, Charcoal Briquettes and LPG Comparative analysis at Nduta; manufacturing of charcoal briquettes at Nyarugusu; and community-based training on energy saving practices and SGBV awareness raising in Nduta, Mtendeli and Nyarugusu camps.

Results showed that the per capita briquettes consumption per day was 0.52kg while the per capita consumption for LPG was 0.1 kg per day. Based on these figures, LPG costs 11,500TZS per person per month while the cost of briquettes stands at 18,720TZS per person per month. Exposure to firewood collection (time spent in firewood collection by household members per week) was reduced by 89% on average. A conclusion can therefore be made that SGBV risks related to firewood collection were reduced by this rate. On the other hand, both LPG and charcoal briquettes were equally preferred by the PoCs while procured dual stoves were generally preferred by the project participants compared to the modified mud stoves. However from a technical and financial point of view, the modified mud stoves are hereby recommended for use with charcoal briquettes.

The charcoal briquettes production project in Nyarugusu camp was not implemented as planned. The restriction imposed by MHA that cooking fuel should not be sold to the PoCs and that free distribution should be adopted was one of the contributing factors as the original design of the project was based on a market-based approach. This then led to redesigning the project such that the refugees are trained to manufacture the briquettes for their own household consumption to ensure sustainability. This new approach is currently being implemented in Nyarugusu Camp. Further, burning rate testing for the briquettes produced using different sources of raw materials was conducted and it is hereby recommended to produce charcoal briquettes from the raw material mixture comprising of rice husks, coffee husks and sawdust.

There is a positive community perception towards RHC use with over 61% of the participants acknowledging reduction in firewood consumption and consequently reduction in the number of firewood collection trips and in turn reduction in SGBV incidences.

On the other hand, fuel efficient stoves coverage in Nyarugusu stands at 78% while that of Nduta and Mtendeli stands at 84 and 81% respectively. Moreover, the top three commonly used stoves in Nyarugusu Camp are the Brick stoves, Insert stoves and Mud stoves while the top three commonly used stoves in Nduta and Mtendeli Camp are the Insert stoves, Mud stoves and three stone open fire. However, results from stove testing experiment indicates that the mud stoves fabricated by CEMDO were the most energy efficient.



Generally, the 2018 Tanzania alternative cooking fuels and training programme has brought significant impact particularly on reduction of SGBV incidences to the PoCs. The project has also brought some positive feedback to the government as the pace of environmental degradation, particularly deforestation for firewood use was reduced. The 2019 Tanzania alternative cooking fuels and training programme is ongoing across the camps and is expected to bring even more positive impacts to both the PoCs and the environment.

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ACRONYMS

CEMDO	Community Environmental Management and Development Organization
DRC	Danish Refugee Council
FES	Fuel Efficient Stoves
GNTZ	Good Neighbors Tanzania
LPG	Liquefied Petroleum Gas
MEGS	Mama Electrical and General Supplies
MHA	Ministry of Home Affairs
PoCs	Persons of Concerns
REDESO	Relief to Development Society
RHC	Retained Heat Cooker
SGBV	Sexual and Gender Based Violence
SNV	Netherlands Development Organisation
UNHCR	United Nations High Commissioner for Refugees

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INTRODUCTION

At present over 90% of households across all three refugee camps in the Kigoma Region of Tanzania use firewood for cooking, which is being collected from the forests within, and around, the refugee camps. The burden of collecting firewood disproportionately affects women and children, who have to travel considerable distances from their homes in order to provide the necessary fuel for cooking, exposing themselves to increased risks of Sexual and Gender Based Violence (SGBV). Recent discussions with refugees has suggested that some women and children are spending between 5 and 8 hours collecting firewood on a single trip and walking over 13 km to complete their task. Furthermore, during regular consultations with women and girls from the three refugee camps, firewood collection has been raised as one of the highest risk factors they face in their daily activities. On the other hand, firewood collection by the PoCs has been closely linked to deforestation of the natural forests surrounding the refugee camps. Additionally, the use of firewood for cooking also exposes the PoCs (mostly women and girls who are involved in cooking) to the health hazards caused by Indoor Air Pollution (IAP) as a result of incomplete combustion of the wood especially when inefficient stoves are used for cooking.

It is owing to the above concerns that UNHCR and partners in Kigoma Region embarked on a pilot programme to provide the PoCs with alternative cooking energy as well as launching energy saving initiatives in Nyarugusu, Nduta and Mtendeli Refugee Camps. This would then alleviate the need for the PoCs to collect firewood; or reduce the demand for firewood through energy efficient cooking practices, and in doing so, the SGBV risks associated with firewood collection would be removed or reduced and pace of deforestation slowed down. This report therefore present the findings, challenges as well as conclusions and recommendations in each of the programme components as detailed on subsequent sections.

PROGRAMME DESCRIPTION

The Safe from the Start programme was launched in the three camps of Nduta, Mtendeli and Nyarugusu camps from October 2018 to March 2019. The programme had three components, namely, Charcoal Briquettes and LPG Comparative analysis at Nduta; Manufacturing of charcoal briquettes at Nyarugusu; and community-based training on energy saving practices and SGBV awareness raising in Nduta, Mtendeli and Nyarugusu camps. DRC, GNTZ, REDESO, CEMDO and UNHCR were involved in the implementation of this programme.

The overall objective of this programme was to introduce alternative cooking fuel and energy saving approaches in the refugee camps of Tanzania. Specifically, the programme aimed at comparing the fuel consumption and costings between LPG and briquettes in Nduta, establishing briquettes production machine in Nyarugusu and producing RHC across the three camps of Nyarugusu, Nduta and Mtendeli. Each of these specific objectives including its methodology, results and conclusions have been explained in detail under each of the programme components in the subsequent sections of this report.

COMPONENT ONE

CHARCOAL BRIQUETTES AND LPG COMPARATIVE ANALYSIS PROJECT AT NDUTA REFUGEE CAMP

INTRODUCTION

The main focus of this component was to collect data on the beneficiaries of the charcoal briquettes because the pilot projects relating to LPG in both Mtendeli and Nyarugusu (late 2017 and early 2018) camps had already obtained significant amounts of data on the LPG beneficiaries. However, due to the difference in the circumstances of the camps, LPG beneficiaries were still needed to participate in this study as the “control group”. In the absence of LPG recipients, there would be a risk that data taken from the briquette recipient groups would not be directly comparable to that of the past LPG pilot projects due to the difference in the project period, location and the implementing agencies. Also, the past two LPG pilot projects in Nyarugusu did not obtain the detailed household data in a quantitative manner (only focus group interviews were conducted for around 50 beneficiaries), while the LPG pilot project in Mtendeli, which did take detailed household data, had a small sample size of 150 beneficiaries. The results of this comparative analysis have been used to assess relative costs of the two fuels as will be presented in subsequent sections.

1. IMPLEMENTATION ARRANGEMENTS AND POPULATION OF CONCERN SELECTION

This section provides an overview of the implementation arrangements as well as the method used to select the project participants as explained in the subsequent subsections below.

1.0.1: Implementation arrangements

This project component was implemented by two agencies which are REDESO and DRC. REDESO was responsible for procuring fuel efficient “*matawi*” stoves, cooking fuels (LPG and Charcoal Briquettes), mud stoves modification as well as monitoring the daily fuel consumption in the beneficiaries’ households in addition to assigning the beneficiaries socio-eco promotion activities. DRC on the other hand was responsible for storage and distribution of the cooking fuels to the project participants.

A total quantity of 135 metric tons of charcoal briquettes were procured and swapping of 2,000 6kg LPG cylinders was undertaken by REDESO and the same stored in DRC’s warehouse, a warehouse which was built under this project’s funding. REDESO also undertook procurement of 400 cook stoves “*Matawi* stoves” and had to modify the existing and widely used improved mud stoves so that they can use briquettes for cooking.



Figure 1: UNHCR staff inspecting the LPG cylinders and burners before distribution to project participants, above

© UNHCR/George Kabado



Fig 2: Procured Matawi fuel efficient stoves ready for distribution to the project participants, below; © UNHCR/George Kabado

1.0.2: Participants selection and implementation methodology

A total of 1,200 PoCs participants were involved in this project in which 400 of them received LPG while 800 received charcoal briquettes. Out of the 800 participants, 400 of them used procured fuel efficient “matawi” stoves while the remaining 400 participants used modified mud stoves. The aim was to compare the efficiency of both stove types in burning the charcoal briquettes and to understand the preference of the PoCs between the two stove types. A random sampling approach was adopted in selecting project participants and then further screening was conducted based on the criteria as shown in Table 1 below. Generally, out of the 21 zones present in Nduta, all the participants were drawn from zone 1-9. The selected zones meets the first selection criteria as can be seen below. The rest of the zones were not meeting the first criteria at the time of participants’ selection.

After selection, the project participants were provided with safety training on proper use of the cooking fuels especially LPG (see figure 3) as well as on best cooking practices. A baseline survey was conducted for all the participants to establish reference data against which project impacts could be evaluated. After the baseline survey and trainings, actual cooking fuel distribution commenced on 28th November 2018 and continued through May 2019. Below section presents and discusses the findings of this project component.

Table 1: Criteria for participants' selection

S/N	Criteria	Rationale
1	Have a lockable transitional shelter and separate kitchen	To reduce the risk of theft.
2	Not PSNs	To avoid duplication with existing support whereby PSNs are provided with firewood
3	Not registered for the voluntary repatriation	To ensure that the participants are able to complete the programme
4	Informed consent to the time-bound pilot project	To ensure that refugees are aware that they will not receive fuel after three months, implying that they would "go back" to firewood.
5	Abide by the project rules including exclusive use of the alternative energy over the project period.	To prevent refugees from mixing with other fuel or sharing with the neighbours, which will affect the data and ultimately undermine the project objectives.



Figure 3: LPG safety training to the project participants before provision of the alternative cooking fuel © UNHCR

RESULTS AND DISCUSSION

This section presents the findings obtained after analyzing the data from the end line survey that was conducted in Nduta Camp. The findings are based on fuel collection and consumption, cooking using the alternative fuel provided, users’ perception on the provided fuel and project impact on protection as well as the impact of the project on livelihood of the participants.

1.1.1: Fuel collection and consumption pattern

The findings of the comparative fuel usage between LPG and charcoal briquettes show that majority of the LPG participants exhaust the 6kg LPG cylinder in 14 days while majority of the briquettes participants exhaust the 25kg briquettes bag in 7days. Although majority of the briquettes participants exhaust the 25kg briquettes bag in 7 days, some of the participants exhausted the briquettes bag in 14 days as well (see figure 4). However, this needs to be cautiously interpreted because before onset of fuel distribution the participants were told that they would be provided with fuel biweekly and therefore they went to the fuel collection point after 14 days even if they had already exhausted the briquettes bag. Most importantly however, findings from the daily household fuel consumption as monitored by REDES indicates that the average number of days to exhaust a 25kg bag of charcoal briquettes is 11 days with a daily per capita consumption of 0.52kg. On the other hand, the average number of days to exhaust a 6kg LPG cylinders is 13 days with a daily per capita consumption of 0.1kg (see Table 2 & 3).

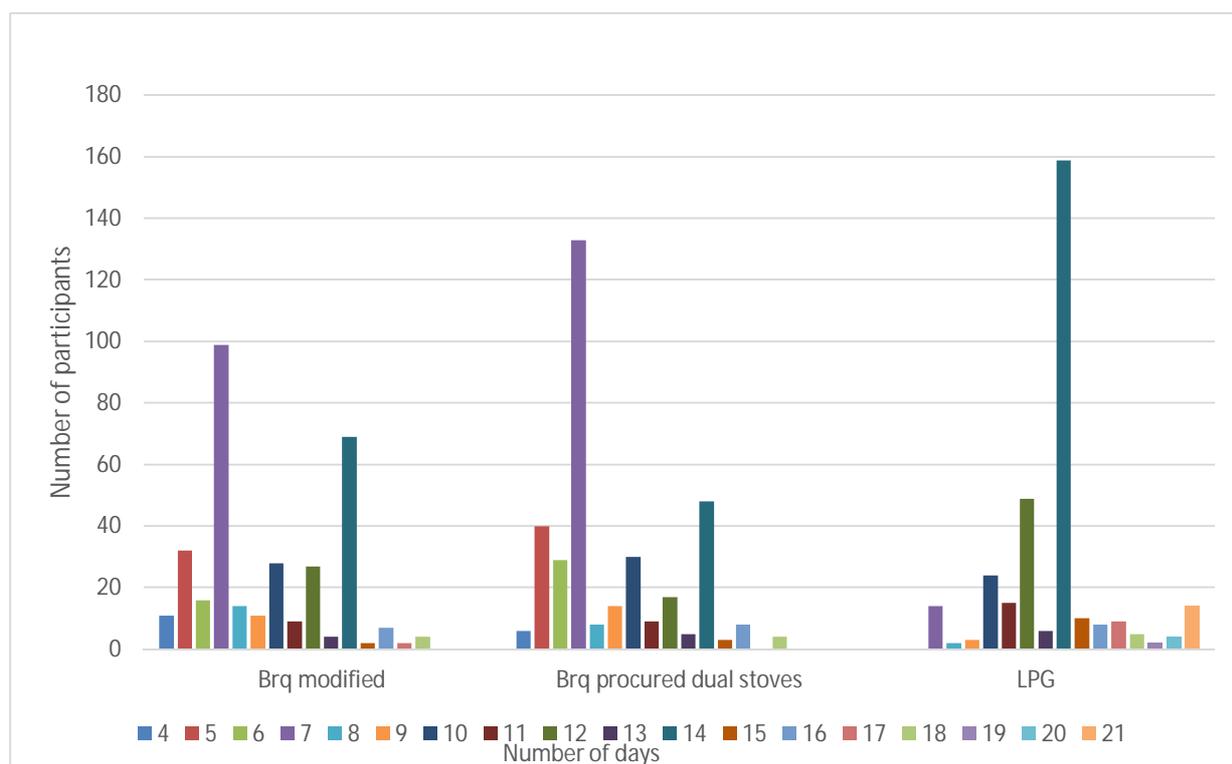


Figure 4: Number of participants against number of days to exhaust the unit of provided fuel

Table 2: Average charcoal briquettes consumption by family size

Family size	No. of days	Fuel amount (kg)	Average daily consumption	Average per capita
1	11.36	25	2.66	2.66
2	11.88	25	2.32	1.16

	3	13.32	25	2.29	0.76
	4	12.02	25	2.39	0.60
	5	10.94	25	2.56	0.51
	6	11	25	2.70	0.45
	7	10.77	25	2.58	0.37
	8	10.09	25	2.67	0.33
	9	12.35	25	2.30	0.26
	10	11.2	25	2.49	0.23
	11	7	25	3.57	0.33
	12	11.67	25	2.56	0.21
Overall average 5	11		25	2.59	0.52

The monthly consumption per person was 15.6kg for charcoal briquettes users and 3kg for LPG beneficiaries. Similarly, considering an average household with 5 members the monthly consumption of charcoal briquettes was 77.70kg and for LPG beneficiaries the monthly consumption was 15.50kg of LPG. It should be noted that the 77.70kg monthly household consumption of briquettes obtained in this project is slightly higher than the actual quantity of 50kg which was provided to the project participants per month. This is why more briquettes users (see Table 4) firewood to fill this monthly fuel gap as compared to LPG users who were receiving 12kg of LPG per month.

Table 3: Average LPG consumption by family size

Family size	No. of days	Fuel amount (kg)	Average daily consumption	Average per capita
1	13.57	6	0.50	0.50
2	13.57	6	0.51	0.25
3	13.72	6	0.48	0.16
4	13.22	6	0.48	0.12
5	14	6	0.47	0.09
6	13.5	6	0.50	0.08
7	13.15	6	0.51	0.07
8	13	6	0.50	0.06
9	9.92	6	0.68	0.08
10	9.67	6	0.63	0.06
11	15.5	6	0.43	0.04
12	14	6	0.43	0.04
13	11	6	0.59	0.05
Overall average 5	13	6	0.52	0.10

Considering the above monthly fuel consumption figures per person and using the cost of 1,200 TZS per kg of briquettes, the monthly briquettes cost per person is 18,720TZS. Similarly, since the current swapping cost for a 6kg LPG cylinder is 23,000TZS and assuming the cost per kg is 3,833TZS the monthly LPG cost is 11,500TZS per person. In other words, the monthly cooking fuel cost for an average household with 5 members is 93,600TZS for charcoal briquettes while it is 57,500TZS for LPG. To provide charcoal briquettes to the entire refugee population in Nduta which stands at 88,082 ¹an estimated amount of 1,648,895,040 TZS is needed per month. On the

¹

other hand an estimated amount of 1,012,943,000 TZS is needed to provide LPG to the entire population in Nduta Camp.

From the above figures it is safe to conclude that LPG is the cheaper (on monthly basis) alternative fuel to provide for free as compared to the charcoal briquettes. However, it should be noted that the LPG monthly cost estimated here is for only swapping (refilling) and so did not include the initial cost of purchasing the actual complete 6kg LPG cook stove set which include a full 6kg LPG cylinder, trivet, burner and ignitor. In other words, while it is cheaper to provide LPG as cooking fuel on monthly basis, the initial cost may be higher than that of charcoal briquettes depending on the number of LPG cook stove sets to be procured. The current price of a complete 6kg LPG cook stove set in Kibondo District is 60,000TZS.

With regard to fuel collection majority of the participants used about 1 hour to collect the fuel from DRC’s distribution point and that 59% of the participants sent more than one person from the household to collect the fuel from the distribution point. However, the findings also indicates that other participants spent more than two hours to collect the fuel from distribution point but this also need to be carefully interpreted because apart from the fact that some participants were living far away from the distribution point, participants spent most of the time at the distribution point for various reasons; including delayed distribution start by DRC as well as some participants especially those who sent other family member to collect the fuel required some time to verify their identities. Generally, distribution of LPG was much more efficient than briquettes.

As stated earlier that some participants especially briquettes users were still required to collect firewood to bridge the monthly fuel gap during project implementation. 11% of those went for firewood collection were briquettes users with the modified mud stoves, 8% were briquettes users with the procured stoves while 6% were LPG users. Table 4 below show more details on firewood collection frequency among the project participants categories.

Table 4: Firewood collection frequency and the percentage of respondents who didn’t go for firewood collection

Participants' categories	Weekly firewood collection frequency				No. of respondents	% of respondents
	0	1	2	3		
Briquettes modified stoves users	180	11	6	6	203	89
Briquettes procured stoves users	192	7	5	5	209	92
LPG stoves users	220	7	7	1	235	94

Generally, frequency of firewood collection (and so of protection risks exposure) per week has been greatly reduced by 93% and 96% for the briquettes and LPG users respectively. That is a reduction from an average of 2.76 times a week at baseline to 0.20 times a week for the briquettes users at end line and from an average of 2.68 times a week at baseline to 0.1 times a week at end line for the LPG users.



Figure 5: DRC staff distributing LPG to the project participants at Nduta Refugee camp  ©UNHCR/George Kabado



Figure 6: One of the project participant on her way home after receiving her LPG cook stove  ©UNHCR

1.1.2: Cooking using the provided alternative fuels

The findings from an end line survey indicate that cooking time was significantly less for the LPG users with an average cooking time of 102.94 minutes while that for the Briquettes users were 141.29 and 161.66 minutes for users with the modified stoves and procured “matawi” stoves respectively. In this project, a household with 1 to 5 members was considered small while that with more than 5 members was considered large. Table 5 below provides more details on the cooking time.

The time consumed in cooking was reduced by 21% for the briquettes participants with the matawi stoves, 31% for the briquettes participants with the modified mud stoves, and 50% for the LPG participants. During the project duration, findings indicate that households cooked 15% more meals than they used to cook prior to the project. This is possibly because participants had to save the inadequate amount of firewood they had prior to this project.

Table 5: Cooking time (minutes) between LPG versus Briquettes users

	Large	Small	Average
Briquettes users with the modified stoves	140.50	142.08	141.29
Briquettes users with the procured stoves	173.25	150.08	161.66
LPG	109.38	96.50	102.94

Generally, provision of alternative cooking fuels resulted into a significant reduction in the cooking time. The average cooking time recorded during baseline survey was 204 minutes when participants when the participants were still using firewood. Interestingly, provision of alternative fuel seems to have stirred interest in the male members to participate in cooking which resulted in a reduction in the share of women members cooking meals in the households from 92% during baseline to 70% after an end line survey. Table 6 and figure 6 provides further details on the share of women members participating in cooking.

Table 6: Share of women members (%) participating in cooking meals in the households

Female ratio in cooking household meals	Baseline	End Line
Briquettes users with the modified mud stoves	92	69
Briquettes users with the procured stoves	94	72
LPG	90	69
Average	92%	70%

It should also be noted that before provision of fuel to the participants, one of the condition they were given is to use the provided fuel exclusively. However, 9% of the project participants used fuel other than the ones provided. The main reasons for this as stated by the participants during an end line survey was that the provided fuel was not enough and that some food types (e.g. *ugal²*) couldn’t be cooked using the provided stoves i.e. LPG stoves and procured briquettes stoves.

² <https://en.wikipedia.org/wiki/Ugali>

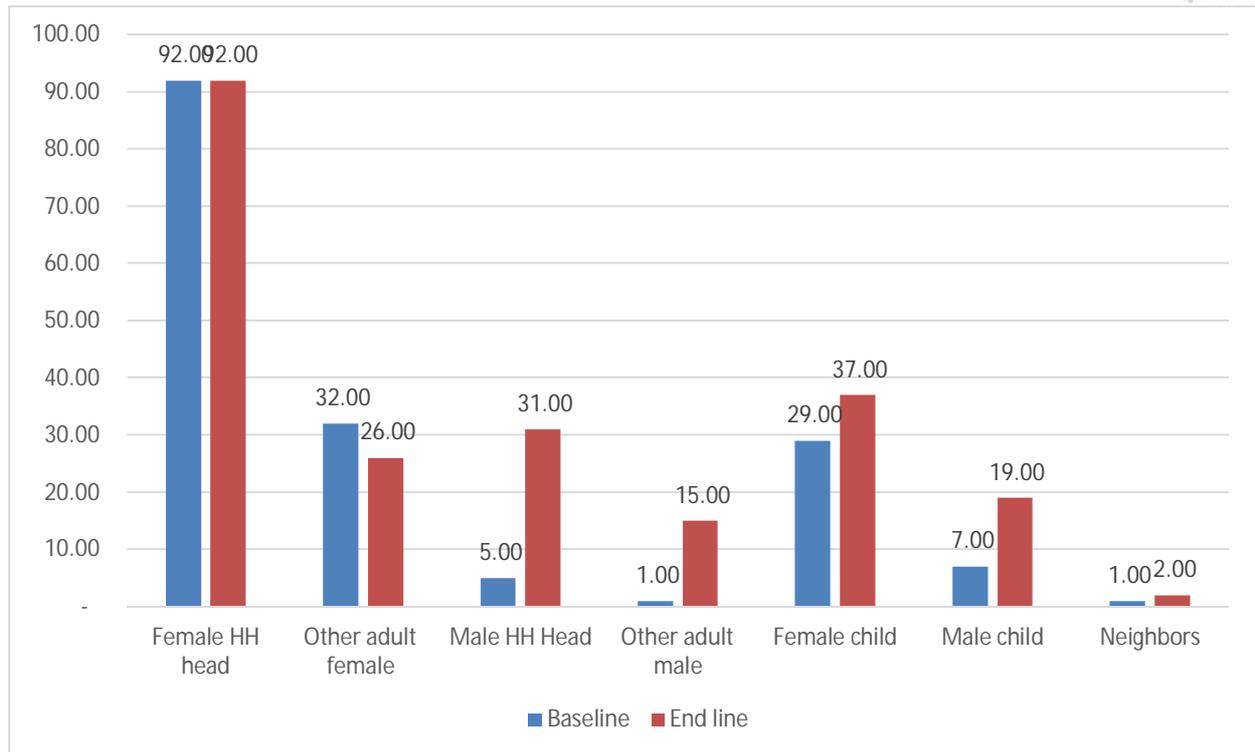


Figure 7: Percentage number of household members cooking meal at baseline and end line

1.1.3: Users' perception on the provided cooking fuels and project impact on protection.

Project impact was realized in terms of reduction in exposure to protection risks associated with firewood collection and user's perception on associated benefits of alternative fuel and cook stoves provision to the PoCs.

Generally, exposure to firewood collection (time spent in firewood collection by household members a week) is reduced by 93% for the briquettes users and by 96% for the LPG users. It can therefore be said that SGBV risks related to firewood collection was reduced by this rate. When asked about other benefits of the project, the following benefits in order of their importance were stated;

- ❖ The provided fuel cooks faster (A)
- ❖ I will now not be attacked in search of firewood collection since I no longer go outside the camp for firewood collection (B)
- ❖ I don't have to spend so many hours collecting firewood (physical fatigue) (C)
- ❖ It is safer to cook with the provided fuel (D)
- ❖ The provided fuel produces less smoke (E)

Table 7 provides additional information across the categories of project participants on the additional benefits of using the alternative fuel outlined above. Generally, benefits related to the reduced cooking time was as strongly felt by briquette users as by LPG users despite the fact that reduction in cooking time for LPG users was twice more drastic than the briquette users.

Table 7: Participants perception (%) on the alternative cooking fuel provided (The letters in the table represents the bullets points above)

Participants' categories	A	B	C	D	E	Participants number
Briquettes modified stoves users	91	91	84	80	50	357
Briquettes procured stoves users	93	90	87	80	62	367
LPG stoves users	95	93	84	79	55	349
Average	93	91	85	80	56	1073

With regard to stoves preference, majority of the briquettes users preferred the procured stoves over the modified mud stoves. Again, this should also be carefully interpreted because PoCs tend to sell most items provided to them. The fact that the procured stoves are portable and have good market price (procured at 70,000TZS), it is therefore easier to sell them and earn money as opposed to the modified mud stoves which are fixed in their kitchen shelters. This assumption also holds true if you consider the cooking time provided by the respondents themselves in Table 5 which indicates that it takes much longer time to cook a meal using the procured stove (161.66minutes) compared to the modified stoves which use an average of 141.29 minutes to cook a meal. The fact that procured stoves were even preferred by the participants who did not use it is also questionable (see Table 8).

Table 8: Stoves preference among the briquettes users

Row Labels	Both are the same	I don't know	Modified mud stove	Procured dual stove	Grand Total
Briquettes modified stoves users	23	2	62	266	353
Briquettes procured stoves users	10	2	50	303	365

Moreover, from financial point of view, the cost of a procured stove is a way higher than the modified stove which cost only 10,000TZS.

When asked whether provision of alternative fuel brought any changes in the family and community relationships, project participants had the following responses;

- i. Better relationship with the partner because of less stress from firewood collection
- ii. Better relationship with the partner because meals are prepared on time
- iii. Better relationship between children and parents because children could go to school
- iv. Better relationship with the neighbors as we cooked for them as well
- v. Better relationship among all family members as we could work and get more money

Table 9 provides additional information across the categories of project participants on the additional benefits of using the alternative fuel. Generally, benefits coming from reduced stress from firewood collection and faster cooking were the top two in addition to 80% of the participants acknowledging better relationships with their children as they could attend school. However, the most major downside (report by 10% of project participants) is the jealousy of the neighbors who were not project participants in this project.

Table 9: Percentage of individual who felt provision of alternative fuel brought changes in the family and community relationship

Participants' categories	Participants responses as from I-V above				
	I	II	III	IV	V
Briquettes modified stoves users	90	90	80	55	51
Briquettes procured stoves users	93	92	78	55	42
LPG stoves users	96	96	80	56	48
Average	93	93	80	55	47

With regard to participants' preference towards the two provided cooking fuels (LPG versus charcoal briquettes), both briquette and LPG users preferred what they used - possibly due to the general satisfaction and the fact that they got used to it. LPG was slightly more preferred with only 14% wanting briquettes as opposed to 20% of briquette users wanting LPG. Majority of the respondents preferred LPG because LPG cooks faster while majority of the respondents who preferred charcoal briquettes stated that it is safer to cook using briquettes than LPG.

"Cooking with LPG is faster and is very convenient during emergency. The stove helped me when my daughter was sick one night, I made her some porridge quickly before rushing her to the hospital for further treatment. I couldn't have managed to do this if I was to use firewood" - Aneth Niyonzima³, one of the project participants.

It should also be noted that the average amount of money participants were willing to pay for charcoal briquettes during an end line survey was 1,486 TZS per month which was less than what participants were ready to pay at baseline (2,246TZS). However, interpretation of the differences in these figures need to be done carefully as the reduction from the baseline does not necessarily mean that participants were disappointed. Participants may have exaggerated their willingness to pay during baseline survey possibly in the aim of showing their interest in alternative energy so that they can be selected as beneficiaries of the project. On the other hand, the willingness to pay for LPG was 3,460. Interestingly, people who did not use LPG showed higher willingness to pay, possibly in recognition/acceptance that one needs to pay more to use LPG than charcoal briquettes.

"Cooking with charcoal briquettes has removed the need for me to go outside the camp to collect firewood. This has also helped my children to improve their school attendances. Cooking with firewood required me to go into the kitchen frequently to see if fire is burning well during meal preparation, with the charcoal briquettes I don't have to do this anymore since the briquettes burn longer."

-Venancia Niyokwizera⁴, one of the project participants in Nduta Camp.

When asked on what they did with the time saved from firewood collection, over 70% of the respondents said that they were involved in environmental conservation activities assigned to them by REDESO. Majority of the respondents also said they used the time saved for practicing kitchen gardening.

It should also be noted that apart from benefiting the project participants, this project has also been of great benefit to PoCs in the two "Protection Villages" in Nduta Camp. These villages

³ Real name hidden for protection reasons

⁴ Real name hidden for protection reasons

hosts the most vulnerable PoCs who are not only cannot to go to search for firewood outside the camp but they also cannot reside with their fellow refugees due to various special protection concerns.

1.1.4: Impacts of the project on participants' livelihood

It was also of interest to know if provision of alternative cooking energy could bring about improved livelihood of the project participants. Results show that for both men and women, average number of income earners increased, especially for briquettes users with the modified stoves. Additionally, households where women are the main income earners increased from 56% to 66%. However, the number of households with income decreased from the baseline to end line (86% to 23%), presumably due to tight control of the PoCs movement and reinforced closure of the common market which enabled goods exchange between the refugees and the host community traders.

1.2: CHALLENGES FACED DURING IMPLEMENTATION OF THIS PROJECT COMPONENT

Generally, poor coordination between DRC and REDESO was observed to be a challenge in implementing this project especially in tracking and monitoring of the participants as well as in resolving emerging challenges. The following two subsections further discusses the challenges related to the specific fuel usage challenges as well as the challenges associated with fuel users.

1.2.1: Challenges associated with fuel usage

The biggest challenge faced by LPG users in particular was the faulty burners. Most of the burners had rust as a result of long term storage in CEMDO's LPG warehouse in Nyarugusu Camp. This resulted in most users not using the LPG especially when this project took off until more burners were brought into DRCs warehouse to replace the existing faulty ones. Nevertheless, the added burners were not new ones, they helped to reduce the magnitude of the problem but did not completely solve the problem. Few PoCs also reported that the use of LPG melted their cooking pots due to the high temperature of the heat coming from the LPG stove. However this is probably due to the cooking pots they were using being too old and weakened already. Moreover, during onset of the project, the participants were afraid to use the LPG stating that the stove was explosive. With continued training on how to safely use the LPG stoves, this was no longer a problem. No safety incidence was reported with regard to LPG stoves usage for cooking.

On the other hand there wasn't a major issue with regard to the actual use of charcoal briquettes for cooking. One particular challenge came from the 400 participants using the modified mud stoves. Majority of them claimed that the modified stoves were not effective in burning the briquettes due to the fact that the ceramic plates placed within the stoves to allow the ashes to drop to the bottom of the stove had few holes and were breaking easily. However, this issue was resolved by replacing the ceramic plates with the metallic plates which had more holes to allow the ashes to drop to the bottom of the the stove improving the burning efficiency of the charcoal briquettes.

1.2.2 Challenges associated with the users and the communities at large

Majority of the participants were using the provided alternative cooking fuels for the first time. Frequent training of the participants was therefore inevitable. This included provision of training on correct use of the fuel so as to reduce fuel consumption as well as training on best cooking

practices (detailed under component three of this project). LPG safety training was also provided during each fuel collection round.

Another challenge experienced during this project implementation was selling of the provided cooking fuel and stoves by some of the participants. Three cases were reported to the police post in Nduta Camp for their follow up on the participants who sold the LPG cook stoves. Since the project did not reach majority of the PoCs in the Camp, 10% of the participants stated to have experienced feelings of jealousy from their neighbors resulting into worsening of relationships. Moreover, the rest of refugee community in Nduta required also to be supported with alternative cooking fuel. Lastly, after the final ratio (6th round) of fuel provision, participants expressed their concern that they have to face again the challenges associated with firewood collection of which they had forgotten. They cry for a sustainable solution to the cooking energy crisis in the camp.

Generally, the high response and participation of beneficiaries in this project (see figure 9 and 10 below) clearly shows the need for alternative sources of cooking energy. Moreover, the success of this project can also be inferred from the increasing requests of other refugees to be part of the project – requests have been expressed during different community engagement forums such as at zone leader meetings and town hall meetings.



Figure 8: Happiness Sengimana and Priscila Nzoyimana⁵ showing the empty briquettes bag and the procured stoves and asking for extension of the project after finishing their final round of fuel collection from DRC © UNHCR

⁵ Real names hidden for protection reasons

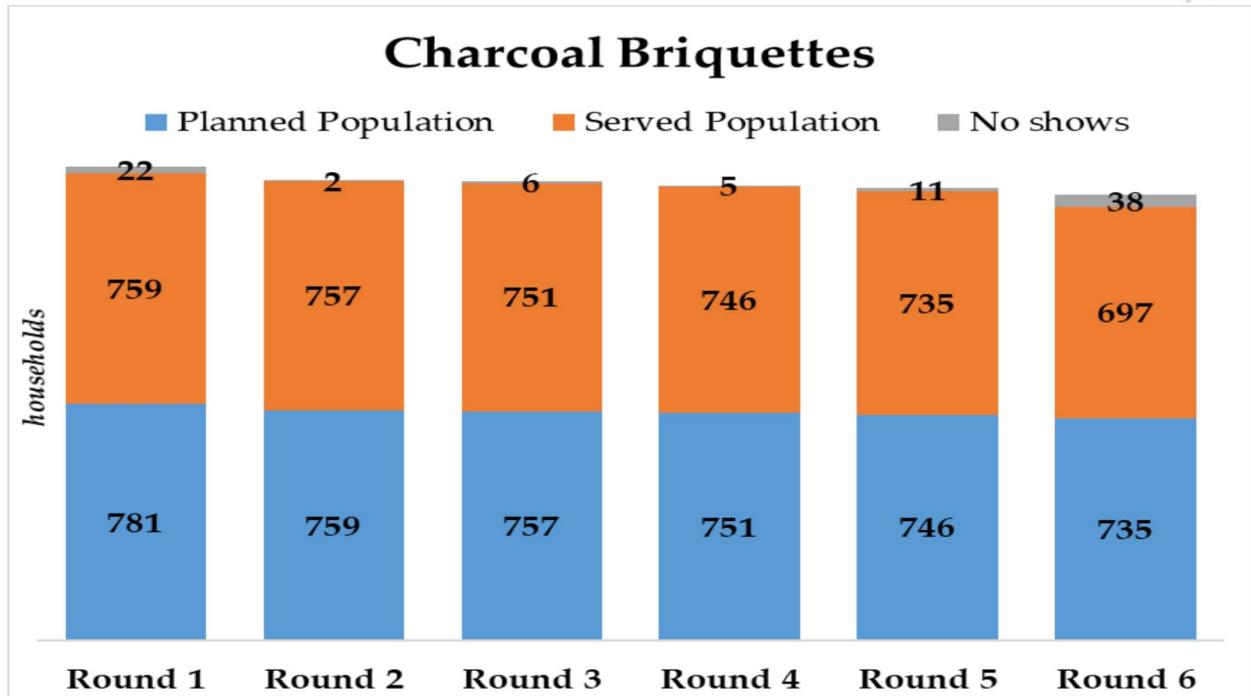


Figure 9: Number of beneficiaries and the entitlements received for Charcoal briquettes

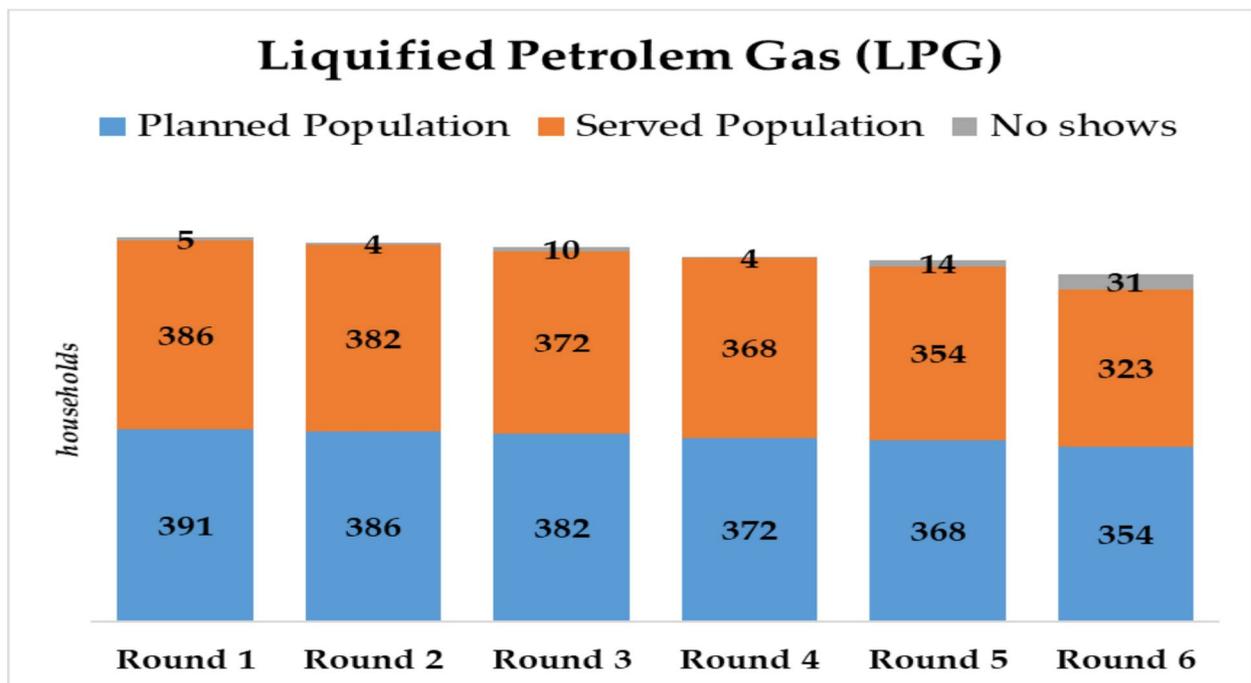


Figure 10: Number of beneficiaries and the entitlements received for LPG.

1.3: CONCLUSION AND RECOMMENDATIONS

Based on the findings of this project, the following conclusions and recommendations can be made;

- Generally, project participants especially briquettes users were taking a longer time at the fuel distribution centre. Some project participants were not clear on where to go and collect their fuel rations as some LPG participants were sending their empty LPG cylinders for swapping at REDESOC offices in Nduta instead of DRC. Generally, coordination between DRC and REDESOC on tracing and monitoring project participants as well as on resolving emerging challenges (e.g. default burners) was not smooth. Based on this, it is recommended that whenever possible, the agency responsible for procurement of the cooking fuel should be the one to distribute the cooking fuel for smooth project implementation. In relation to this, it is also recommended that a feedback mechanism platform (helpdesks) need to be established to enable the PoCs to communicate their complaints or ask questions about their entitlements.
- The per capita briquettes consumption per day is 0.52kg while the per capita consumption for LPG is 0.1 kg per day. Generally, based on the costing per kg of the two fuels during this project implementation, LPG appears to be a relatively cheaper (on a monthly basis) option for free provision of alternative cooking energy to the PoCs. LPG costs only 11,500TZS per person per month as compared to the cost of charcoal briquettes which stands at 18,720TZS per person per month. However, LPG may have a higher initial cost associated with the procurement of the complete LPG cook stove sets as compared to briquettes which require just slight modification of the existing mud stoves. The author also strongly recommends that UNHCR should establish its own briquettes production machines rather than relying on procuring ready-made briquettes from external suppliers. If procurement of ready-made briquettes is inevitable then UNHCR should negotiate with briquettes suppliers on the price per kg as the current prices observed in this project are relatively high.
- Exposure to firewood collection (time spent in firewood collection by household members per week) was reduced by 89% on average. A conclusion can be made that SGBV risks related to firewood collection is reduced by this rate.
- The main benefit of cooking with LPG as perceived by the project participants was fast cooking as compared to briquettes while cooking using briquettes was perceived by participants to be safer than LPG and that the briquettes burn longer than firewood. A general conclusion can be made that both fuel types were equally preferred by the PoCs. However, project participants need to be reminded regularly about how to use the LPG and dual stoves effectively through practical demonstrations during distributions.
- Procured stoves were generally preferred by the project participants than the modified stoves. However from technical and financial point of view the modified mud stoves are hereby recommended for use with charcoal briquettes. The procured stoves are seven times more expensive than the modified mud stoves and yet the modified mud stoves performed better in terms of cooking time per meal than the procured stoves. Furthermore, the use of the procured stoves are at a higher risk of being sold and jeopardizing project implementation.
- The use of old burners for LPG cook stoves in this project caused some inconveniences for the LPG users as they had to wait until a working burner was available for replacement. This is a good

lesson learnt and a recommendation can be drawn that future interventions in cooking energy particularly those involving LPG provision should make sure new burners are in place.

- The project resulted in multiple protection-related benefits to the PoCs in Nduta Camp especially to the project participants. SGBV risks exposure associated with firewood collection were estimated to be reduced up to 94% for the project participants. Moreover, the project has enabled two protection villages and families with members suffering from heart diseases to have access to alternative cooking energy resulting in reduced indoor air pollution responsible for most respiratory tract diseases. Provision of LPG and briquettes has also resulted in better family relationships especially between the partners as well as the parent-children relationship. It is important to note that only 1.4% of the PoCs in Nduta Camp have enjoyed the benefits of this project, majority are still suffering from acute shortage of alternative cooking energy. Worse still, even the firewood which majority of them rely for cooking is dwindling around the camp forcing refugees to travel long distances searching for firewood. More funding is therefore required to support provision of cooking energy for the refugees not only in Nduta Camp but in Mtendeli and Nyarugusu Refugees Camps as well. This is crucial in achieving SDG7 for providing modern, affordable, reliable and sustainable energy for all.

COMPONENT TWO

MANUFACTURING CHARCOAL BRIQUETTES AT NYARUGUSU REFUGEE CAMP

2.0 Introduction

As it has become increasingly apparent that free distribution of fuel to refugees is not sustainable at a large scale, the refugee response in Tanzania was urged to establish a mechanism whereby cooking fuel is produced and sold at an affordable price to the PoCs. In this regard, charcoal briquettes production machines (with 4.5 tonnes production capacity) were to be purchased and established for Nyarugusu Refugee Camp. This project component therefore provides the findings of the charcoal briquettes project in Nyarugusu Camp.

This project was jointly implemented between GNTZ and UNHCR in Nyarugusu Refugee camp and UNHCR's role was procurement of the charcoal briquettes machines. However, two setbacks were encountered during implementation of this project component. The first setback was failure by UNHCR to procure the briquettes machines because the successful bidder could not adhere to UNHCR procurement policy at the final stages of the procurement process. The second setback was a restriction imposed by MHA that cooking fuel should not be sold to the PoCs and that free distribution should be adopted instead. Due to these setbacks, the project had to be reoriented to a community-based charcoal briquettes production model. This new approach would enable the PoCs to have access to charcoal briquettes at no cost as per MHA directives. The community-based briquettes production is now ongoing in Nyarugusu Camp under the 2019 SftS funding.

2. 1 RESULTS AND DISCUSSION

It should be noted that although the briquettes machines were not procured, other planned activities for production of briquettes in Nyarugusu were still implemented. This subsection presents the findings particularly on the training component for char powder and briquettes production as well as raw material testing for charcoal briquettes production.

2.1.1: Training on char powder production

Char powder is the carbonized form of the biomass materials (e.g. agricultural wastes, coffee husks, timber saw dust etc.) used for producing the charcoal briquettes. Training on char powder production was conducted for 98 farmers from the host community in Mvugwe and Mkuyuni villages. A total of 100 kilns (metallic drums, see figure 11) were distributed to the two villages for char powder production. Table 10 indicates the types of raw materials used to produce the char powder and the resulting quality of the charcoal briquettes after a burning rate test.

It should also be noted that during the charring process there were emissions of smoke and exposure to heat during carbonization process when using the kilns. Health and safety procedures were also followed by carrying out training on using Personal Protective Equipment's (PPEs) such as mask, gloves, and goggles. The aim of this training was to capacitate the producers with skills and knowledge of reducing health risks associated with the carbonization process.



Figure 11: Metallic kilns used for charcoal production at one of charcoal production sites in Mvugwe village in Kasulu District © UNHCR

2.1.2: Training on charcoal briquettes production

Training on charcoal briquettes production by using 10 manual pressing machines (hand held pressing tools, see figure 12) was carried out for Mvugwe farmers with the aim of equipping them with both knowledge of charcoal powder production and briquettes production at a small scale for household consumption. This activity pleased the National Uhuru torch convoy which visited the village and welcomed the group members to showcase the product of briquettes produced. Training on briquettes production was also done to incentive workers in Nyarugusu camp where they produced briquettes from mixed charcoal powder sources and the briquettes produced were used for burning rate testing to get the best raw material combination for good quality briquettes.

2.1.3: Burning rate test of the different raw materials for charcoal briquettes production

The charcoal briquettes produced from various sources of charcoal powder were put into experiment to determine the best one in terms of both heat intensity and burning rate. Results of the burning test indicate that charcoal briquettes from coffee husks performed best. This is an interesting finding given the abundant nature of the coffee husks (provided for free from a coffee processing plant in the host community) which will ensure sustainable supply of raw materials for charcoal briquettes production in Nyarugusu Camp. Table 10 shows the results of the burning rate testing for the charcoal briquettes produced from different raw materials. 250 grams of each type of charcoal briquette were subjected to the burning test.

Table 10: Raw materials from various biomass and their performance in producing charcoal briquettes

S/N	Raw Material Type	Burning Time (Minutes)	Quality	Observation
1	Rice Husk	40-50	Good	Good but perform better when mixed with either of no 2,3 & 4
2	Timber saw dust	60-80	Very good	Very good in burning and can perform better without any mixture
3	Maize cobs	45-60	Very good	Very good in burning rate and last for more than 45 min and can perform better without any mixture
4	Coffee Husk	100-120	Excellent	Excellent, perform better alone, burns faster and make dish ready in short time, best quality compared to other char powder from other materials
5	Mixture	70-90	Very good	Charcoal briquettes resulting from mixed materials perform better and it depends on what kind of materials has been used. Coffee husks, maize cobs and timber saw dust improves the quality of briquettes when added to inferior raw materials like grasses.



Figure 12: Manual pressing tools used to produce the charcoal briquettes in the community-based charcoal briquettes production in Nyarugusu Camp.

2.2 Challenges encountered during implementation of this project component

As stated earlier, there two main challenges which faced this project component implementation. The first challenge was failure by UNHCR to procure the briquettes machines because the successful bidder could not adhere to UNHCR procurement policy at the final stages of the procurement process. Production of the briquettes therefore using those machines was not done. The second challenge was restriction imposed by MHA that cooking fuel should not be sold to the PoCs and that free distribution should be adopted instead. The initial plan was to produce the briquettes and sell at an affordable price to the PoCs to ensure a sustainable production and availability of the briquettes in the camp as an alternative cooking fuel. Due to the above challenges, and bearing in mind that it is difficult to sustainably provide cooking fuel for free at a large scale, this project component was reoriented to a community-based charcoal briquettes production mechanism which is now ongoing in Nyarugusu camp under the 2019 SftS funding.



Figure 13: Charcoal briquettes currently being produced using manual pressing tools in the community-based charcoal production in Nyarugusu Camp.

2.3: Conclusions and recommendations

The charcoal briquettes production project in Nyarugusu camp was not implemented as planned. The restriction imposed by MHA that cooking fuel should not be sold to the PoCs and that free distribution should be adopted was one of the contributing factors as the original design of the project was based on a market-based approach. This then led to redesigning the project such that the refugees are trained to manufacture the briquettes for their own household consumption to ensure sustainability. It should however be noted that there is always a trade-off on the briquettes quality between small scale briquettes production (usually producing low quality briquettes due to low level of compaction pressure applied to the char powder-binder mixture) and large scale briquettes production which usually results in high quality briquettes. However, without a market-based approach, a large scale production of briquettes which normally bears a significant operational costs is not sustainable.

On the other hand, the results of burning rate testing for the briquettes produced using different sources of raw materials indicates that coffee husks briquettes performed best followed by saw dusts briquettes, maize cobs briquettes, rice husks briquettes and lastly briquettes produced from grasses. However, in order to make best use of all the available resources it is hereby recommended to produce charcoal briquettes from the raw material mixture. Beside, results from burning rate test indicate that charcoal briquettes produced from the raw material mixture performed second best to those briquettes produced from coffee husks alone.

COMPONENT THREE

RETAINED HEAT COOKER PRODUCTION AND COMMUNITY BASED TRAINING ON ENERGY SAVING PRACTICES IN NYARUGUSU, NDUTA AND MTENDELI CAMPS

3.0 Introduction

This project component was focused towards community-based training on energy saving practices across the three Camps of Nyarugusu, Nduta and Mtendeli in order to reduce firewood consumption and collection frequency and its associated SGBV incidences. To achieve this, the following activities were implemented by REDESO, CEMDO and GNTZ:

- Production of retained heat cookers (RHCs)
- Cooking demonstration at the food distribution site
- Survey of fuel-efficient stoves coverage, status and usage

3.1 Results and discussion

This section presents the findings of each of the above activities during project implementation in relation to how they contributed towards firewood reduction and reduction in SGBV incidences.

3.1.1 Production of retained heat cookers (RHCs)

A Retained Heat Cooker, often introduced as a *fireless cooker*, is a standalone, non-electric insulated bag (basket in this case) designed as an energy (fuel) saving cooking device (see fig 13 below). Instead of being placed on top of a cooking stove for the entire cooking duration, food is heated to a boiling temperature on the cooking stove and then transferred into the RHC where it continues to cook until it is fully cooked without requiring additional cooking fuel. The use of RHC saves up to 50% of cooking fuel.



Figure 14: A Retained Heat Cooker as seen from one PoC beneficiary household at Protection Village 15, Nduta Refugee Camp.

Production of RHCs was under GNTZ's supervision across the three refugee camps of Nyarugusu, Nduta and Mtendeli. As in the case of charcoal briquettes production explained under component two, the government (MHA) restriction to distribute cooking energy to the PoCs for

free also affected this project component. The original project design was to manufacture the RHCs and sell to the PoCs and the profit obtained was to be used to procure more raw materials for further RHC production and this would be a sustainable venture. The project therefore shifted the implementation modality from a business orientated model to a free distribution model across all the three refugee camps. Nevertheless, below are some of the accomplishments achieved.

- ❖ Provision of training on RHC production to 30 PoCs These PoCs (15 Nyarugusu, 10 in Nduta and 5 in Mtendeli) are now hired as incentive workers (RHC mobilizers) in all three camps. Moreover, during training, these PoCs received both business skill training as well as training on RHC production training (on both theory and practical sessions).
- ❖ Distribution of 800 RHC to the PSN and PoCs in the protection villages has been completed in all three camps. Over 61% of RHC beneficiaries reported reduction in the number of firewood collection trips from three times a week to once or twice a week.
- ❖ Community sensitization on RHC use was conducted in different zones in the camps. Special training also were conducted to the zone leaders where 4 sessions were conducted per month making a total of 72 sessions. Community sensitization covered more on cooking practice using RHC and the importance of using RHC such as saving amount of firewood to be used during cooking and also reduce SGBV cases during firewood collection were strongly emphasized to the refugee community.



Figure 15: RHC in use (left) and RHC distribution (right) in the camps.

3.1.2 Challenges encountered in the implementation of this activity

The main challenge encountered in the implementation of this activity was government restriction on market based initiatives within the camps. The sustainability of this component was based on the market based approach where producer groups could be able to procure the raw materials for further RHC production. The shift to a free distribution of the RHCs mean that this activity will not be able to self-sustain after the project implementation period.

Another challenge with regards to RHC uptake was the wrong perception (due to cultural issues) that food cooked through RHC does not have a good taste and preferred cooking completely using firewood. However, through continued community sensitization sessions their negative perception towards RHC use was gradually changed.

3.1.3 Conclusion

Beside the change in implementation modality of this activity from business model to free distribution of the RHC, RHC production is still ongoing across all the three camps under the 2019 SftS funding. Community perception on RHC is positive with over 61% of the participants acknowledging reduction in firewood consumption and consequently reduction in the number of firewood collection trips which is highly linked with SGBV incidences. The demand for RHC in the camp is still high as PoCs have requested for more RHC distribution to cover most families in the camps.

3.2 Cooking demonstration at the food distribution sites

This subsection focused on sensitization of the refugee community in the camps on best cooking practices in order to reduce fuel consumption. To achieve this, four sensitization events were conducted in each camp where best cooking practices were demonstrated and included the following techniques;

- ❖ Double cooking (placing a pot on top of another pot during cooking, see figure 15)
- ❖ Covering pots during cooking
- ❖ Using tenderizers for cooking hard foods like peas
- ❖ Preparing meals to be cooked before setting up fire to save fuel.
- ❖ Pre- soaking of peas/beans (placing the peas/beans in water for some hours prior to cooking so as to reduce the cooking time, resulting in reduction of cooking fuel per meal)

As stated above, the main objective of these demonstrations was to create awareness among the community on how to use the available fuels efficiently and effectively. In line with this, it is also worth mentioning that, for some years now, the PoCs in the camps have been complaining that the presoaked beans lose their natural taste. Under this project, UNHCR and partners actually decided to test this notion by conducting blind food tasting where by presoaked versus non presoaked peas/beans were both given to the same participant (blindfolded) to confirm whether there was really a difference in the peas/beans taste? The results were interesting

where majority of the test participants acknowledged that the presoaked beans were actually more delicious than the non-presoaked beans.



Figure 16: One of the cooking demonstration events (Preparing the food before igniting the fire-top left, double cooking-top right, pre-soaking of peas-bottom left and blind food blind tasting-bottom right)

The target participants of these trainings were those individuals who could influence and disseminate knowledge on best cooking practices to the rest of the refugee community in the camps. These included zone leaders (De-zones from zone 1 to 13), village leaders, women and girls as well as spiritual leaders who are the most influential people in the society.



Figure 17: Igniting the fire once food preparation is ready-cooking demonstration in Nyarugusu camp

A total of 350 individual were trained in Nduta and Mtendeli (see table 11) while a total of 800 individuals were trained in Nyarugusu (526 female and 274 male). After the training, the individuals managed to train and disseminate the knowledge to the rest of the refugee community. It was reported that 10,087 individuals were reached for the training in Nduta and Mtendeli Camps and that these trainings were ongoing.

Table 11: Categories and number of individual trained on the best cooking practices in Nduta and Mtendeli

S/N	Title Of Participants	Number Attended
1	Women representative	109
2	Zone leaders	64
3	Community watch Team	157
4	Religious leaders	20
	Total	350

3.3 Survey of fuel-efficient stoves coverage, status and usage

The focus of this project sub-component was to establish a baseline on the current coverage, status and usage of the different types of cooking stoves within the refugee camps in order to identify gaps which require further interventions. In line with this, stove testing was conducted to determine the efficiency of different stoves types in order to inform further stove efficiency improvement. Stove testing was conducted in collaboration with SNV.

A census of the number and type of stove was conducted in Nyarugusu Camp while a sampling approach was adopted on surveying the number and types of stoves in Nduta and Mtendeli camp. As a result 60% of the total households in Nduta and 66% of the total households in Mtendeli were surveyed.

Results of the surveys indicate that;

- ❖ The fuel efficient stoves coverage in Nyarugusu stands at 78% while that of Nduta and Mtendeli stands at 84 and 81% respectively.
- ❖ There is a range of cooking stove types existing in the camps which include mud stoves, modified mud stoves, brick stoves, Sv80 stoves, rocket stoves, insert stoves, LPG stoves, Matawi stoves, institutional stoves as well as three stone open fire.
- ❖ Most of the stoves which are fabricated within the camps are not durable and therefore do not last long possibly due to the nature of the soil used and due to the use of unburnt bricks.

Table 12: Distribution of cooking stoves in Nyarugusu Camp (Congolese)

Zone	Brick Stove	Insert Stoves	Mud stoves	Sv80	Rocket Stove	Institutional	Charcoal	3 Stones	Total
1	455	467	718	44	87	2	39	259	2071
2	734	546	805	41	113	4	49	377	2669
3	717	496	302	51	167	3	17	413	2166
4	853	441	440	35	189	10	23	349	2340
5	1071	597	332	44	108	6	5	405	2568
6	940	627	290	19	129	4	9	385	2403
7	933	407	303	12	109	6	59	409	2238
Total	5703	3581	3190	246	902	35	201	2597	16455

Table 13: Distribution of cooking stoves in Nyarugusu Camp (Burundians)

Zone	Brick Stove	Mud Stoves	Insert Stoves	Modified Bricks Stoves	Rocket Stove	Institutional	Charcoal	3 Stones	Total
8	1369	686	155	22	0	4	104	423	2759
9	1098	957	903	50	0	0	96	735	3839
10	313	177	811	19	1	0	23	106	1450
11	1277	664	607	37	19	0	11	605	3220
12	335	127	0	18	0	0	23	321	824
13	158	53	0	4	0	0	34	304	553
Total	4550	2664	2476	150	20	4	291	2494	12645

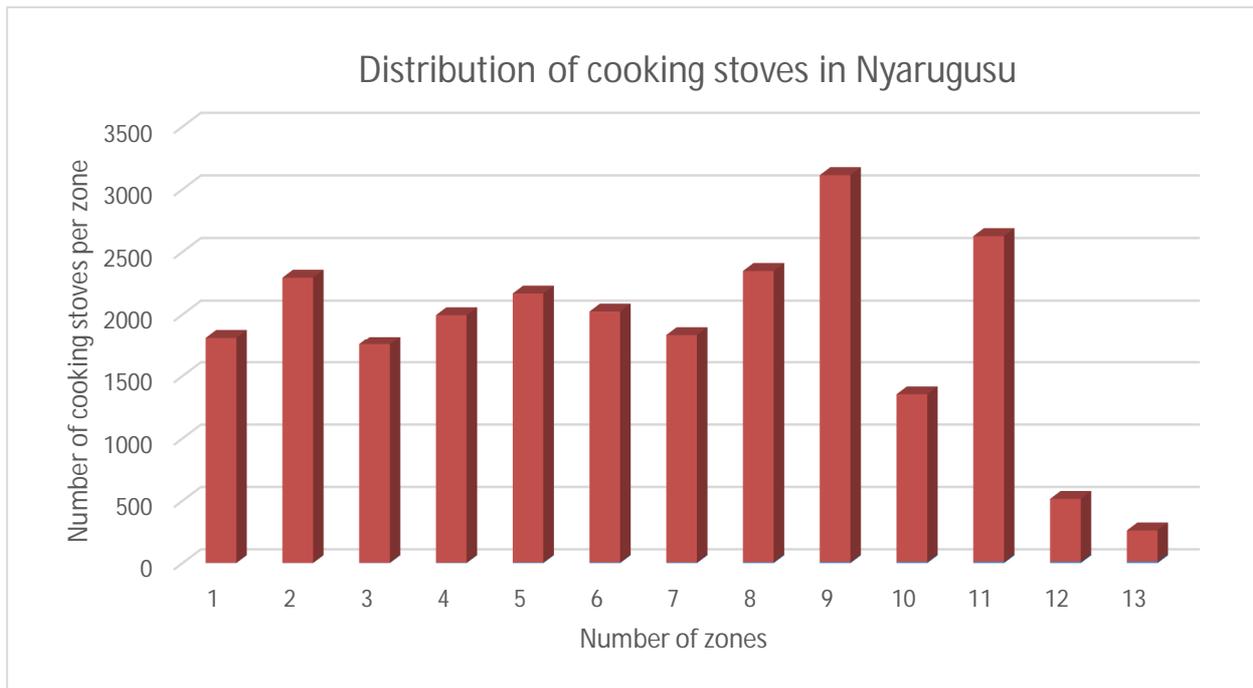


Figure 18: Distribution of cooking stoves in Nyarugusu Refugee Camp.

It should also be noted that the differences in the number of stoves across the zones is mainly due to the size of the zones. Precisely, zone 9 is the largest while zone 13 is the smallest. Although the percentage coverage of the fuel efficient stoves in the camps is fairly good, more efforts is still required in fabrication and repair of the stoves. Understandably, due to energy “fuel” stacking, there is still significant quantity of the three stone open fire across the camps. For example, three stone fire accounts for 18% of all the stove types in Nyarugusu Camp and 16% in Nduta and Mtendeli Camps.

On the other hand, the top three commonly used stoves in Nyarugusu Camp are the Brick stoves, Insert stoves and Mud stoves (Table 12 and 13) while the top three commonly used stoves in Nduta and Mtendeli Camp are the Insert stoves, Mud stoves and surprisingly, three stone open fire (Fig 18)

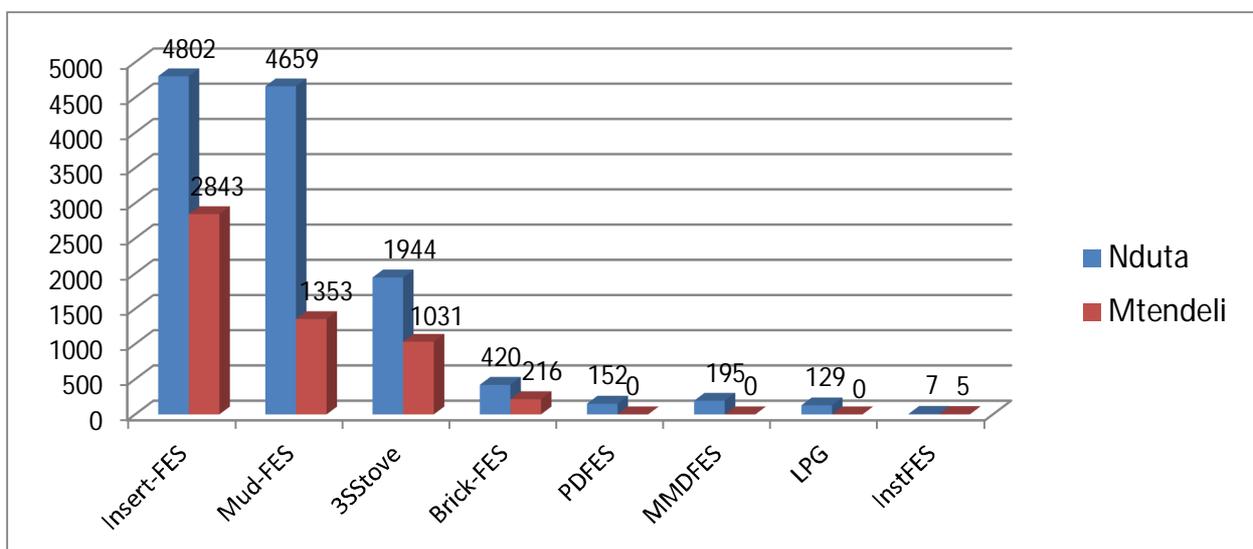


Figure 19: The most used types of stoves in Nduta and Mtendeli Refugee Camps.

3.4 Stove testing results

This section presents the findings for the stoves testing experiments conducted by UNHCR and partners in collaboration with SNV to determinate the efficiency of different stove types existing in the refugee camps. The objective of the stove testing was therefore to measure stove performances based on 3 performance parameters which are thermal efficiency, specific fuel consumption and time to boil. The following stoves were tested;

- ❖ Rocket Stove (CEMDO),
- ❖ Mud Brick Stove (CEMDO),
- ❖ Mud Stove (CEMDO),
- ❖ Envirofit Insert Stove (CEMDO),
- ❖ Mud Brick Stove (REDES), and
- ❖ Mud Stove (REDES).

A typical Three Stone Fire was used as the baseline stove. Stoves were tested using a water boiling test (WBT) protocol due to its simplicity and low cost compared to other testing protocols such as Control Cooking Test (CCT) and Kitchen Performance Test (KPT). The results of this testing are presented below.

Rocket Stove (CEMDO)

- ❖ 31% more in thermal efficiency
- ❖ 29% less specific fuel consumption
- ❖ 13% more time to boil water



Mud Brick Stove (CEMDO),

- ❖ 29% more thermal efficiency;
- ❖ 26% less specific fuel consumption
- ❖ 2% less time to boil



Mud Stove (CEMDO),

- ❖ 77% more thermal efficiency
- ❖ 47% less specific fuel consumption
- ❖ 13% less time to boil water



Envirofit (Insert) Stove (CEMDO),

- ❖ 47% more thermal efficiency
- ❖ 45% less specific fuel consumption
- ❖ 6% less time to boil water



Mud Brick Stove (REDES0)

- ❖ 11% more thermal efficiency
- ❖ 16% less specific fuel consumption
- ❖ 6% more time to boil water



Mud Stove (REDES0).

- ❖ 41% more thermal efficiency
- ❖ 42% less specific fuel consumption
- ❖ 8% less time to boil water



From the testing results it is clearly seen that some stoves, on certain performance measures outperformed the baseline stove while others underperformed. For those stoves which performed below the baseline stove there is the need to re-design them by modifying their dimensions such as the height of combustion chamber and pot rest to improve their performance.

From the above results a conclusion was made that the mud stoves fabricated by CEMDO performed best in terms of thermal efficiency, specific fuel consumption and time to boil water. It is therefore recommended to scale up fabrication of the fuel efficient stoves across the camps based on the dimensions of this stove prototype while refining its performance in the process.

4.0 GENERAL CONCLUSIONS AND RECOMMENDATIONS

The 2018 Tanzania alternative cooking fuels and training programme was implemented in the three refugee camps of Nyarugusu, Nduta and Mtendeli. The programme had three components (projects) which were charcoal briquettes and LPG comparative analysis in Nduta refugee camp, manufacturing of charcoal briquettes in Nyarugusu Refugee Camp and community-based training on energy saving practices across the three Camps. Based on the findings from this project, the following conclusions and recommendations can be drawn.

The per capita briquettes consumption per day is 0.52kg while the per capita consumption for LPG is 0.1 kg per day. Based on these figures, LPG costs 11,500TZS per person per month while the cost of charcoal briquettes stands at 18,720TZS per person per month. However, these costings are based on monthly consumption and did not include the initial cost associated with procurement of the complete LPG stove set.

Exposure to firewood collection (time spent in firewood collection by household members per week) was reduced by 89% on average. A conclusion can be made that SGBV risks related to firewood collection are reduced by this rate. Moreover, awareness campaigns and training sessions on SGBV awareness were conducted to ensure further reduction in SGBV incidences. Fliers and SGBV manuals were developed and have been used on different events in the camps.

Both LPG and charcoal briquettes were equally preferred by the PoCs while procured dual stoves were generally more preferred by the project participants than the modified stoves. However from a technical and financial point of view, the modified mud stoves are hereby recommended for use with charcoal briquettes.

The charcoal briquettes production project in Nyarugusu camp was not implemented as planned. The restriction imposed by MHA that cooking fuel should not be sold to the PoCs and that free distribution should be adopted was one of the contributing factors as the original design of the project was based on a market-based approach. This then led to redesigning the project such that the refugees are trained to manufacture the briquettes for their own household consumption to ensure sustainability. This new approach is currently being implemented in Nyarugusu Camp.

The results of burning rate testing for the briquettes produced using different types of raw materials indicates that coffee husks briquettes performed best followed by saw dust briquettes, maize cobs briquettes, rice husks briquettes and lastly briquettes produced from grasses. However, in order to make best use of all the available resources it is hereby recommended to produce charcoal briquettes from the raw material mixture.

There is a positive community perception towards RHC use with over 61% of the participants acknowledging reduction in firewood consumption and consequently reduction in the number of firewood collection trips which is highly linked with SGBV incidences. Scaling up of RHC production is therefore recommended in order to cover more families and further reduce SGBV incidences.

There is a need for REDES and CEMDO to increase the frequency of sensitization and demonstration on the best cooking practices and stove fabrication efforts to ensure adoption of the energy saving techniques.

The fuel efficient stoves coverage in Nyarugusu stands at 78% while that of Nduta and Mtendeli stands at 84 and 81% respectively. CEMDO and REDES should therefore increase their sensitization efforts on fabrication of fuel efficient stoves to increase the coverage and use of the same. It is also recommended that stoves repair should be done not only for the insert stoves but to the rest of the stoves types since PoCs tend to revert to three stone fire use when the stove is damaged.

The top three commonly used stoves in Nyarugusu Camp are the Brick stoves, Insert stoves and Mud stoves while the top three commonly used stoves in Nduta and Mtendeli Camp are the Insert stoves, Mud stoves and surprisingly, three stone open fire. However, results from the stove testing experiment indicate that the mud stoves fabricated by CEMDO were the most energy efficient. It is hereby recommended to adopt and scale up fabrication of the same across the camps for more energy saving outcomes.

Generally, the 2018 Tanzania alternative cooking fuels and training programme has brought significant impact in the UNHCR Tanzania operation particularly on reduction of protection risks such as SGBV incidences to the PoCs. Moreover, this project has also brought some positive feedback to the host government as environmental degradation, particularly deforestation for firewood use, has been a major concern for quite some time now. Implementation of the 2019 Tanzania alternative cooking fuels and training programme is ongoing across the camps and is expected to bring even more positive impacts to both the PoCs and the environment.



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