

## **Energising Development (EnDev) Clean Cooking Technologies**

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Fifth mission in Monrovia/ Liberia  
6th October to 3rd November 2015



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## **EXECUTIVE SUMMARY**

The Energising Development (EnDev) Partnership is an impact-oriented global sector programme cooperating with 24 partner countries in Africa, Latin America and Asia. EnDev activities in Liberia have started in 2012 and focus on five components: clean cooking technologies, electricity of households, mini grids, energy for social institutions and energy for SMEs.

The main objective of the Clean Cooking Technologies department is to support, create and maintain safe, healthy, economic and green cooking solutions for Liberian households, institutions and enterprises. The production of locally produced improved charcoal stoves “Red Fire Pot” (RFP) is part of the GIZ/EnDev program since 2013. During previous missions, I designed the RFP to suit Liberian cooking habits and to fulfil the EnDev criteria. The targeted objective is to provide clean cook stoves among 15,000 people, which equalizes 1,500 sold stoves. Out of a total number of 17 trained producers, 10 persons were still active. The process of establishing an effective market for the improved stoves was slowed down due to the Ebola outbreak.

The main objective of the mission between 6<sup>th</sup> of October and 3<sup>rd</sup> of November 2015 was to back the local stove team in their activities. This included the organisation of the stove team and defining their tasks; discussing the marketing strategy and designing appropriate marketing materials and a showcase.

After meetings all producers and retailers agreed on a fixed price of 14 US\$ for a small RFP and 17 US\$ for a big one. I further supported the monitoring and quality work, trained local staff in conducting safety tests and Regional Water Boiling Tests (RWBT) and helped to start the process of establishing a producer association. After the mission, I further supported the team via weekly Skype meetings.

The follow-up of RFP users showed once more that the life span is the major challenge in Monrovia and that proper maintenance is the a key fact for a long-lasting product.

Moreover, we developed strategies how to target various challenges in the production. This includes activities how to keep trained producers in the programme and how to speed up the production. Two sets of mechanical tools were introduced to the producers and a tools training conducted. A major issue in the cooperation between the producers and EnDev is that EnDev has still not established a market for the RFP. Therefore, the production still depends on purchases through EnDev, which is not attractive for the producers because of long and complicated payment procedures.

Three different trainings were organized at the Monrovia Vocational Training Center (MVTC): A six-days training for 13 new producers (2 female, 11 male), three one-day tool trainings to improve the efficiency and quality of production, and a three-weeks production workshop. The production workshop aimed to further improve the skills of the producers and to monitor the quality of the product. A total number of 500 stoves were manufactured during this workshop.

EnDev Liberia also targets to facilitate 30 institutions and 50 small enterprises with improved cook stoves. To collect user feedback, two different institutional wood stoves were provided to schools and prototypes of a large version of the Red Fire Pot, called XL RFP, to restaurants before the mission. Besides this, the stoves were checked for their efficiency according to the EnDev criteria.

The cooks at the schools appreciated both stoves, the “Orka” stove from the manufacturer Prakti as well as the locally produced “Kala”, for their reduced smoke, less exterior heat and the comfortable cooking height. They personally preferred the Kala stove, because it is faster and the pot is more stable. Based on a small number of valid tests, only the additionally tested „EFI 100L“ from Envirofit fulfils the EnDev criterion by a specific fuel reduction of 50%. The locally produced Kala stove with a reduction of 28%, (but a time reduction by 58%) and the imported Prakti stove with 25% "failed" the test. These are not definite results. It is recommended to repeat tests to get reliable results.

The cooks at the restaurant, who were testing the XL RFP, experienced that the stove saves a lot of charcoal, but needs to be refilled at least once during the cooking process. The RWBT confirmed this finding. Therefore, a new prototype with a deeper combustion chamber to hold more charcoal was commissioned. The new prototype will need to be tested before distribution.

### **Acknowledgements**

The work reported here, like any work, is a joint achievement and would not have been possible without the EnDev Liberia team (especially Hartlieb Euler, Daniel Y. Partee, Thomas Scott, Youngor Flomo, Morella Siemers, Boakai Sheriff and Stephen Mulbah); the support from MVTC, our motivated female and male trainees of the Red Fire Pot and the previous work, expertise and support of the GIZ Éclair project team (Christoph Messinger, Christa Roth, Gregor Kraft and Julien McHardy).

## 1. Support of local EnDev team

The main objective of this mission was to support the local stove team in several activities concerning the marketing, training and quality control, monitoring and testing of the stoves.

### 1.1. Stove team

#### 1.1.1. Organisation and tasks

The local EnDev stove section is mainly formed by Daniel Y. Partee, Thomas Scott, Youngor Flomo and Morella Siemers and is backed by the EnDev office structure. I helped the team to organize and structure their tasks.

The attached task list describes the essential activities, sets interim targets and timing, and defines the responsible person and additional staff.

Daniel Y. Partee	- Production management, training, quality control
Thomas Scott	- Monitoring sales, field worker for retailers, mapping data
Youngor Flomo	- Household monitoring, RWBT
Morella Siemers	- Coordination
(Boakai Sheriff	- Marketing assistant until mid 12/15)

#### 1.1.2. Capacity works

In a team meeting, we developed a paper that gives an overview about the essential points of the work of the “GIZ/ EnDev Clean Cooking Technologies Department“. This includes its inputs and activities, the use of the outputs, the results and objectives of the project, the overall objectives and a stakeholder analysis.

The paper is also attached to this report.

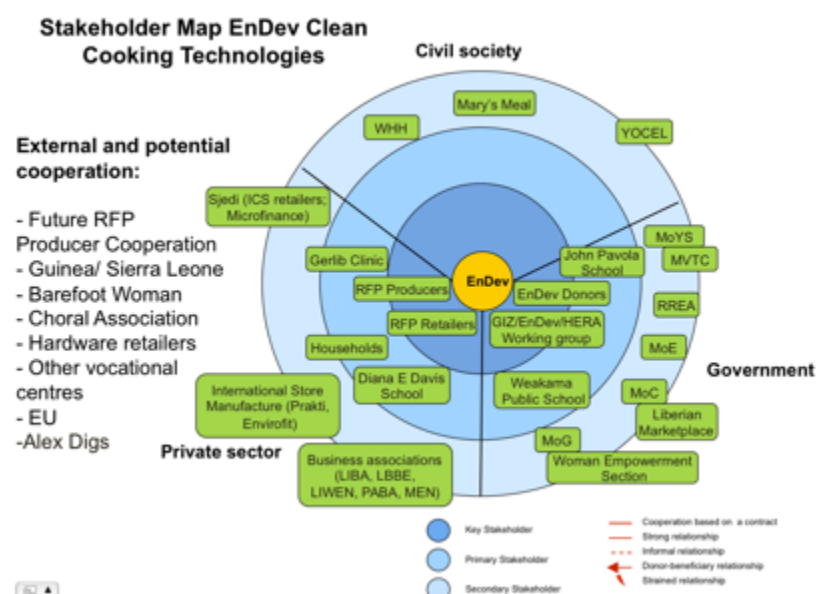


Fig. 1: Stakeholder analysis, Morella Siemers, 10/ 2015

## **1.2. Marketing**

Together with the stove team and RREA, I worked over the marketing strategy paper, which already had been discussed during my mission in July 2014 before the Ebola outbreak. The marketing strategy includes planning of the campaign, raising awareness on radio and TV, advertising, public relations with partners and organisation of selling events with competitive cook shows at local markets. It also involves managing the production of marketing materials, including posters, flyers, and radio jingles and TV spots. The objective is to create an effective market for the locally trained producers and retailers respectively and to sensitize users on the related health, environmental and gender issues.

This paper formed the base for recruiting a local marketing assistant. During the first weeks, I interviewed five potential candidates for the product launch of the Red Fire Pot and its related activities. The contacts of all candidates are listed in the appendix.

Hartlieb Euler and I decided to hire Boakai Sheriff, a Liberian entrepreneur with a company of 40 permanent employees and working experience with Mercy Corps. The proposed contract, depending on the actual performance in terms of stoves sold, was finally not possible due to GIZ regulations. Boakai Sheriff quit before the end of this intended contract. This leaves again an open position, which is crucial to the success of the project. The stove team is currently responsible to catch up with the marketing activities.

### **1.2.1. Sales areas and marketing strategy**

We defined the main market areas in Monrovia as following and located them on a map:

- a) Red Light Market (Paynesville)
- b) Duala Market (Freeport)
- c) Waterside Market (Waterside)
- d) Rally Time Market (Central)
- e) Nancy Doe's / Jorkpentown Market (Sinkor)
- f) Gardnerville Supermarket (Somalia Drive)

Further important markets are Airfield market (Airfield), Joe Bar Market (Congo Town), Fiamah Market (Fiamah/Matadi), ELWA market (Paynesville) and Brewerville.

The first market outreach with no sales at the Red Light Market showed that the marketing strategy needed to be adjusted. The product introduction should rather start at middle-income communities and later proceed to the major market areas, when an initial awareness is created.

### 1.2.2. Price discussion

One of the main bottlenecks for the market introduction of the Red Fire Pot is the relatively high price. The price of 15 US\$ for a small and 20 US\$ for a medium sized stove were based on the material costs and a relatively high producer margin. Therefore, I compared the prices for related improved charcoal stove in four West African countries. The percentage comparison showed that the material expenses are ranking around 55-65% the producer's profit around 25-35% and the profit of the retailers around 10-15% of the total wholesale price.

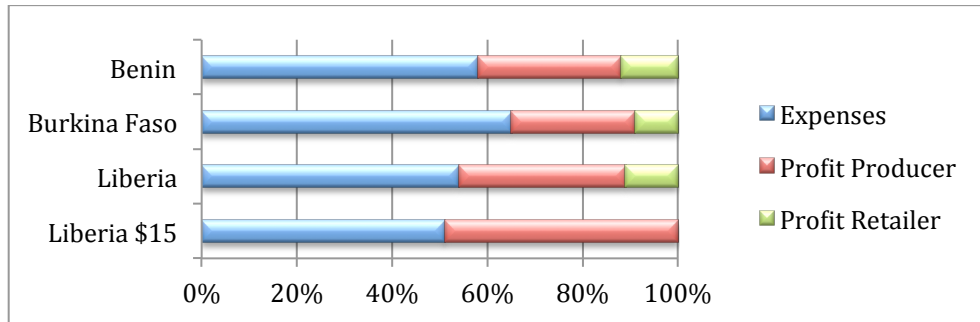


Fig. 2: Percentage of factors forming the retail price of a small sized improved charcoal stove

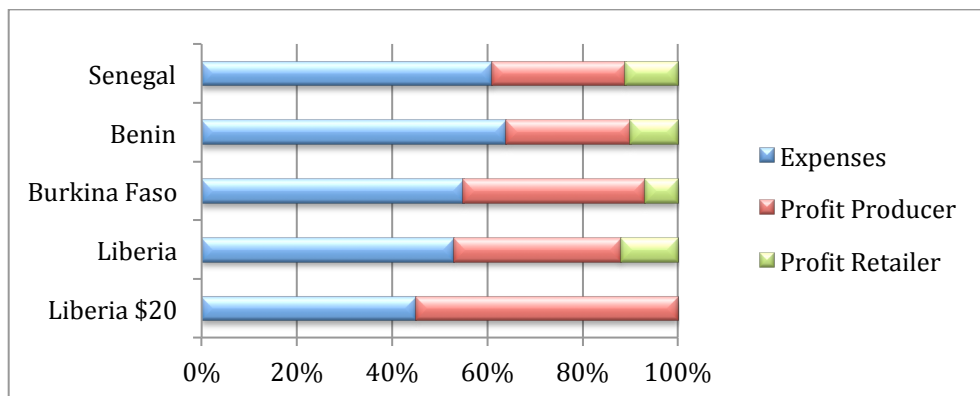


Fig. 3: Percentage of factors forming the retail price of a big sized improved charcoal stove

The wholesale price for the small and the medium RFP could be lowered to 14 US\$ and 17 US\$. The retail and wholesale price for single (5US\$/ 7US\$) and double stands (8US\$/ 10US\$) were adjusted accordingly.

Boakai Sheriff discussed the profit margin with the retailers and all produces, which accepted these fixed prices. Furkuna Metalworks is the only workshop, which is not willing and able to produce for this money.

	Small RFP	Big RFP
Producer expenses	7,60 (54%)	9,00 (53%)
Producer profit	4,40 (31%)	6,00 (35%)
<b>Retail price</b>	<b>12,00</b>	<b>15,00</b>
Retailer profit	2,00 (14%)	2,00 (12%)
<b>Whole sale price</b>	<b>14,00</b>	<b>17,00</b>

Fig. 4: Prices for small and big Red Fire Pot

### 1.2.3. Marketing material

To support the marketing activities, I designed the product label, flyers and promotion t-shirts. All data are attached to this report.



Fig. 4: The sticker, which shows the product name and EnDev’s contact details, labels the stove

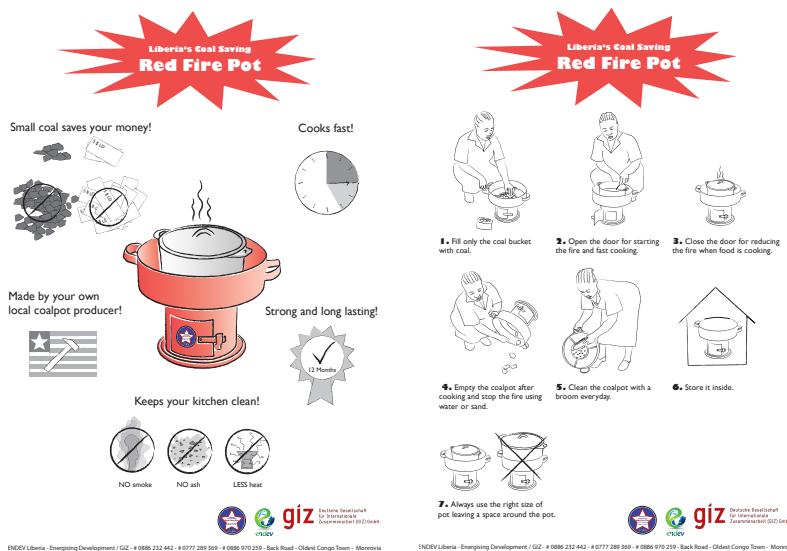


Fig. 5: The two-sided flyer shows the advantages and handling of the stove with easy understandable images and words



Fig. 6: Two-sided t-shirt for the promoters shows the product and the contact information

Moreover, an official email address and Facebook page were created.

- E-mail: [redfirepot@gmail.com](mailto:redfirepot@gmail.com)
- PW: [EnDev+500RFP](https://www.facebook.com/Endev+500RFP)
- Facebook: [www.facebook.com/redfirepot](https://www.facebook.com/redfirepot)

### 1.2.4. Showcase design

I designed a mobile showcase for the promotion of the Red Fire Pot, which serves as product display and may also be used as food selling stall to attract the attention along the road or at markets. It is a lightweight metal structure with dimensions of L 85cm x H 160cm x W 45cm, to fit into EnDev's vehicles for transport. It offers space for six small or big RFPs, one double and one single stand and a small stool.

The showcase was built at local welding workshop "Weld Liberia Inc.". It is protected by an anti-rust coating. Johannes Weber supervised the manufacturing process after I left. A local artist is commissioned to decorate the showcase with icons in the typical cartoon style. The inside of the door wings show icons, which explain the advantages of the Red Fire Pot in comparison to the traditional coalpot. The outside of the door wings is painted with the Red Fire Pot logo. The base colour of the showcase is blue to contrast the red stoves (Fig. 7).

As wheelbarrows are the most common mobile sales display at Liberian markets, also this showcase has two wheels at the back (Fig. 8) and to be moved around. An additional umbrella provides shadow for the seller.

To install the booth, the retailer takes out the double stand with two RFPs to prepare food for sale. Thus, potential customers are able to see the stoves "in action". The sales person may provide first hand information about the advantages of the stoves. She/he works as testimony for the product, while earning extra money.

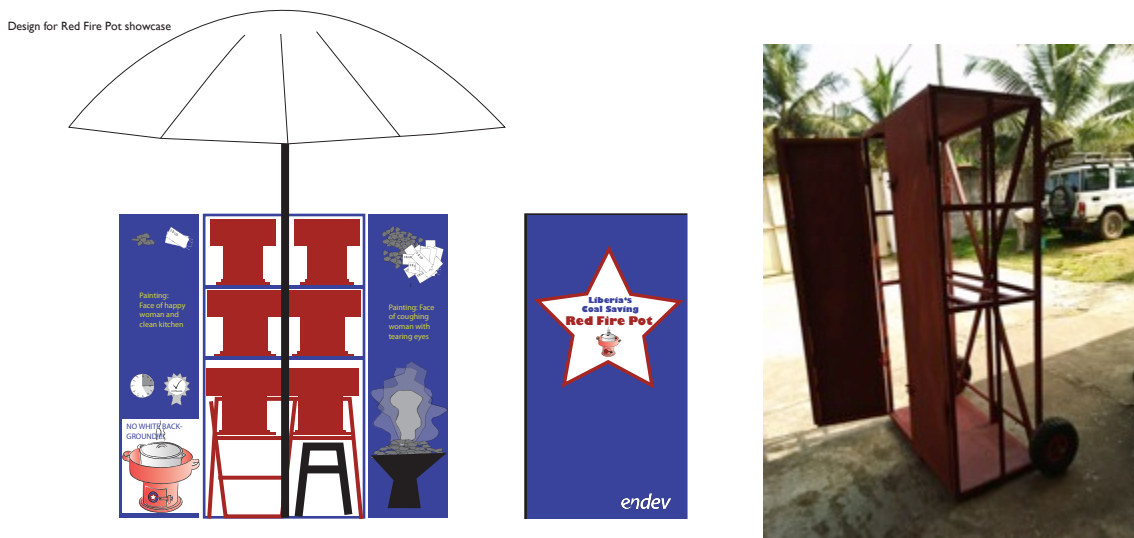


Fig. 7: Opened and closed showcase showing the explaining drawings

Fig. 8: Side view with wheels

**1.3. Monitoring and quality control**

**1.3.1. Monitoring sales**

In order to ease the monitor of sales, I developed an invoice, which is given to the RFP retailers and producers. It is designed in the way that also retailers and producers with limited literacy skills are able to fill in the form.

It comes as a receipt block with three copies, so that one copy stays with the customer, one with the retailer or producer and the last one with EnDev to prove the sales. It also contains all necessary information for the required household monitoring and the regular EnDev monitoring every six months.

Moreover, I collaborated with the consultant Hamza Zbidi to adapt the form on a smartphone or tablet using the innovative application KoBo Toolbox.

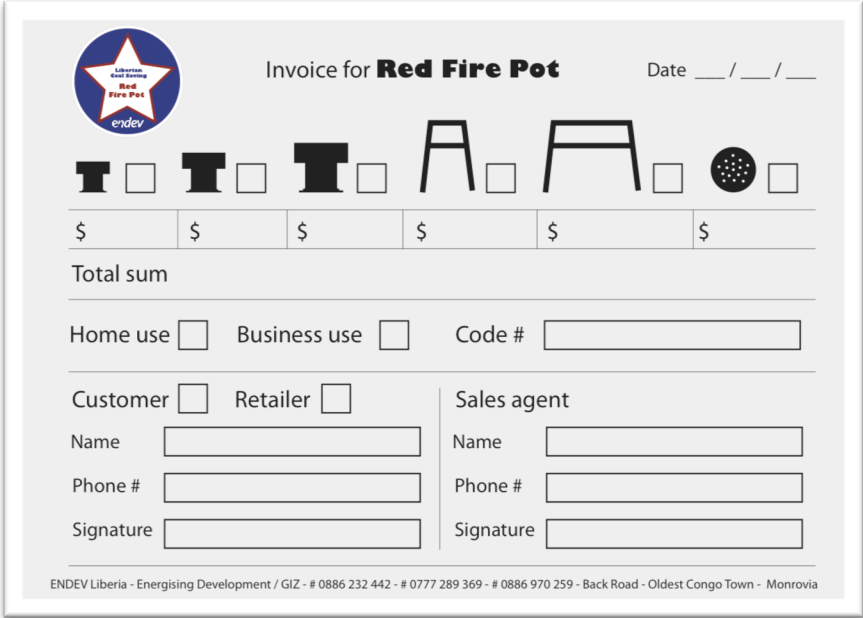


Fig. 9: Invoice

**1.3.2. Household monitoring**

In August 2015, Daniel Y. Partee did the latest user monitoring mostly via phone interview and describes his findings in a written form. This showed two difficulties: Firstly, it is not sufficient to do the monitoring only via phone interviews, to get a clear picture about the real usage and condition of the stoves. Secondly, the written reproduction of the phone call makes it difficult to compare and analyse the results.

I highly recommend visiting households besides the phone interviews; even though it is more time consuming. It would be recommended to use motorbikes of the project to be able go get around in Monrovia more flexible.

In order to standardize the household monitoring and especially to make the data comparable, I developed a simple questionnaire.

This questionnaire may be optimized during the process. Tim Rabe (GIZ/Endev) already gave useful advices, which are attached to the report. Once the questionnaire is finalized, it will be transferred to a digital form based on KoBo Collect. This will further simplify the comparison of data and its analysis.

Youngor Flomo is in charge of the coming household monitoring. She already conducted the first household visits and some phone interviews (read more at 2.1. of this report). It seems that support will be needed to analyse the findings.

### 1.3.3. Quality control

I prepared a simplified quality control sheet, which is attached to the report. It explains with icons and simple words the crucial points of the product. Daniel Y. Partee introduced this new quality control sheet to the producers during the training. A laminated copy was provided for each producer.

It is also recommended to train the future retailers to check the quality of the product when buying from the producers.

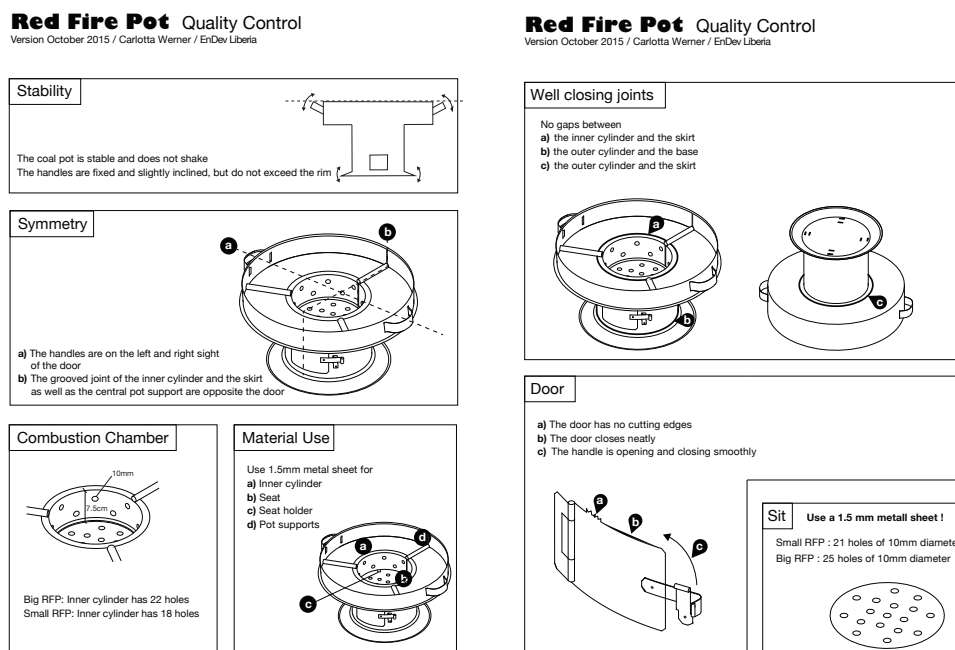


Fig. 10: Simplified quality control sheet

## **1.4. Testing stoves**

### **1.4.1. Safety Test**

In June 2015, Daniel Y. Partee, Youngor Flomo and Michael Collingwood conducted the required safety test for the Red Fire Pot following the “Stove Testing Safety Guidelines”. Some of the results did not seem to be correctly done. Thus, together with Thomas Scott I went through the paper and repeated some exercised.

Unfortunately, we could not finalize the safety test, because of defective thermometers. The test needs to be repeated once more. Thomas Scott is now able to explain this procedure to the team when he is back from his mission in February 2016.

### **1.4.2. Regional Water Boiling Test (RWBT)**

To qualify for the EnDev criteria for improved cooking stoves, a stove needs to achieve a 40% reduction of specific consumption compared to a commonly used traditional baseline stove. This 40% can be reduced down to 30%, if there is a significant time reduction. To verify the performance of the improved cook stoves, three Regional Water Boiling Tests (RWBT) need to be conducted per stove to calculate the average performance.

The aim of the RWBT is to measure the specific fuel consumption (in gram per kilogram water boiled, g/kg) and the time to boil (in minutes, min). The „time to boil“ is measured from the lightening of the charcoal or wood until the water temperature reaches 100°C. During this time, the temperature of the water is measured every five minutes.

Youngor Flomo was trained to conduct the Regional Water Boiling Test for charcoal and wood fire stoves. She is now familiar with the procedure, but not completely autonomous in her work. She will need further assistance and guidance to deliver reliable test results.



Fig. 11: Youngor Flomo during the RWBT of an institutional stove

## **1.5. Producer association**

EnDev intends to establish a self-organized and local owned association of the Red Fire Pot producers with clear structures and rules. I helped the team in starting the process and Morella Siemers and Daniel Partee proceeded and set the bylaws.

The main goals of the association are:

- 1) Simplifying contact and orders between retailers, producers and EnDev
- 2) Making large-scale deliveries of RFPs possible
- 3) Providing mechanical tools and loans for material
- 4) Agreement on fixed wholesale and retail prices
- 5) Reporting on production and sales on a monthly basis to GIZ/EnDev

We discussed the advantages and responsibilities and cleared their commitments to create the association with all active producers. We decided to form three production groups according to their workshop location: Group A) Red Light Market, Group B) Somalia Drive group, Group C) Bush Road Island. Each group elected one leader and one treasurer.

## **1.6. Presenting the stove team**

The support and organisation of the team was far more time consuming than expected. Therefore, Hartlieb Euler and I decided not to focus on a major event like “Solar Liberia”, but rather concentrate on the on-going process.

I presented the EnDev stove program to the Minister of Gender and her deputy minister, to the country director of UNIDO and at Monrovia Vocational Training Center (MVTC) for discussing further cooperations.

During the visit of the GIZ Director General for Africa Department, Mrs. Broemmelmeier, and the GIZ Director for the Division West Africa I, Mrs. Bauerochse, the activities of the clean cooking technologies component were presented at EnDev office, as well as at a nearby metal workshop and at MVTC during the production workshop. The fact sheets are attached to the report.

## **1.7. Back stopping**

Until mid of January 2016, I continuously supported the team in their activities via Skype consultations. The major topics were the shortage and production of stands, organisational questions of the production workshop at MVTC, marketing and sales issues, as well as the difficulties concerning the sudden leave of Boakai Sheriff.

## **2. Red Fire Pot**

### **2.1. User follow-up**

The user feedback and information about the durability and the usability of the Red Fire Pot are based on Daniel Partee's report among 20 users and my observations during the mission.

Monitoring report, August 2015:

*„People love the stove because it helps family members to save more money on buying coal and it is environmental friendly. Even those that complain on the metal also accepted that the stove is good.*

*And even the damaging of the stove before the one year period, I also observed from the few homes that I visited that some of the damages are caused by the user themselves; because some people don't really follow the instruction for the usage of the stove and some used it 24 hour around the clock. They sometime use the stove and just leave the ashes in the stove, and the ashes can cause corrosion, which damages the inner cylinder and the seat for the stove. And I also observed that some of the producers are not ready using the 1.5mm steel plate for the inner part of the stove.“*

The findings about the handling correlate to my observation. An additional factor for the life span is, whether the stove is produced in the old or according to the new design starting from July 2014. As there are currently two different designs on the market and in the stock, it is important for the survey of the lifespan to understand, which version the stove is. The simplest indicator for the old design is the interlocking tongues from the outer cylinder at the top part. This aspect needs to be integrated in the questionnaire.



Fig. 12: During the household visit at Olive Kun, I found the two RFPs in a good condition, even though the stoves are done with the old design. She is using the stoves everyday since June 2014 and carefully maintaining them. She even went to a welding shop to repair the top part.



Fig. 13: The XL RFP at Aquila Restaurant showed damages after one year of heavy everyday use. Besides the broken seat, the stove (new design) showed that the rim of the inner cylinder is corroded while the 1.5mm top part is still in good condition.



Fig. 14: The RFPs, which Youngor Flomo observed during her household visits, were also produced according to the old designs, which explains the fast break.

Considering Partee's report, the users claimed that the used material needs to be improved, that the price is too high and that more awareness rising is needed. We answered the concerns by lowering the price, using thicker metal sheets for the inner cylinder and the top for the first 500 stoves.

## **2.2. Challenges of production**

EnDev Liberia faced several challenges associated with the production of the RFP, such as a slow production, the losing of trained producers and difficulties in the payment process. In order to address these issues we developed the following responses and discussed them with all producers at MVTC.

### **2.2.1. Losing of trained producers**

In comparison to other stove programs, EnDev Liberia is still in the process to build up its network of reliable producers.

Out of 17 trained producers, only ten are still active. Out of the seven quitted producers, four producers stopped because of personal reasons (age, moved away, no more EnDev activities in Foya) and only three, because they had difficulties with the production. A detailed list with all trained producers and their reasons to stop production is attached.

Way forward:

- a) Careful recruiting of skilled craftsman with business attitude is crucial for a successful and long-term cooperation with the producers
  - > Amara Sumawolo is commissioned to do the next recruiting
- b) Continuously improving the skills of the producers
  - > Organizing a production workshop after the first training at MVTC

### **2.2.2. Slow production**

EnDev claimed that the production has been slow, especially for large-scale orders. This is due to a limited number of producers, the financial situation of producer (e.g. no money to pre-finance material) and a time consuming communication with each producer.

Way forward:

- a) Increase the productivity by more producers
  - > Training for new producers at MVTC
- b) Increasing the output by using mechanical tools
  - > Introducing tools and organizing a tools training at MVTC
- c) Building up the stock at EnDev office
  - > Organizing a production workshop at MVTC with provided material
  - > 250 additional stoves to the stock

### **2.2.3. No market - no production**

EnDev stated that there was no initiative of actively producing the RFP. This was mainly caused, because there is still no effective market and customers' demand. EnDev's artificial offer to purchase all produced stoves for the stock, was not attractive for the producers, because of complicated and late payments by EnDev. The producers described their mentality with the proverb "A fast nickel beats a slow dime" meaning that they will always go for what brings a fast refund, even though it is a smaller margin, because they do not have any savings.

Way forward:

- a) It is the main task of EnDev to create a market with and for the producers
  - > The marketing assistant Boakai Sheriff was hired to build up a strong retailer network (not successful until now)
  - > Explaining the marketing approach to producers to increase confidence in the product and its market potential
- b) Making the product more attractive for customers by lowering the price
  - > All producers agreed to the fixed price (see 1.2.)
- c) EnDev needs to improve its payment process to harmonize it with the small workshops

### 2.3. Scaling up of production

In general, the up-scaling from an inefficient artisanal towards a semi-industrial production can be achieved by increasing the usage of appropriated tools and machines and/or by dividing the production steps between different workers. Increasing one of the two options will create a more efficient artisanal production (Fig. 15).

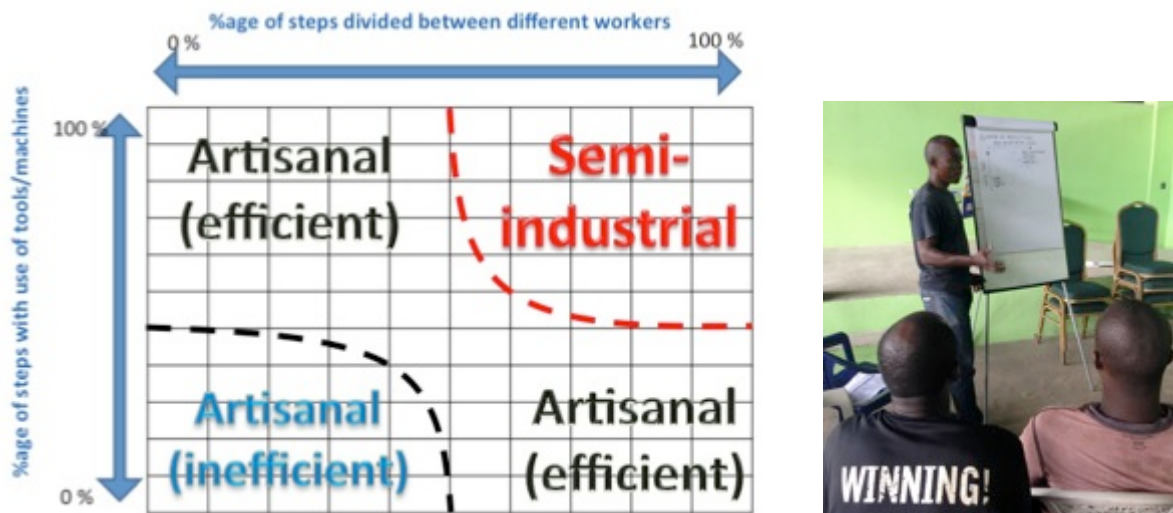


Fig. 15: Mode of production, Christoph Messinger, presentation 03/2014

Fig. 16: Daniel Partee discusses the two strategies of scaling up at MVTC

Therefore, two initial sets of mechanical tools (Fig. 18) were introduced to the project. The selection of tools was based on the experience for the production of the Taruu stove, corresponding the RFP in Senegal. The tools were ordered in Germany and carried to Liberia.

The tools were installed at MVTC and introduced to each group of producers during a one-day course. The training included the discussion about the possibilities of scaling up as well as the instruction of proper usage and maintenance of the tools. All steps of production were written down together with the producers. We discussed, which tooling is helpful and how the steps can be divided between different workers (Fig. 17). Some of the producers, e.g. Mamadou Kamara, already divide the working steps among their workers.

Once the association is established, EnDev hands over one set of tools per group. The tools will be installed at the workshop of the leader of the group. He assures the safe storing and free access to his group members during working hours.

#	Production step	Regular tool	Improved tool	Worker
1	Marking the templates on the metal sheet	Templates + scribe		A
2	Cutting all pieces	Chisel + hammer	Cutting machine and/or scissor	B
3	Punching holes of seat and inner cylinder	Puncher/ washer + hammer	Punching machine	C
4	Preparing grooved joints, folding edges at various pieces	Hammer + anvil	(Folding machine)	D
5	Rounding cylinders and skirt	Hammer or wooden stick	Rounding machine (difficult because of door elements)	E
6	Moulding base and edges of top part	Hammer + round anvil	Press	F
7	Preparing small pieces: - Door - Handles - Seat holders - Pot holders	Hammer + anvil		C
8	Assembling all pieces	Hammer		G

Fig. 17: Required steps of production

Tool		Company Art.- Nr. / Product name	Delivered quantity
Punching machine		Hundt GmbH 298101 / Hebellochstanze 21/8	2
+ required matrices		Hundt GmbH Matrize 10,2mm für Hebellochstanze	3
+ required washer		Hundt GmbH Stempel 10.0mm für Hebellochstanze	3
Cutting machine		Stabilo Fachmarkt GmbH 24396 / Blehschere / Handhebelschere für Bleche EAN: 4031765243964 Modell: 24396	2

Small cutting machine		Stabilo Fachmarkt GmbH Rollenblechscherer / Blechscherer RBS16 EAN: 4031765206228 Modell: 20622	2
Rolling machine		Spichala 110019 / Rundbiegemaschine Walzbohrer / WB 635	2
Folding machine		Stabilo Fachmarkt GmbH 18519 / 2in1 Bördelmaschine & Sickenmaschine EAN: 4031765185196 Modell: 1851	1
Press + moulds		Press produce and designed by Fyrkuna Metalworks, Brewerville	

Fig. 18: Table of introduced tools

### Conclusion

The punching, the cutting machine and the press are most helpful and are highly praised to speed up the production.

The rolling machine is also recommended and gives perfectly rounded cylinders. It is, however, difficult to roll the cylinders because of the folded door parts, which need to be prepared before rolling. The door area will need to be redesigned in order to make proper use of the rolling machine.

The small cutting machine and the folding machine were almost of no use for the producers. Even though, the products were appropriate for the required material thickness, the tools were not properly functioning for its intended use.

## **2.4. Training activities**

During the mission, I supported the following training activities: a six-days training for new producers, three one-day tool trainings and a three-weeks production workshop. MVTC provided its facilities and even aims to include the production of the RFP in its curriculum for the next year.

### **2.4.1. Producer training**

Daniel Partee and his co-trainer Amara Sumawolo self-reliantly trained 13 metal workers (2 female, 11 male), among them 4 graduates from MVTC (Fig. 19).

Each participant received a set of templates, a compass and a punch with a diameter of 10mm and its counterpunch as well as the updated training manual. The manual provides all necessary information about the production and explains the manufacturing process step by step.

As an additional positive output of training, MVTC offered the two female producers scholarships for its institution.

<b>Name, contact, nearest market</b>		<b>Description, Produced products, Skills</b>
<b>Amos Jiply</b> # 0888456324 Place: Duala/ col.west Market: Duala market		<ul style="list-style-type: none"> <li>- good Skills (3)</li> <li>- employee at Tony Doe workshop</li> </ul>
<b>Tony Doe Williams</b> # 0886595445 Place: Duala /col.west Market: Duala market		<ul style="list-style-type: none"> <li>- good skills (3)</li> <li>- boss of workshop, worker Amos working with him</li> </ul>
<b>Forkpah Kollie</b> # 0880769662 Place: Red Light Market: Red Light market		<ul style="list-style-type: none"> <li>- MVTC graduate</li> <li>- more into welding</li> <li>- medium skills (2)</li> <li>- has own workshop, 4 boys working with him</li> </ul>

<p><b>Stephen Kwiete</b></p> <p># 0886805511 # 0775276838 Place: Bardnersville Market: Dry rice market</p>		<ul style="list-style-type: none"> <li>- MVTC graduate</li> <li>- more into welding</li> <li>- medium skills (2)</li> </ul>
<p><b>Yurkuba Evans</b></p> <p># 0880 68 14 58 Place: Congo Town, next to EnDev office Market: Joe Bar Market, ELWA market</p>		<ul style="list-style-type: none"> <li>- good skills (3)</li> <li>- boss of the workshop, 1-2 person working with him</li> <li>- oven, coal pots</li> </ul>
<p><b>Karamoh Konneh</b></p> <p>Tel: 0880959172 Place: New Georgia Market: New Georgia market</p>		<ul style="list-style-type: none"> <li>- good skills (3)</li> <li>- boss of the workshop, 5 person working with him</li> <li>-</li> </ul>
<p><b>Matthew N. Gonotee</b></p> <p>Tel: 0886341841 0776402497 Place: Freeport Market: New Georgia market</p>		<ul style="list-style-type: none"> <li>- MVTC graduate</li> <li>- good skills (2)</li> <li>- serious on training</li> <li>- boss of workshop with 6 persons</li> <li>- welding</li> </ul>
<p><b>Abdullie Freeman</b></p> <p>Tel: 0770854412 Place: New Georgia Market: New Georgia market</p>		<ul style="list-style-type: none"> <li>- MVTC graduate</li> <li>- medium skills (2)</li> <li>- workshop with 4 persons</li> <li>- welding</li> </ul>






<p><b>Grace E.K. Howe</b></p> <p>Tel: 0770 46 09 03 Place: Benson Hospital junction Market: Red Light</p>		<ul style="list-style-type: none"> <li>- medium skills (2)</li> <li>- working in workshop with 11 persons</li> <li>- iron door, oven, coal pot</li> </ul>
<p><b>Jacqueline Gorfah</b></p> <p>Tel:0776 20 88 37 0886 24 84 47 Place: Watch tower junction Market: Red Light/ ELWA</p>		<ul style="list-style-type: none"> <li>- medium skill (2)</li> <li>- working in workshop, 11 persons</li> <li>- welding steel door, window, coalpot</li> </ul>
<p><b>Elijah P. Nupolu</b></p> <p>Tel: 0886614117 Place: peace island Jacob town Market: Red Light market</p>		<ul style="list-style-type: none"> <li>- MVTC graduate</li> <li>- medium skill (2)</li> <li>- welding</li> </ul>
<p><b>Varmoyah Siryon</b></p> <p>Tel: 0777489086 Place: Duala Market: Duala market</p>		<ul style="list-style-type: none"> <li>- good skills (2)</li> <li>- older brother is the boss of the workshop</li> <li>- round coalpot production</li> </ul>
<p><b>Daniel T. Howe</b></p> <p>Tel: 0886 89 02 20 Place: Duport Road Junction Market: Red Light / ELWA</p>		<ul style="list-style-type: none"> <li>- medium skills (2)</li> <li>- welding workshop, steel door, window, coal pot</li> <li>- boss of workshop with 4 persons working with him</li> </ul>

Fig. 19: List of new producers in October 2015

### 2.4.2. Tools training

As describe at 2.3.), the tools training introduced simple mechanical tools to improve the efficiency and quality of production.

### 2.4.3. Production workshop

The general craftsmanship in Liberia is rather low and metal products are often of a rough quality. The experience from the training in 2014 showed, that a one-week course might not be sufficient to encourage continuous production, due to the longer and demanding production compared to the traditional coal pot.

Therefore, the production workshop aimed to increase the capacity of the producers and their abilities in using the newly introduced tools. EnDev Liberia provided the required materials and daily allowances.

We decided to produce “extra strong” stoves with a 1.5mm skirt top to prolong the lifespan of this batch. The extra costs are approx. 0.45 US\$ per stove.

The total output of the production workshop was 500 stoves. 250 stoves were delivered to EnDev’s stock as return for the provided materials and 250 stoves were intended for direct sale of the producers. Unfortunately, there was no equivalent market demand created until this date.

		<b>1mm: Stove parts</b>	<b>1.5mm: Inner cylinder + seat</b>	<b>1.5mm: Skirt top</b>
<b>Small</b>	Normal	6 / 16.6	20 / 5	-
	Extra strong	8 / 12.5	20 / 5	19 / 5
<b>Medium</b>	Normal	5 / 20	16 / 6.25	-
	Extra strong	7 / 14.3	16 / 6.25	15 / 6.6

Fig. 20: Numbers of stoves per metal sheets / number of metal sheets per 100 stoves

### **3. Institutional stoves**

EnDev Liberia targets to facilitate 30 institutions and 50 small enterprises with improved cook stoves. Before the mission, seven prototypes of charcoal and wood stoves were provided for testing at restaurants, schools and an orphanage home to collect user feedback. Besides this, the stoves were checked for their efficiency according to the EnDev criteria. The tests were started at the backyard of the office in October 2015.

Smaller businesses and restaurants in the city use charcoal for preparing the food, while school canteens and other larger institutions use wood. Thus, the two settings are considered separately.

#### **3.1. Institutional wood stoves**

The three-stone fire is predominantly used stove in Liberian institutions. Therefore, EnDev provided the “Orka” stove from Prakti and the “Kala” stove, which I originally designed for Indian institutional kitchens, to two schools and one orphanage home. Both stoves can hold the local aluminium casted pots.

The “EFI 1001” from Envirofit was not distributed for testing, but later included in the Regional Water Boiling Tests (RWBT).

The five prototypes of Rocket stove, which I commissioned to Fyrkuna Metalworks in July 2014, were never delivered and therefore not tested.



Fig. 21: Three-stone fire (baseline), Prakti’s “Orka”, “Kala” stove, Envirofit “EFI 1001” (from left to right)

EnDev Liberia is still discussing a larger school programme with Mary’s Meal (MM), a Scottish School Feeding programme. MM stated an urgent need for improved cook stoves since several schools in the programme are struggling with wood fuel shortages.

### 3.1.1. User feedback

During a trip to Tubmansburg, I was able to gather feedback on the “Kala” and the “Prakti” stove at Pavola School. The stoves were tested since a few weeks and therefore were in good conditions. The cooks always use both stoves at the same time. They appreciate both models, for their reduced smoke, less exterior heat and the comfortable cooking height. They personally preferred the Kala stove, because it is faster and the pot is more stable than on the Prakti stove. Following the experience of the cook, both stoves are economical and save fuel.

The Prakti stove, designed to suit large flat-bottomed Indian pots, left a wide space between skirt and local pot, which lowers its overall efficiency a lot.



Fig. 22: Kala and Prakti stove at Pavola School in Tubmansburg

Fig. 23: Initially the cook overloaded the combustion chamber, but learnt how to fill it properly

Location	Distributed stove and feedback
Pavola school, attached to MM headquarter	1x Prakti, 1x Kala: see above
MM school at the entry of Tubmansburg	1x Kala: Cooks appreciate the stove because of the fast cooking, comfortable cooking height, little exterior heat and reduced fuel consumption
D.E. Davis Orphanage home	Prakti: Cook gave very positive feedback for the monitoring report, but did not actually use it as we observed during our visit. The stove is not appropriated for its use, because food is prepared for 25-30 children only. > I agreed with Diane Davis that the Prakti stove will be provided to the canteen at school, where food for 300 students is prepared. > In return I provided a prototype of the XL RFP for testing

Fig. 24: Feedback on institutional wood stoves

Additionally, I observed an institutional brick stove with chimney at the prison of Tubmansburg, which was provided by the International Committee Red Cross. The stove has two combustion chambers. The outlets are only appropriated for big pots. This is why the cooks also used three stone fires for smaller pots at the same time, causing a lot of smoke.

A local bricklayer had properly done the brick structure. The combustion seemed poor, because of a insufficient air draft, no preheated air underneath the fuel and a missing insulation of the combustion chamber. Nevertheless, the bricklayer is an interesting contact for building the fix structure around the Jumbozama (3.3.)



Fig. 25: Brick stove at prison of Tubmansburg

**3.1.2. RWBT**

The baseline stove for the institutional stoves is the three-stone-fire used with purchased firewood. The pots have a diameter of 66cm (approx. 12.500g) and are filled with 40.000g of water. The specific consumption is calculated as followed, the leftover charcoal is not subtracted.

*(Wood start in g- Wood left over in g) / water start in kg*

The calculation shows that only the Envirofit fulfils the EnDev criterion by a specific fuel reduction of 50%. The locally produced Kala stove with a reduction of 28%, (but a time reduction by 58%) and the imported Prakti stove with 25% "failed" the test. The testing sheets are attached to this email.

RWBT Liberia V - October 2015 - BASED ON 40LITER!!!			
	% reduction av KALA	% reduction av ENVIRO	% reduction av PRAKTI
Date			
total consumption	28	50	25
specific consumption	28	50	25
time to boil	58	14	13

Fig. 26: Overview of RWBT results for institutional wood stoves

### 3.1.3. Conclusion

#### a) Envirofit

The stove EFI 1001 (<http://www.envirofit.org/products/?sub=cookstoves&pid=11>) showed the best performance in terms of specific fuel consumption (50%). This performance is most probably linked to the adapted and integrated pot used for the stove system. The time to boil is rather slow (14%), compared to what the manufacturer promises: *Fuel Reduction up to: 80% and Cooking Time Reduction up to: 50%* There was a lot of smoke in the beginning. Later there was hardly any smoke to the cook, because of the integrated chimney and very little exterior heat. It is rather difficult to light the fire, because of the small and narrow entry to the combustion chamber. The cost (over 1,000 US\$) is high and there is no experience of the life span for Liberia yet.

#### b) Kala stove

Regarding the test, the locally produced Kala reduces the specific consumption by 28%, but has a significant time reduction of 58%. The cooks at Mary's Meal preferred this stove, because of the fast cooking and the little exterior heat. It is rather cheap (150 US\$) and locally produced. The life span needs to be monitored.

#### c) Prakti stove "Okra"

The Prakti stove "Okra" is a portable Rocket stove by the Indian manufacturer Prakti. The two performed tests are quite irregular and should be repeated.

The tests showed a 25% fuel reduction and 13% time reduction. The poor result is probably caused, because pot and stove are not fitting to each other. The stove is designed to fit flat-bottomed pots. The local pot leaves a wide gap between the skirt and the pot, which does not force the hot gases to flue around the pot surface, but rather vanish. The effect of the skirt does almost not exist. Using the same stove with an adapted pot would most likely give a much better result. The smaller Okra for 80Liter capacity fits better to the local pots.

The manufacturer promises: *"Reducing fuel up consumption by up to 80% and cooking time by up to 70%, the Prakti Orka is an ideal institutional stove for school feeding programs, humanitarian interventions, hospitals, prisons, and other institutional feeding arrangements."*

The investment cost (around 1,000 US\$) is very high compared to the performance.

#### d) Jumbozama

Jumbozama is a newly designed stove for institutional use. It combines a technologically advanced efficient combustion chamber with a locally build brick/mud and metal structure. This avoids theft and problems associated with transport, while incorporating the latest technology. The bricks and mortar body will also reduce the exterior heat.

Christa Roth/ Germany and Rocket Works/ South Africa recently developed this stove and introduced it to Daniel Partee, Hartlieb Euler and Stephen Mulbah at the stove workshop in Ghana in November 2015. Daniel Partee and Thomas Scott are in charge to

build the first prototype at the office compound following the construction manual by Christa Roth. Later, Youngor Flomo is responsible to do the RWBT.



Fig. 27: Combustion chamber by Rocket Works (left), outer brick structure and metal pot rests (right), Christa Roth, 10/15

**3.2. Institutional charcoal stoves**

The tested institutional charcoal stove is the XL Red Fire Pot. It is appropriated for small restaurants serving up to 50 persons and suits pots up to a 45cm diameter. The testing locations should have been selected accordingly.

**3.2.1. User feedback**

The prototypes were manufactured and provided to five locations (Fig. 28). The stove was not appropriate for all of them and therefore no useful candidates. The only value user experience was from a restaurant and a school canteen. They stated that the stove saves a lot of fuel, but needs to be refilled at least once during the cooking process. The seat and the top part were broken after one year of heavy usage. The owner of the restaurant also recommended putting a top to the stove so that it can be used as an oven or dryer.

Location	Feedback on XL RFP
Aquila Restaurant	Fast, fuel saving, stove was broken after one year of heavy use
Canteen at D.E. Davis school	Fast and fuel saving, stove is used at the canteen only for hot water and tea, while cooking is done with bigger pots on 3 three-stone fires
Canteen of Family Planning Center/ 16 <sup>th</sup> street	No valid information: Cook past away, stove is not any longer at the canteen
Canteen at Mary’s Meal Deaf school	No valid information: Stove was not used, because their pots are too big for the skirt > Stove was given to D.E. Davis orphanage home as the XL RFP is suitable for the number of fed children
Foya/Lofa	No information

Fig. 28: Feedback on institutional charcoal stove

### 3.2.2. RWBT

For the RWBT for charcoal stoves, we used the traditional four-corner coal pot as baseline stove. The batch size (=initial charcoal filled in) is 1800g of charcoal, as an average of three user tests (1504g/ 1912g/ 2002g). The prototype of the XL Red Fire Pot has a batch size of 600g and the "Econochar" stove by Envirofit a total batch size of 200g.

The pots with a diameter of 45cm are filled with 10.000g of water.

The RWBT failed for both tested stoves. It showed that the batch sizes of charcoal stoves are not sufficient to boil the required amount of water in a desired cooking time and keep the water on 100°C during the simmering phase.

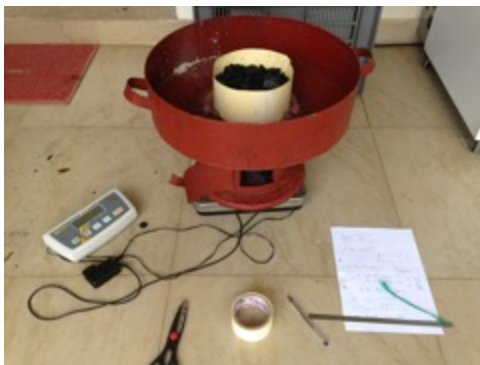


Fig. 29: Calculating the dimensions for a new prototype of the XL RFP

Fig. 30: Econochar by Envirofit

### 3.2.3. Conclusion

To increase the amount of charcoal, I changed the design of the XL RFP to hold at least 850g of charcoal. The new prototype is commissioned to Fyrkuna Metalworks according to measurements below.

The Envirofit stove is not appropriated for being used in a canteen or restaurant, but adapted for household sizes.

	<b>New measurement of XL Red Fire Pot</b>
Depth of combustion chamber	16cm
Height of inner and outer cylinder	+ 9cm (compared to small RFP)
Arrangement of secondary air holes	3 levels of holes (attached drawing)
Material	2mm: seat 1.5mm: inner cylinder, skirt, top part, pot holders
Height of skirt	17 cm
Diameter of skirt	> 47cm

Fig. 31: Dimension of new XL RFP prototype

### 3.3. Recommendations

A final recommendation can be done after the construction and testing of the Jumbozama stove, the repeated tests for the Prakti, Kala and Envirofit stove and the new prototype of the XL RFP

## 4. Next steps

### 4.1. Agreements

Fyrkuna Metalworks is commissioned to produce one more prototype of the XL Red Fire Pot. Youngor Flomo will conduct the RWBT. If the stove shows positive results and fulfils the EnDev criteria, EnDev should start its dissemination.

We agreed with the stove team that Amara Sumawolo does the next recruiting of producers. The TOR are prepared and attached.

Moreover, I designed the layout for the outside wall of EnDev compound to communicate the activities of the programme with icons. I discussed the process with the artist and prepared the TOR.

### 4.2. Possible programme for next mission

The programme for a next mission might include:

#### 1) Institutional stoves

- Selection of locally produced and imported institutional stoves
- Train manufacture in the production of institutional stoves
- Architectural recommendations for better ventilated kitchens

#### 2) Scale up production

- Research on production process at RFP workshops
- Analysing the scaling up potential of workshop organisation and its tooling
- Training of producers

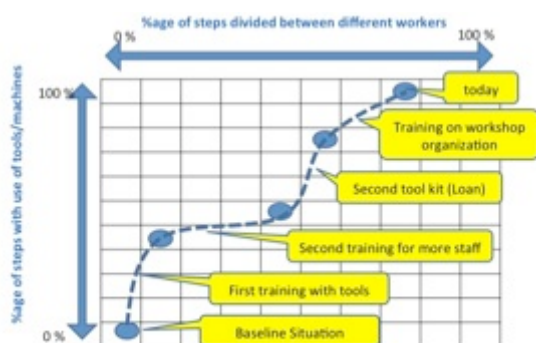


Fig. 31: Mapping the change of the mode of production, presentation by Christoph Messinger, 03/14

### 3) Follow-up of RFP

- Introducing RFP version 2.0, if the long-term experience in Senegal is positive:  
Including improved seat holder and mobile combustion chamber

### 4) “Innovation Liberia” conference (similar to “Solar Liberia”)

- Theoretical and hands-on workshops on design-thinking and strategic user research in developing markets in cooperation with Julien McHardy
- Workshop about product development in the field of improved cook stoves for Liberia for e.g. engineers, sociologists and craftsmen

I would be glad to discuss any other request.

## **APPENDIX**

### **1.) Contacts**

<b>Organisation</b>	<b>Name</b>	<b>Position</b>	<b>Contact</b>
Ministry of Gender	Hon. Julia M. Ducan- Cassell	Minister	# 0777 720 577 # 0886 492 817 Julia.cassell@mogd.gov.lr
	Sieane Abdul-Baki	Deputy Minister of Gender	0886 566 655 sieaneb@yahoo.com
	Steven Jaken	Women Empowerment Division	# 0886 702 263 # 0772 655 79?
	Sylvia B. Paye	Secretary of Minister	# 0886 837 513
Vocational Centers Liberia	Aubrian Smith-Forbes	Director General of TVET/MYS	# 0886 362029 ausmith1969@yahoo.om
Mary's Meal Liberia	James K. Ndebeh	Field manager Bomi County	# 0775 801129 kpehe2010@yahoo.com
Ministry of Youth and Sports			
Monrovia Vocational Training Center (MVTC)	Wilfred S.K. Payne	Director	# 886 623 952 # 0770 623 952 wilpayne@yahoo.com
	D. Payedoe	Deputy minister for administration	# 0886 433514
	Olive Karr	Canteen manager	# 0886 556 853
	Jo Wohwah	Senior instructor of welding & fabrication	# 0777 019 575 # 0880 698 150
	Juwle Warkie	Junior instructor of welding & fabrication	# 0770 177 253
Potential next RFP trainer at MVTC	James B. Toe Sr. („bright fellow“)	Student at MVTC and former trainer of workshop in Vai town	# 0886 409 921
SKY TV	Alaric Crump	Producer	# 0886 454 845 # 0776 640 586 alariccrump@gmail.com
Ministry of Education	Sangay M. F. Faeflen		# 0886 525 632

	Felicia Sackey Doe-Sumah	Assistant Minister Bureau of Basic & Secondary Education	# 0886 554 670 # 0777 554 670 fdoesumah@moe.gov.lr
UNIDO Liberia	Stavros Papastavrou	Country director	S.Papastavrou@unido.org
European Union	Stefano Ellero	Head of Section Operations	# 777 860481
RWBT assistants	Ruth		# 0880 665617
	Jacqueline		# 0886 229747
Former ECO stove project	Franklin King	Responsible for project	# 0555 611750
Harbel Supermarket	Sam	Rice importer with wide distribution network in Liberia	# 0886 661661
Monitoring GIZ/Lofa	Alfred Dahn		
Marketing EnDev	Boakai Sheriff	Marketing	
	Varlee Kamara	Assistant	# 0886 229 269 # 0777 055 860
Interviewed marketing candidates	George Collin	Worked for EnDev before, Libbuys.com director	# 0886 309 249 # 0776 573 394 gcollins@libbuys.com
	Michale Collingwood	Worked for EnDev before	
	John Zorleh	Regional coordinator for NGO for marketing at health sector	# 0770 372 755 # 0886 823 420
	William Torbert	Experiences in various marketing activities in Liberia, graduated in US	# 0770131692 wtolbertiv84@gmail.com
	Boakai Sheriff	Entrepreneur, experience with NGO work	
Weld Liberia Inc.	Jimmy Cooper	Boss at welding workshop at SKD Blvd	# 0775 543198 # 0777 339470 # 0880 415095 weldliberia3@gmail.com

## **2.) Attachments**

### 2.1.) Marketing

- Flyer
- T-shirt print
- Label
- Supermarket poster
- Design showcase
- Price list
- Price comparison

### 2.2.) Stove team organisation

- Task list

### - Capacity works

- TOR Amara Sumawolo
- Design for outside wall + TOR artist

### 2.3.) Monitoring

- Quality control
- Questionnaire monitoring
- Comments on monitoring questionnaire by Tim Rabe

### 2.4.) Production

- Tools delivery note
- Fact sheet MVTC
- List of all trained producers since 2013
- Bylaws ARFPP

### 2.5.) RWBT

- RWBT sheet

### 2.6.) Institutional stoves

- Manual Jumbozama
- Kitchen ventilation by Christa Roth
- Prakti info about Orka stove

## **3.) Credits**

Unless otherwise stated all tables and images are created by the author.

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