
Socio-Economic impacts of the deployment of improved Fuel Efficient Stoves: the ILF Uganda Commercialization Program

Conséquences socio-économiques du déploiement de cuisinières à haute efficacité énergétique : Programme de commercialisation de l'ILF en Ouganda
Repercusiones socioeconómicas de la utilización de estufas de bajo consumo de combustible mejoradas: el Programa de Comercialización para Uganda del ILF

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Socio-Economic impacts of the deployment of improved Fuel Efficient Stoves: the ILF Uganda Commercialization Program

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Abstract. Biomass accounts for 91% of the total energy used in Uganda, but is often used unsustainably: if deforestation continues at the present rate, it could lead to the destruction of all Ugandan forests by 2050. As a consequence, wood and charcoal are becoming scarce and their price is increasing. Fuel Efficient Stoves are a way to tackle these issues by decreasing the amount of biomass used for cooking.

International Lifeline Fund (ILF) has launched in 2008 the cookstove Uganda Commercialization Program in the region of Lira. The program consists in the local production of improved Fuel Efficient Stoves and their selling to households by local vendors.

The socio-economic impacts of this program, both on end users and on the local economy, have been studied during a field mission conducted by ENEA Consulting in 2012.

The ILF Fuel Efficient Stoves reduce the domestic consumption of charcoal and energetic expenditures. Interviews of end users confirmed that they feel safer with ILF Fuel Efficient Stoves than with previous devices. They also perceive a reduction of health problems linked to domestic air pollution and an increase in women's free time. Users also report a positive impact on domestic life as the use of the cookstove reduces the quarrels between husbands and wives by keeping meals warm and ready. Finally, the main local economic benefit along the value chain of the project appears to be the direct creation of several long-term full-time jobs.

Possible improvements of the business model will be suggested, in particular to ensure its long-term economic viability.

Keywords. Cookstoves, Fuel Efficient Stoves, FES; Biomass, Charcoal, Social impacts, Economic impacts, Uganda

1. Background and introduction

Biomass accounts for 91% of the total energy used in Uganda [1]. However, it is used unsustainably and the rate of deforestation is very high: Uganda has lost nearly a third of its forest in the last two decades and could lose all of its forest cover by 2050 if deforestation continues at the present rate [2]. As a consequence, wood and charcoal are becoming increasingly scarce and more expensive. Fuel Efficient Stoves (FES, also called "improved cookstoves") can contribute to mitigating these issues by

decreasing the biomass needed for cooking purposes, and thus the pressure on the resource¹. The main challenges for the organizations trying to introduce quality FES are the accessibility and affordability for the end consumers and the marketing of these products, as there is a wide range of cookstoves (most of which are very inefficient) already available in the

¹ It should be noted that wood and charcoal demands for energetic purposes are not the only cause of deforestation. The growth of population increases the pressure on the forests in other ways, for example by an increased demand for land settlement or conversion of forest lands to agriculture.

market.

International Lifeline Fund (ILF) is a Non-Profit Organization based in the United States. Its mission is to reduce human suffering through interventions that generate the greatest possible impact at the lowest possible cost. ILF has launched projects in Tanzania, Uganda, Haiti, Kenya, and Darfur.

In Uganda, ILF is conducting a Water Program and a Stove Program. The Water Program consists in boreholes drilling and sanitation and hygiene promotion activities. The Stove Program is composed of three sub-programs: the Institutional Stove Program focusing on fuel-efficient stoves for large buildings (schools, health centers, orphanages...), the Rural Fuel Efficient Stove Program focusing on fuel-efficient stoves using firewood for households, mainly in rural areas, and the Commercialization Stove Program focusing on fuel-efficient stoves using charcoal for households, mainly in urban areas.



Figure 1. Okelo Kuc Stove (ILF)

The Commercialization Stove Program started in the region of Lira (located in the northern Uganda) in 2008. It consists in the local production, distribution and commercialization of FES, named “Okelo Kuc Stoves”, available in several sizes. Okelo Kuc, which means « Peace Maker », is the name given by the local communities because they feel that this stove cooks the food without too much smoke and the families are healthier and happier. The stoves are designed with a ceramic insulative charcoal combustion chamber which uses rice husks as insulation, which ensures a better efficiency of the stove. The ceramic combustion chamber is cooked in a woodless kiln. A woodless kiln, unlike regular kilns, does not use any firewood in firing the ceramics, and uses biomass residues instead. ILF operates the only woodless kiln in Uganda which by itself saves tons of trees being cut.

The most popular are the Small and Medium stoves, the diameters of which are respectively 11 inches (27.94 cm) and 12 inches (30.48 cm). Overall, 22 752 FES were produced and distributed in the region of Lira between 2008 and 2012.

A similar program was launched in 2012 in Kampala (the capital city, in central Uganda), with the settlement of a cookstove factory. By the end of 2012, the production had started and the commercialization was just beginning.

The goal of this article is to share experience about the potential socio-economic impacts of FES projects and their field

evaluation, from the mission conducted in December 2012 by ENEA Consulting. This evaluation focused on the Commercialization Stove Program in the Lira area, and was built to get a holistic vision of the local socio-economic impacts of the program, and discuss the limitations of the indicators used.

2. Methods

The method and indicators used to evaluate the program were developed by ENEA Consulting. A holistic approach was used to identify potential positive and negative impacts in several social and economic impact categories. The assessment thus covers a wide range of issues: Education and knowledge, Health, Safety and security, Domestic comfort, Social cohesion, Household budget, Local value creation, Direct and indirect economic impacts. In each of these categories, several indicators were developed. The indicators were chosen to reduce the time needed to collect data: when a quantitative indicator could not easily be built or used, for lack of available data or collection time constraints, we chose to build simple scales rather than indicators requiring long observations.

A socio-economic impact evaluation is composed of several steps. The first step is the identification of the context, the needs of the organization in terms of evaluation, and the value chain stakeholders. The second step is the selection of appropriate indicators. It is followed by the creation of a questionnaire and interviews in the field. The last step is the analysis of results, and the production of a report.

ENEA Consulting has developed a list of indicators focusing on the evaluation of outputs, outcomes and impacts of cookstove-related projects, rather than monitoring only inputs and activities. Outputs are defined as the results of the activity, outcomes as changes in the lives of the target population, and impacts as goal-level changes in the lives of the target population and even future generations [3]. The indicators selected to evaluate this project are those evaluated and analyzed in section 3, and cover the impacts on end-users (reduction of charcoal consumption and impact on household budget, impact on safety, impact on health, impact on time, impact on domestic life) and the impacts on the local economy.

Some of the indicators are based on facts, and other focus on the perception of the person interviewed. Indicators based on the perception of users include concrete elements to differentiate various “levels of change”. In the questionnaire, questions are formulated to avoid biases such as guided questions, memory distortions and ambiguities as much as possible. The 8-day evaluation in the field consisted in two parts: value chain reconstruction (see Figure 2), and interviews of end-customers and value chain stakeholders (as identified in red in Figure 2). The following value chain stakeholders were identified: the suppliers, the workers of ILF factory, ILF staff, ILF FES vendors, and the end-users. Sixteen users, five vendors and three employees of ILF were interviewed. All of the vendors and employees interviewed also use ILF FES at home. Most of the interviewees were women (23 out of 24): they are the ones in charge of cooking at home, and they

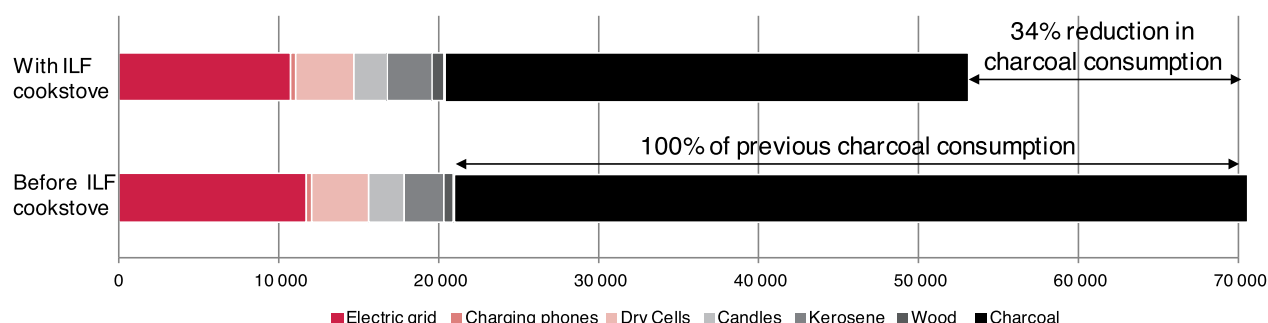


Figure 3. Distribution of average monthly energy expenditures (in UGX) of households interviewed in the region of Lira (ENEA Consulting)

spend more time at home than their husbands, who are working outside of their house.

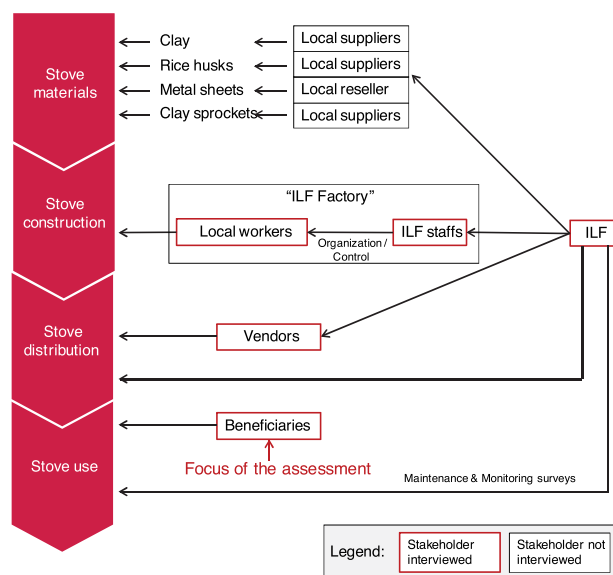


Figure 2. ILF Commercialization Stove Project in Lira: value chain and stakeholders interviewed (ENEA Consulting)

The evaluation was thus conducted on a small sample of persons interviewed, but the indicators built could also be used on a larger sample. The small size of the sample means that the results cannot be interpreted statistically. However, the evaluation process enables to raise questions, provide an external feedback on the project and identify trends based on quantitative and qualitative information gained. Although non-statistically significant, gaining these insights is the first step in the decision-making process leading to improving socio-economic conditions.

3. Results and discussion

3.1 Impacts on end-users

3.1.1 Reduction of charcoal consumption and impact on household budget

The ILF FES are more expensive than other types of regular (i.e. not fuel efficient) stoves available on the local markets,

but more efficient, durable and appealing to users than traditional stoves. A regular clay stove costs between 2,500 Ugandan shillings (UGX) (\$0.94) and 5,000 UGX (\$1.9), and a regular metallic stove between 5,000 UGX (\$1.9) and 15,000 UGX (\$5.7) (prices are calculated at the exchange rate in February 2013: 10,000 UGX = \$3.77)².

The Small ILF FES (11 inches in diameter) are sold for 18,500 UGX (\$7.0) and the Medium ones (12 inches in diameter) for 22,000 UGX (\$8.3). The retail prices go up to 50,000 UGX (\$18.9) for the XXL stove (27 inches in diameter). These retail prices are only a fraction of the full cost (including operational cost and salaries), which is for example around 37,000 UGX for a Small stove.

However, this price difference compared to other locally available stoves should be compensated by savings on the consumption of charcoal: ILF FES are more efficient than “ordinary charcoal stoves” made of clay or metal. The charcoal savings also have a positive impact on the environment by reducing the pressure on the resource.

During the field survey, end-users were asked how often and how much they use of each type of fuel, as well as its cost, which enabled to evaluate the average monthly energy expenditures both before and after ILF stove. Before having and ILF stove, end-users interviewed used basic mud or metallic regular charcoal stoves. As shown in Figure 3, the overall expenses have decreased when using the ILF fuel efficient stove, mainly through the reduction of the share of charcoal expenses (and consumption). On average, the expenses on charcoal (black bar in Figure 3) decreased by 34% (from about 49,600 UGX (\$18.6) to 32,800 UGX (\$12.3), which corresponds to an average 16,800 UGX (\$6.3) saved per household per month, which is just slightly lower than the retail price of a Small or Medium ILF Fuel Efficient Stove. There are important differences between households: some users say that their consumption of charcoal has decreased by 67%, whereas others have not noticed any change.

Based on the price of the stove bought and the average monthly saving per household interviewed, the average payback time of the ILF Fuel Efficient Stove is of about 1.5 month. For 70% of the sample, the payback time varies from 0.3 to 6.2 months.

30% of the people interviewed declared that their charcoal consumption has not changed. The notion of payback time is

² Since 2013, the price of regular clay stoves have increased from 2,500 UGX to 3,000 UGX.

not applicable for these households. There can be several reasons to an unchanged charcoal consumption: they may not have noticed a decrease in their consumption of charcoal because they cook more than before with the new stove (rebound effect), or because they do not use it properly (with open doors for example) and the cookstove loses some of its efficiency. However, they are still satisfied with their ILF Fuel Efficient Stove due to the other positive impacts mentioned below.

Overall, the average payback time is very short for an energetic product and the commercialization of the ILF FES at full cost should be possible for most of the clients. Achieving the sustainability of the ILF Commercialization Stove Program is key: the stoves are currently sold below their total cost of production. Thinking over a pricing strategy could reduce the project's dependency to external funds or to potential carbon credits revenues and improve overall sustainability. Some suggestions about this pricing strategy will be made in the discussion of the business model.

3.1.2 Impact on safety

The use of charcoal cookstoves can lead to a variety of domestic accidents, often burns and fire accidents due to projections of charcoal and the high temperature of the stove. When designing the ILF Fuel Efficient Stove, ILF paid a close attention to the safety of the equipment. Women who participated in the preliminary discussions with ILF asked for the cookstoves to be heavy, so they do not fall easily when kids are playing around. The design also includes insulating material that prevents the stove from getting too hot, while improving the efficiency through reduced heat losses, and handholds so it can be moved easily, even when it is still warm. A lid was also added to ensure the stability of the cooking pot, and doors were added to avoid projections of charcoal during the combustion.

As shown in Figure 4, 100% of the customers interviewed feel safer using ILF FES compared to their previous equipments. This feeling is confirmed when users mention factual elements: 79% of them declare that they have experienced a significant decrease in accidents (mainly burns). The ILF FES seems to fulfill the expectations of the beneficiaries in terms of safety.

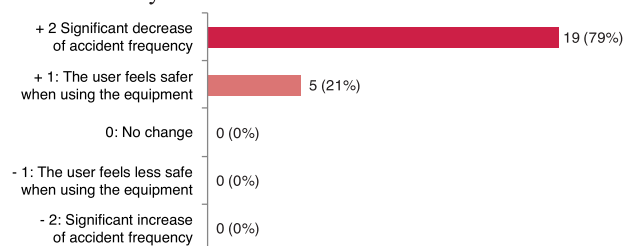


Figure 4. Impact of ILF FES on safety for people interviewed in the region of Lira (ENEA Consulting)

3.1.3 Impact on health

The main health issues for people using charcoal stoves are pollution-related diseases due to particulate matter exposure.

Several respiratory diseases can be observed, from the most benign one to serious respiratory complications such as cough, tightness in chest, asthma and tuberculosis.

Eighty-eight percent of the users interviewed feel that they are in better health since they started using ILF FES. Forty-six percent declared that they have noticed a significant decrease of acute health problems, especially due to less smoke emission. However, some users also specified that smoke emissions depend on the quality of the charcoal used. The user that feels in worst health conditions said that the ILF Fuel Efficient Stove is affecting her health because it is much heavier than her previous stove. This complaint regarding the excessive weight of the ILF Fuel Efficient Stove was often mentioned by the people interviewed, although they overall feel in better health condition.

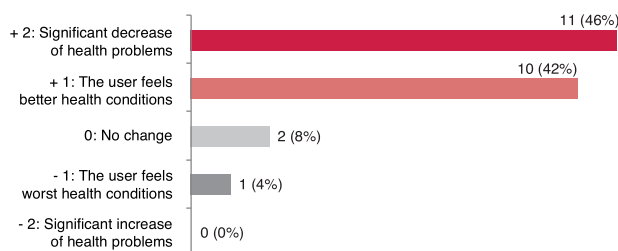


Figure 5. Impact of ILF FES on health for people interviewed in the region of Lira (ENEA Consulting)

However, the focus should be on the long term health impacts. These are difficult to measure during a punctual evaluation: it is impossible to get precise and reliable data when people are asked to talk about their past. Therefore, we have chosen a simple and easy to use indicator to avoid the problems linked with the reconstruction of a baseline.

A regular assessment of user's health would be needed to avoid potential memory distortions. Precise and quantified indicators could be based on medical exams, or on the frequency of visits to the hospital, the consumption of drugs etc. Concerning Fuel Efficient Stove projects, the most relevant indicator could be the level of particle matter exposure of users. It can be evaluated through physical measurements, such as the analysis of air exhaled by the users, or evaluated indirectly through stove emissions. An indirect exposure indicator could be built, taking into account the type and number of emitting devices used by the household (stoves, kerosene lamps and other devices using combustibles), where these devices are used (inside or outside the house – if it is inside the house, the rooms' configurations should also be considered) and the daily time of exposure of each person living in the house.

3.1.4 Impact on time

Before buying an ILF Fuel Efficient Stove, the average time for cooking for a household was 9.5 hour per day. After buying the stove, it goes down to 8.5 hours a day. Despite an increase in energy efficiency, and a reduction in charcoal consumption (as described in section 3.1.1), the ILF Fuel Efficient Stove does not necessarily reduce the time for cook-

ing of a household in the same proportions.

This result is explained by the cultural habits of the region: lots of dishes are traditionally steamed for hours, and meals have to be ready and warm when the men come home. As a consequence, women prefer to keep the stove working to have warm food at any time (this subject is developed in the section below).

By time of cooking, we meant the time the stove is on. It does not mean that women are cooking the whole time: they perform other household chores in the meantime, such as cleaning the house or showering the kids or washing clothes. ILF FES have a significant impact on this aspect: the high efficiency of the stove and the fact that it remains warm during a long time without the constant need to add charcoal allows women more available time. They use it for their other activities and highly value this flexibility.

This indicator underlines the difficulties linked with the measure of time. It is often difficult to ask people to estimate the time they spend on a particular activity every day. There are two possibilities to get an idea of what a typical day looks like: the first one is listing the activities with the person interviewed, and trying to estimate the time spent each day on each activity. The second one is to reconstitute the timetable of the person interviewed, asking him (or her) what he (or she) usually does during a certain period of time. Those methods are less time consuming, and slightly reduce memory bias but will never be as accurate as observation campaigns, which reduce the bias regarding non-daily activities.

The interpretation of this indicator also highlights the importance of gathering qualitative data in addition to quantitative data: without the information completing the quantitative data, the quantitative results on this indicator would have been impossible to analyze correctly. This qualitative information can be gathered on the field during the interviews, but also during the phase of construction of the evaluation. It is useful to design relevant indicators and evaluate changes as closely as possible. In this case, we could have refined the indicator, measuring the time used to light the cookstove, maintain it warm, and prepare the food.

3.1.5 Impact on domestic life

From a general point of view, the evaluation has revealed no particular impact of FES on social cohesion in the community: users have not noticed the creation of new social activities, nor an increase in the interactions with their neighbors due to the acquisition of the stove.

However, there is a significant impact at the scale of the household, as many women interviewed related that the number of disputes between husband and wife has decreased because the stove remains warm during a very long time, and meals can be ready very quickly at all times. This is also a marketing argument, as the name of the cookstove is “Okelo Kuc Stove”, which means “the cookstove that brings peace”, and has been chosen by the local population.

3.2 Impact on the local economy

In order to assess the impact of the ILF FES on the local

economy, the value chain of the project was reconstructed.

The main stakeholders of the ILF Commercialization Stove Program are: the local suppliers providing the clay, the rice husks and the clay sprockets to the ILF Factory; the employees of the ILF Factory where the stoves are built; the local vendors who are selling the FES in their already existing shops. The local vendors are in direct contact with the end-customers, who are mainly households.

ILF is involved in all the steps of the value chain: the organization selects and contracts with the local suppliers, manages the production of the FES and their distribution to local vendors. ILF also helps vendors with marketing activities, takes care of the maintenance of the FES and monitors their use by end customers.

The main impact of the FES on the local economy, beyond fuel savings by households and revenue available for other expenses, is the creation and reinforcement of jobs. Cookstoves are mostly used to cook for families. There is no increase of revenues for the users, as there is no business creation due to the acquisition of the stove. The customers using the Fuel Efficient Stove for a food business (restaurant or selling food directly on the street) are saving money due to the decrease in charcoal consumption, but there is no specific increase in their sales due to the new stove.

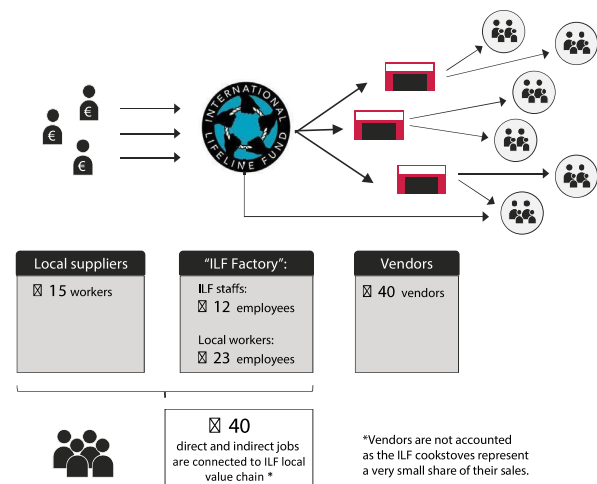


Figure 6. Jobs connected to ILF among the value chain stakeholders in the region of Lira (ENEA Consulting)

The results are presented in Figure 6 : approximately 40 jobs are connected to the ILF project on the value chain. As the ILF FES represent a very small share of their global sales, the vendors were not considered as jobs created indirectly by ILF. According to the vendor interviews, it can be roughly estimated that the average profit per stove is around 3,500 UGX (\$1.3), and that the ILF FES sales represent around 5% of a vendor’s monthly benefit. The number of stoves sold by vendors varies between 10-15 stoves to 40-60 stoves per month.

All the jobs linked with the local ILF structure in Lira are occupied by local people, with the exception of the program director, and ILF employs many women. As for the whole ILF structure in Uganda, it also employs mainly local people:

the whole staff is local, with the exception of the country director and program directors. Integrating local people to the top management is still a challenge for ILF, mainly because of the difficulty to find a local person with the adequate skills.

The salaries are similar or above usual average salary for equivalent positions in the area. Besides, the work is stable, and this security is appreciated by workers who had unstable activities before. Working with ILF is also seen as a good opportunity to grow new professional skills and as a very good reference for the future.

From a general point of view, it is difficult to evaluate a precise number of jobs linked to a particular project: the suppliers may be working for other customers. It is hard to determine which share of their activity and which jobs depend on the project.

Questions may also be raised about the replicability of the model: the Commercialization Stove Program is a real success in Lira. Twenty-three out of the 24 end-users interviewed are satisfied or very satisfied with their cookstove, which has been quickly adopted by the local population who named it. ILF is currently launching a similar project in Kampala, and it remains to be seen which adaptations are needed in this region³. For instance, adaptations of the Fuel Efficient Stove will be necessary, mainly for lack of local materials, such as clay which is not available in Kampala; mica will be used instead. The urban environment also brings other challenges: cooking habits are different, the competition is higher for the sale of both traditional and improved charcoal stoves, and the distributing network is still to be built. However, since the charcoal is almost twice as expensive in Kampala compared to Lira, the average payback time should significantly be shortened.

4. Discussion about the business model

The improvement of the business model of the project could lead to a better penetration of the market, independence from external subsidies, and sustainability of the model. Improvements on the business model can be of two kinds: ensuring a better implementation of the current business model, and finding new ways to improve the model.

To ensure a better implementation of the current business model, and improve the level of satisfaction of customers, it would be necessary to raise the awareness of ILF free maintenance policy. Indeed, ILF offers a 7 year warranty on the FES, and the possibility to buy a new lid to change damaged ones, but customers are not always aware of this. The vendors are central to this potential improvement, since they received training by ILF regarding how the ILF cookstove should be used, and are in charge of explaining to the clients. Posters have also been developed by ILF in this purpose. Vendors are also in charge of informing customers of the maintenance policy. However, it seems that they do not always transmit all the necessary information to the customers. Intensifying the vendors training and giving regular updates to increase proper usage of FES would decrease the maintenance issues due

³ Update : ILF has closed the Kampala production facility and decided to centralize the production center. The production facility in Lira has been upgraded and more infrastructure added.

to bad handling and keep a high level of satisfaction by customers. Tests of other ways of communicating (mainly radio announcements) about existing warranties on potential defects on parts of the ILF stove are planned to be implemented in 2013 by ILF⁴.

To find new ways to improve the business model, the first step would be to get a clear idea of the total cost of an ILF Fuel Efficient Stove so as to build a pricing strategy. This figure has not been calculated so far. The calculation should include the production costs, and also the costs linked with the ILF structure and the maintenance. Several paths could then be tested to set a new pricing strategy.

The first possibility could be to connect the selling of the cookstove with the selling of charcoal. Customers currently buy the two products from different vendors and the link between buying an ILF Fuel Efficient Stove and saving on charcoal is not well understood among households. ILF finds it difficult to take advantage of the very short payback time. Figure 6 is an example of a marketing strategy ILF could use to convince new customers. As stated above, the Small and Medium FES are currently priced at 18,500 UGX (\$7.0) and 22,000 UGX (\$8.3), and enable an average 34% reduction in charcoal expenditures. As of December 2012, a bag of charcoal in the Region of Lira costs between 15,000 UGX (\$5.7) and 40,000 UGX (\$15.1). Considering an average price of 30,000 UGX (\$11.3) for a bag of charcoal, this means customers can either buy 2 bags of charcoal or a fuel Efficient Stove and 1.3 bag of charcoal for 60,000 UGX (\$22.6), which is slightly higher than the average charcoal expenditure for non-ILF customers, and then start saving on charcoal expenditure from the second month. With the observed price increase underway, a bag of charcoal could easily reach the 40,000 – 60,000 UGX (\$15.1 – \$22.6) range and clients could start saving even earlier.

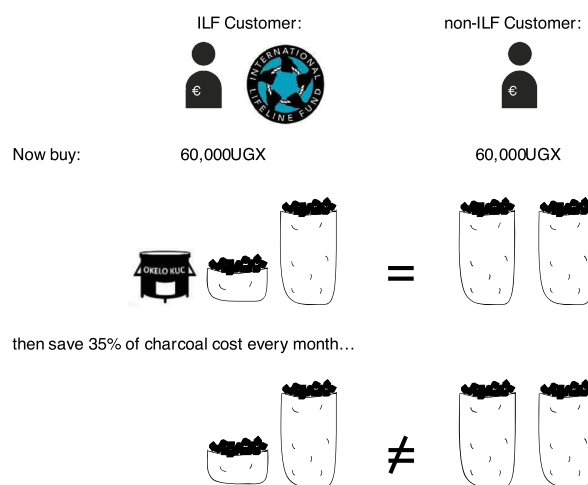


Figure 7. Proposal for the improvement of the marketing strategy (ENEA Consulting)

Since in Lira the FES are sold by local vendors and not

⁴ Since 2012, ILF has been using the local radio to discuss the benefits of the stoves, usage and maintenance on live radio shows. Since radio is the biggest communication tool in Uganda, people call the radio and ask questions about the stoves.

directly by ILF, ILF would need to discuss and find a compromise with the local vendors to sell the Fuel Efficient Stove and the charcoal together. It might be complicated if the number of local vendors increases rapidly.

The second possibility would be to look for micro-credit mechanisms or other financing solutions. Cooperation with finance institutions to try to find a way to overcome the relatively high investment cost of the ILF Fuel Efficient Stove could be a solution. As an indication, the average monthly household income is 303,700 UGX (115 US \$) in Uganda and 141,400 UGX (53 US \$) in the Northern Region where Lira is located and 959 400 UGX in Kampala (362 US \$) [4]. Although reasonably priced, the ILF FES still represent a significant fraction of income for the local population. The reimbursement of the micro-credit could be attained with the energy savings due to the efficiency of the stove. Potential carbon revenues could also be used to lower the selling price of the cookstoves, or cover maintenance and awareness actions. ILF seriously considers this option, as the overall ILF Commercialization Stove Program is part of a PoA (Program of Activities) that was registered by the Uganda Carbon Bureau in December 2012. Part of the Commercialization Stove Program will thus be supported by carbon finance mechanisms.

The third possibility would be to differentiate the price of the cookstove, depending on the revenues of the clients: households which could afford it could pay its full price, and households which cannot afford to pay full price could be subsidized, for instance through the distribution of reduction coupons to vulnerable households. This idea could work in Kampala where clients with higher revenues are also interested in this kind of product.

5. Conclusion

The ILF Commercialization Stove Program in Lira can overall be considered a success regarding the social and economic impacts on the local population. All steps in the value chain are handled locally, and mainly by local people. ILF thus has created local economic value in the form of stable jobs created, and increase in local professional skills. Users particularly value the positive impacts on health and safety, the increase in available time for the cook, and the domestic climate improvements linked to the ILF Fuel Efficient Stove. The majority of them also report savings in charcoal expenses and use. However, great disparities exist among households on charcoal use, which can be partially explained by improper use of the stove. Also, to consider the project a full success would require to evaluate its performance, in particular regarding economic viability and operational efficiency. This type of evaluation would be complementary to the evaluation of socio-economic impacts and was not in the scope of this study.

The socio-economic impacts could further be improved by strengthening the communication to the customers regarding proper Fuel Efficient Stove use and ILF maintenance policy. This would also strengthen customers' high level of satisfaction and potentially help convince new customers.

A fully sustainable business model still has to be found,

and solutions for a pricing strategy be found. Potential solutions range from raising the awareness on the link between the purchase of a Fuel Efficient Stove and future reduction in charcoal expenses, to using micro-credit mechanism to cover the initial investment cost, and subsidizing FES only for households with lower revenues. Carbon finance mechanisms will help cover part of the full price, but finding a way of building a sustainable business model is key to reaching long-term sustainability.

6. Acknowledgments

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