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Residential Cooking Stoves and Ovens

Good Practice Technology: Rocket Stove

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1 Good Practice Technology: Rocket Stoves

1.1. Technology description

Rocket stoves include an insulated L-shaped combustion chamber that allows for partial combustion of the gases and smoke in a stove, and thus achieve important emission benefits compared to open fires or crude stoves. Biomass input can be improved by up to 70 per cent and emissions reduced by up to 86 per cent at comparably low costs.

Introduction

Rocket stoves are designed in a way to make the cooking process more healthy and efficient while keeping it affordable at the same time. Rocket stoves can be used for all kitchens that rely on biomass fuels ranging from family sized cooking to cooking for big institutions. It can be build from various materials and are characterised by their L-shaped combustion chamber. This design ensures correct fuel-air mixture and minimizes heat losses. Depending on the design, rocket stoves can reduce biomass input by up to 70 per cent compared to an open three-stone fire. Rocket stoves can be centrally mass-produced stoves, local artisanal products, or anything in between.

Design and operational features

Rocket stoves usually incorporate a fuel magazine, a combustion chamber, a vertical chimney and a heat exchanger, which transfers the heat to the cooking pot. Generally spoken, rocket stoves are defined by an insulated L-shaped combustion chamber that allows for partial combustion of the gases and smoke in a stove, and thus achieve important emission benefits compared to open fires or crude stoves (see figure 1).

Materials: It is possible to build rocket stoves from many materials, ranging from clay over bricks to metal (see figure 2). While the advantage of clay and bricks is that they are freely available in many countries around the world, metal rocket stoves require more initial investments but are more durable. Initial investments depend on the used materials as well as on their availability in the respective country and range, for instance, from 1 to 32$ in Southern Africa (GTZ ProBEC).

Figure 1: Rocket stove from steel and clay

Source: Envirofit/rechorocket.com

Sizes and shapes: Rocket stoves are available in different sizes ranging from household stoves to industrial stoves which are designed for pots with a volume of 300 litres. But also on the household level designs differ. There are rocket stoves for single pots of different sizes but also designs for two pots. The so called *Rocket-Lorena stove* for instance is much larger than other rocket stoves for households, which often even are portable (see figure 3). Rocket stoves of the Lorena type are stoves which were modified in order to fit the socio-economic setting in several districts of Uganda (Komuhangi 2006). The design of Lorena types strictly asks for locally available materials as clay mixed with grass, ant-hill soil and sawdust in order to make it cheap or even without costs obtainable for poor families living in rural areas.

Figure 2: Lorena-rocket stove

Source: GTZ Uganda

Energy efficiency, environmental and health impacts

Fuel input can be reduced from 39% to 70% depending on build and type. CO Emissions can be reduced up to 86%.

Energy efficiency: The fuel consumption of rocket stoves as well as the other parameters differ from the design type. It is claimed by the GTZ that the use of rocket stoves as they are used in Uganda, Malawi, Ethopia and Kenya saves up to 60% of biomass. The Rocket-Lorena stove reduces wood input by up

70% and allows families in Uganda to save 3,1 kg of wood per day (GTZ 2007; Komuhangi 2006). Other types of rocket stoves, which are being used in India, reduce fuel input by up to 47% depending whether these are single pot design (41%), two pot designs (47%) or designs with chimney (39%) (MacCarty et al. 2008).

Environmental impacts: In addition to this, emissions harmful to health are reduced massively as rocket stoves allow almost smokeless burning (Komuhangi 2006). MacCarty et al. claim that Carbon Monoxide (CO)-emissions are reduced by up to 86%, while particle pollution is reduced by up to 78% depending on the design (MacCarty et al. 2008). Furthermore, due to the improved efficiency of the rocket stove, firewood scarcity, a severe constraint in rural areas of many developing countries, can be eased (Komuhangi 2006).

1.2 Advantages / Disadvantages

Advantages: Rocket stoves combine improved energy efficiency with low construction costs and therefore represent a stove design which has high potentials to raise cooking efficiency of poor households. Next to the reduction of biomass inputs, the rocket stoves significantly reduces smoke emissions occurring during the cooking process and thereby improves the overall health situation of households which use it. As they drastically reduce fuel use, rocket stoves have direct environmental advantages compared to open three-stone fires by reducing negative implications related to wood scarcity (Komuhangi 2006) as well as greenhouse gas emissions.

Disadvantages: In contrast to these very positive effects of rocket stoves, an evaluation report by USAID found that inconsistencies in the design of such stoves can result in reversing these efficiency gains. This disadvantage is not related to the technology of the stove itself but rather to the way of its promotion, especially concerning such stoves constructed by target households themselves. This way of dissemination of the technology partly leads to large changes in the design of the stoves undermining the positive energy efficiency effects of rocket stoves (USAID 2007: 25).

1.3 Policies towards the availability of rocket stoves

Policies supporting dissemination of rocket stoves

The dissemination has to be carefully planned, due to some methods being much less effective than others, such as when household members helping each other might lead to large changes in the design of the stoves undermining the positive energy efficiency effects of rocket stoves.

It is mostly installed in African countries, but also South America and Asia. It is claimed that 700.000 rocket stoves have been built in Uganda.

In many developing countries in Africa, South America and Asia, rocket stoves are available on markets or/and are promoted by developing agencies. For instance, the GTZ claim that more than 700.000 rocket stoves have been built only in Uganda through their support (GIC/GTZ 2010). In Bolivia, more than 10.000 metal rocket stoves have been disseminated (GAUL 2009). In total, the GTZ estimates more than 1.5 improved stoves which have been promoted by GTZ projects mostly in Uganda, Malawi, Ethiopia and Kenya (GTZ 2007).
An evaluation report by USAID identifies three different approaches of how different NGOs promoted energy efficient stoves in rural areas of northern Uganda (USAID 2007: 29-30). First, the so-called *Training of the Trainers (ToT) approach* is based on a certain number of extension agents who are trained on how to construct and maintain rocket stoves. After being trained, these extension agents pass on their knowledge to the targeted households which can start to build stoves themselves afterwards. The construction of the stoves by the households is overseen by the extension agents which also encourages households members to support each other with the construction. However, this approach was found to lead to design inconsistencies due to poor instruction by the extension agents and thereby to unsatisfying results. Second, the so-called *Modified ToT approaches* tries to reduce these inconsistencies by limiting stove construction responsibility to closely monitored specialists. This approach resulted in more feasible construction of stoves, but partly led to unequal dissemination as certain households were favoured while others were not reached at all. The approach used by NGOs for dissemination of improved cooking stoves was the so-called *come and get it approach*. With this approach, a certain number of members of the target group is trained in production of clay-bricks and construction of the stove and offers material as well as guidance for the construction done by the target households themselves. This approach was found to be the most effective and desirable approach of all presented above.

1.4 Implementation case studies

An implementation case study

The *GTZ Energy Advisory Project (EAP)* managed among other actions to build over 110 000 Rocket Lorena stoves in Western Uganda in twelve months. The dissemination of the stoves followed a *pyramid strategy*. On the first level, GTZ experts involved in the project chose one NGO in each target district in order to build their capacities on the construction of Rocket Lorena stoves.

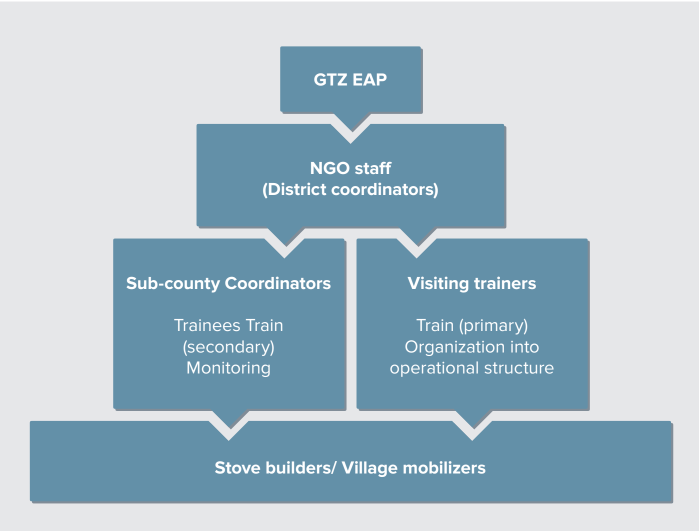

Figure 3: Lorena-rocket stove dissemination

Source: GTZ Kampala

The chosen NGOs appointed a sufficient number of district coordinators responsible for the up-scaling and dissemination process. The district coordinators like-wise build the capacity of staff on the sub-county. These sub-county coordinators again select stove builders on the parish level and are responsible for conducted trainings on the parish level in the villages. Each staff responsible for a certain level checks the next level below resulting in an innovative and successful scheme for the dissemination of rocket stoves in Uganda. The approach was several times modified and is flexible enough to be replicated in other regions.

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Figures

Figure 1: Rocket stove from steel and clay: Source: Envirofit /rechorocket.com. Available at: http://www.envirofit.org/products/?sub=cookstoves&pid=3; http://www.rechoroket.com/Home_files/English.pdf

Figure 2: Lorena-rocket stove. Source: GTZ Uganda. Available at: http://www.energyprogramme.or.ug/rocket-lorena-firewood-shelf-stove/

Figure 3: Lorena-rocket stove dissemination. Source: GTZ Kampala. Available at: http://www.betuco.be/stoves/Rocket%20Lorena%20stoves%20uganda.pdf

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