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Reading Comprehension Passage

<u>Getting Rocket Stoves to the market – the case of the Rocket Stove in Malawi</u>
By Christa Roth, Andreas Michel and Dr Christoph Messenger
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QUESTIONS

[1] Give an example of an inefficient cooking method.

[2] Are potential savings greater for cooking smaller or larger quantities? Explain why.

[3] In tests to cook 100kg of nsima, how much less wood did the first Rocket Stove use than a traditional fire? Express this as a weight and as a percentage.

[4] Describe ways in which Rocket Stove principles have greater potential benefit for institutional cooking.

[5] Why is using the existing cooking pot important?

[6] Describe ways in which the use of Rocket Stoves helps the environment.

[7] What might dissuade someone from changing from their traditional fire to a Rocket Stove?

[8] What are the cost benefits of the Rocket Stove?

[9] Other than the financial and environmental benefits of the Rocket Stove, what are other possible benefits to the user?

[10] Why is the balance between durability and insulating properties a challenge in constructing the stoves?

[11] "Production of the Rocket Stoves supports local tradesmen". Discuss.

ANSWERS

[1] Open fires.

[2] There are greater savings to me made when using larger pots (for larger quantities), because with these, more energy is wasted.

[3] The traditional fire used 170kg wood, the Rocket Stove used less than 17kg. Therefore the Rocket Stove used at least 153kg less; the Rocket Stove used less than 10% of the wood of the traditional fire.

[4] The variety of food and pots used is more limited than in domestic cooking, which is significant because the pot accurately fit the stove for the heat transfer to

be efficient. There are also greater savings when using large pots (because of the greater heat loss).

[5] It reduces the investment cost for the new stove, making the technology switch cheaper and increases the willingness to do so.

[6] Savings in firewood (between 50 and 95%, depending on the previous technology used) means reduced deforestation; and less wood transported on the roads means less CO_2 emission from trucks.

[7] Cost or inconvenience.

[8] Less firewood required, and less burning and wastage of food.

[9] Health benefits include: reduced smoke emission and therefore less damage to eyes and respiratory functions, less exposure to heat, and reduced danger of burning oneself. There is also the added convenience of shorter cooking times.

[10] The materials used to line the fire chamber must be hard-wearing enough to withstand wood being forced into it, but also provide good insulation so that the heat is transferred to the pot.

[11] Dedza pottery produces the insulating materials that line the fire chamber, and there are now four producers of the steel work across Malawi. Using local tradesmen and suppliers supports the local economy.

Getting Technologies to the market – the case of the Rocket Stove in Malawi

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Wasteful baseline technology

A survey conducted in 2003 in Malawi revealed that the majority of institutional cooking was done with firewood using inefficient technologies, including open fires (Figures 1 & 2). The Bellerive-type, which is an excellent, but expensive stove, was only found in a few places, as its selling price in Malawi is beyond the reach of most customers.

Figure 1 Inefficient firewood cooking at Maula prison (*photo: Christa Roth*)

Figure 2 Inefficient firewood cooking lauderdale tea factory in Mulanje district (*photo: Christa Roth*)

New technology that works better

In order to create an improved and more affordable technology, GTZ-ProBEC asked Peter Scott in 2004, from Aprovecho Institute, to apply the rocket stove principle to stoves, in Malawi, for 50 – 300 litre pots. The first prototypes were developed in 2004 in Mulanje and designed with a square combustion chamber.

Much has been written in this magazine previously about rocket stove technology, and so we present only a very brief summary here, taken from a presentation by Peter Scott (Figure 3). The rocket stove principle combines improved combustion efficiency, whilst reducing smoke output, with optimised heat transfer efficiency. More details and a video can be found at: www.aprovecho.org/web-content/media/ashden.htm

The rocket stove principles are optimally suited for institutional stoves:

Firstly, more energy is wasted from an open fire as pot size increases, therefore the potential savings are greater for larger pot sizes. In the first tests at the kitchen of Lauderdale Tea Factory in Mulanje, it took 170 kg of wood to cook 100 litres of the staple food nsima (maize meal) on the open fire, whereas the first rocket stove built by Peter Scott required less than 17 kg of wood.

Secondly, the rocket principle relies on optimised gaps between pot and stove to deliver the best results. This is easier to achieve in institutional cooking, as normally the variety of food cooked and pot sizes are limited, unlike in households. In Malawi a stainless steel pot is cheaper than a rocket stove by a factor of two, so it is economic sense to keep the existing pot which institutions already use to prepare food. The rocket stove is then tailor-made to fit the existing pot, reducing the overall investment costs for a new stove. This not only makes the technology switch considerably cheaper but increases willingness to do so.

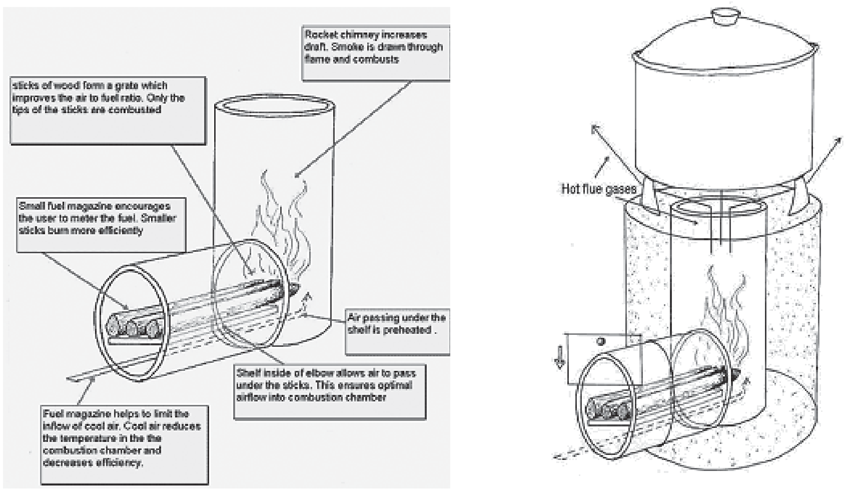

Figure 3 Diagrams showing the principles behind the fuel efficiency in rocket stoves (*diagram: Peter Scott*)

Why is it better than what was there before?

Due to better combustion and heat transfer efficiencies, rocket stoves give the following benefits:

To the user:

Reduced health risks

- Reduced smoke emissions: shorter-term benefits included less coughing and burning eyes whilst longer-term benefits include a reduction of respiratory and eye infections for the cooks.

Theme

Figure 4 In this school in Tanzania, this sight of a Bellerive-type stove, right, being used with long uncut pieces of wood and the door left open is not uncommon. However, it is still an efficient stove compared to the 3 stone fire, even when the door is open. Its high cost has prevented further dissemination (*photo: Christa Roth*)

- Less exposure to heat: the fire/flames are contained within the combustion chamber and the hot flue gases are shielded by a skirt (enhancing heat-transfer to the pot). The exhaust gases leaving the gap between the skirt and the pot normally don't exceed 190°C.
- Reduced danger to the cook from burning, as the cook is not exposed to an open flame.

Convenience

Convenience is a factor that should not be underestimated when discussing stove design and efficiency. Cooks will always find the most convenient way to use a stove, which often does not favour efficiency, or they will not use an inconvenient stove at all (Figure 4). This means that even the most efficient stove-design will then have zero impact! For example, the Bellerive stove is a very efficient stove (Figure 4), but the draft system is designed to work with a closed door to function efficiently. This requires firewood not only to be split, but cut into 20cm long pieces to fit into the fire chamber. Reality often shows a different picture: normally it is the cook's duty to prepare the firewood. Unless the economic savings achieved by this extra work are shared out to the cook, there is no incentive to use the stove properly.

Cooks from the kitchen shown in Figure 4 preferred the rocket stove because:

- Less time and effort needed to prepare wood: the rocket stove can take any length of firewood, therefore there is no need to cut wood. The only requirement is to split the wood lengthwise into pieces ideally around 3-6 cm thickness, which is not as strenuous as cutting. Also, less wood needs to be prepared due to the economy of the stove on firewood use (Figure 5).
- Less smoke even without a chimney.
- No chimney to sweep, therefore less maintenance work.
- Reduced cooking times compared with an open fire.

Figure 5 Less wood is needed to cook the equivalent amount of food with a rocket stove (*photo: Christa Roth*)

Figure 6 Caked food from traditional fire, left, and from rocket stove, right, with same maize flour used (*photo: Christa Roth*)

The usual feedback from rocket stove users is similar to that from Emmanuel Teacher Training College in Blantyre: the three cooks really treasure the stove and look after it, and do not wish to return to using the open fire, when they had to take turns of less than ten minutes in the kitchen filled with biting smoke in order not to choke. They attribute health improvements to the rocket stove. Athough they mention that the rocket stove needs more frequent attention to push the firewood in at the right pace than the open fire, but that it is outweighed by shorter overall cooking times.

To the owner (buyer, head of the institution):

Economic

- Cheaper to buy than other available improved technologies, such as the Bellerive-type stove.
- Considerable savings in firewood, ranging between 50 to 95 %, depending on the inefficiency of baseline technology.
- Reduced transport costs for firewood (e.g. Maula prison: 4 truckloads of firewood per week without Rocket Stove, 1 truck load fire wood per week with Rocket Stove).
- Less burning and waste of food.
- Better quality of food prepared in the rocket stove as compared to the open fire, as more equal heat distribution and faster cooking (Figure 6).
- No chimney to be passed through the wall or the roof (no leakages).

To society:

Environmental

- Reduced deforestation as result of reduced wood consumption.
- Less wood transport on the roads, therefore a reduction in CO_2 emissions from trucks.

How does the technology become a 'product' and find its way to the user?

We need to look at two aspects:

1. Who is involved in turning the raw materials into a sellable product?

2. Who is involved in causing the product to reach the user?

Input supply of raw materials

Metal for the structure, insulative bricks and high temperature mortar for the lining of the firechamber, are the major materials needed for a rocket stove. All metal ingredients are available from regular steel suppliers in the larger centres of the country. Manufacturing the insulation material was a challenge, as no natural material like pumice or processed vermiculite was available. Together with the clay expert Chris Stevens from Dedza pottery, insulation material was developed out of white refractory clay and sawdust, fired at 1250°C. The bricks in a 100 litre stove cost about $15, which is less than 8 % of the total cost of the stove. Dedza pottery now tailor-makes sets of insulating bricks for the three most common fire chamber sizes. For other sizes the bricks are cut with a hacksaw blade.

ProBEC negotiated for minimum stocks to be kept, as manufacturing times for insulative bricks can exceed 6 weeks, due to the slow drying of the moisture-absorbing sawdust. The density of the fired bricks is about 0.8 g/cbcm. This makes them physically vulnerable, especially at sites where the firewood is 'rammed' in. Our hardest challenge was in a prison in the capital Lilongwe: cooking is done by the inmates, who are capable of destroying a stove in less than 6 months. Under normal circumstances the lifespan should exceed 3 years. This prison has become a valuable testing ground: anything surviving the 'stove abuse' there is fit for normal use. Dedza pottery developed hard, high-density tiles about 1 cm thick, made out of the same white clay mentioned previously, resistant against physical shock and abrasion. They are interlocking and fitted on the lower part of the fire chamber to protect the area in direct contact with the firewood. It is always a challenge to balance the durability versus the insulative properties of a stove. So far the tiles used since October 2006 have not reduced the efficiency of the institutional stoves as the heat

Figure 7 WFP type of stove: lower skirt, less L-shape at the entrance to cut costs, designed for half-220l gallon oil drum (*photo: Christa Roth*)

Figure 8 Stoves waiting to be loaded at Ken Steel Engineering in Mulanje (*photo: Christa Roth*)

loss through the tiles is compensated by the longer cooking times in the institutions. The tiles have enticed some producers to increase the warranty for the stoves from 6 to 12 months. ProBEC constantly monitors the performance of the stove components and adjusts materials and designs as the need arises.

Who turns the raw materials into stoves?

Ken Chilewe from Ken Steel Engineering in Mulanje was the first producer to be trained in 2004 (Figure 7 & 8). Since then, he has successfully sold over 1,500 institutional rocket stoves (see as well Ashden Awards video).

In 2005, a further four entrepreneurs were selected for training according to the criteria that they were already in business, had an equipped workshop and at least one successful product on the market. Even though there were promising orders available, only 3 took up stove production. A fourth was later trained and now 4 producers cover the 3 major regions of Malawi.

Who is involved to make the product reach the user?

This will be further elaborated in a next issue of Boiling Point.

Profile of the authors

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