FINAL REPORT

ProBEC Study
on the Impact of the
Institutional Rocket Stoves in
School Kitchens

August 2007

Report Prepared by:

Lead Consultant:
Joseph DeGabriele
PO Box X 141, Lilongwe Malawi
degabriele@sdnp.org.mw

Consultant
Amulike Msukwa
PO Box 219, Lilongwe Malawi
amulike_msukwa@yahoo.co.uk

Acronyms and glossary

GTZ BEP	GTZ Basic Education Programme
HTM	High temperature Mortar
IFSP	Integrated Food Security Project (formerly implemented in Mulanje district, Malawi)
Likuni *phala*	fortified porridge made from a blend of maize and Soya flours. Some brands are quick cooking while others require prolonged cooking. Porridge supplied for children under the age of 6 years nursery feeding programmes are fortified with milk and sugar.
Mafua	traditional 3 stone fireplace cooking
Mbaula	stove for cooking with firewood or charcoal
MVAC	Malawi Vulnerability Assessment Committee
PEA	Primary Education Advisor
ProBEC	Programme for Biomass Energy Conservation
VLOM	Village Level Operation and Maintenance
WFP	World Food Programme

*Cooking half drum pot on **mafua** – note firewood stored in kitchen*

***Mbaula** – uses charcoal*

Acknowledgements:

The consultants would like to thank the following for their support:

- The cooks operating the rocket stoves in centres with school feeding programmes
- The teaching and administrative staff at the various public secondary schools operating a school feeding programme
- The District Education Staff, including District Education managers, Primary Education Advisors, and District and Zone Coordinators
- Administrative and Field Staff at Mary's Meals, WFP and GTZ BEP.
- The private institutions who assisted in detailed discussions on the use of the stoves and allowed access to their records
- The stove producers
- ProBEC staff

Full details are found in annex 10.7.

Executive summary

The objective of this study is to conduct qualitative and quantitative research on the rocket stoves used for institutional cooking and to establish the following parameters:

- Usage of the stoves
- Durability of the stoves
- The number of people directly benefiting from the stoves through the school feeding programmes
- Proper use of the stoves, including firewood and kitchen practices
- Wood savings achieved

The consultants sampled over 60 schools from among 3 donors supporting school feeding programmes: Mary's Meals, GTZ Basic Education Programme, and World Food Programme. In addition, over 20 schools and institutions having purchased the stoves from their own funds were sampled. All four certified producers as well as the producer of the ceramic components were consulted.

The study concluded that the rate of usage of the stoves depends on several factors or variables:

- The people who are trained in stove use, especially those who will be using the stoves on a day to day basis
- The quality of the training, and if it is of a practical nature
- That each and every stove that is delivered should be tested and certified on site
- That the users (cooks and administrative staff) are motivated to use the stove through savings in time and fuel
- That there should be an adequate number of stoves and pots to cook for the entire number of beneficiaries on one session
- The stoves should be used with the correct sized pots and lids
- And the supporting institution should provide frequent monitoring services, which are also occasions to support the schools in the use and management of the stoves.

The other factors (i.e. proper use, durability, economy, number of beneficiaries) may be considered as dependant variables of usage.

The results indicate that the strategies adopted by Mary's Meals achieve the best results with 94% usage rate, while those adopted by GTZ BEP are the least effective, with 42% usage reported. There are several proxy indicators to support this including continued use of older technologies, with only 13% of schools supported by Mary's Meals still using older technologies, compared with 90% of schools supported by GTZ BEP.

In conclusion, the advantages of the rocket stove are well appreciated by cooks and administration alike – with rankings that reflect their specific interests. The lessons learnt in this study, and the recommendations made, will assist the supporting partners to evaluate their interventions and strategies in order to improve the impact of the use of the stoves in the school feeding programmes.

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Part 1: Background

1. Introduction

The Programme for Biomass Energy Conservation (ProBEC) has promoted the production, installation and use of Rocket Stoves in large kitchens e.g. schools. Particular emphasis was given to the promotion through school feeding programmes of organizations like World Food Programme WFP, Basic education programme (GTZ-BEP), Mary's Meals and UNICEF.

2. Objectives of the study

So far ProBEC has worked with a lot of assumptions when calculating the figures that are reported to DGIS. The objective of the study is to substantiate the guesses and replace them with researched facts, including:

- Usage of the stoves
- Durability of the stoves
- The number of people directly benefiting from the stoves through the school feeding programmes
- Proper use of the stoves, including firewood and kitchen practices
- Wood savings achieved

Refer to the Terms of Reference (annex 10.1) for a comprehensive outline of the research questions relating to the objectives.

3. Scope of work

Enquiries are to be made from sample sizes of 20 from each of the 4 main sampling population groups, namely:

- Donor 1 – Mary's Meals – 20 schools
- Donor 2 – GTZ BEP – 20 schools
- Donor 3 – WFP – 20 schools
- Business approach – 20 institutions

If possible the sampling is to be stratified according to the dates of deliveries of the stoves. In addition, the sampling is to be done from the Districts with the highest density of stoves; a total of 2 to 4 districts have to be selected.

Apart from surveys, the study will conduct participatory sessions with the users (e.g. cooks, institution management team).

The findings are to be documented and presented to the key partners (WFP, GTZ BEP, UNICEF, and Mary's Meals) and ProBEC.

4. Methodology

The sampling was designed with the following parameters in mind:

- The study requires the enumeration of institutions using a stratified sampling approach, with purposive (i.e. non-probability) sampling. The reason for such an approach was that this is particularly suited to an ethnographic enquiry in order to understand how things work with a group of people.

- Sample sizes of 20 from each of the following: Mary's Meals, GTZ BEP, WFP, and private institutions
- Budget, logistical and time constraints precluded samples within a district that were very far from each other. The samples were generally selected from one Education Zone per district.
- The study team was obliged to make changes to the agreed ToRs in light of new information regarding areas of operation (e.g. GTZ BEP in Dowa); these changes were done in consultation with ProBEC.

The selection of the zones and schools was purposive in order to learn in the first instance the main issues affecting the use of the rocket stove, so schools under the following categories were visited:

- during a feeding session (to observe firewood and kitchen management practices)
- after the feeding session (to observe the condition of the stove),
- schools that have been using the stoves continuously for 3 years in order to assess the experience of the cooks and assess long term damage if any,
- schools that are no longer in the feeding programme in order to see if the stoves are put to use,
- schools with very large enrolments – and either with a large number of stoves or few stoves,
- schools that are known to keep very good records in order to assess running costs and savings of the rocket stoves.

For the WFP operations, schools from the two high impact areas (Kasungu and Lilongwe) were sampled and operational staff interviewed in order to assess any differences between the 2 districts.

With GTZ BEP, as the operations in Zomba had already been completed it was decided to include schools in this sample in order to assess a completed cycle and find out to what use, if any, was put to the rocket stoves. Schools in Dowa were sampled as part of the ongoing operation (even though the programme had already been phased out).

4.1 Literature review

The key documents included:

- The Terms of Reference
- Firewood management fact sheet on household energy saving technologies (Module 2 Intervention 3, produced by IFSP, Mulanje, May 2004)
- Kitchen management fact sheet on household energy saving technologies (Module 3 Intervention 3, produced by IFSP, Mulanje, May 2004)
- Rocket Stove *Zovomerezeka ndi Zoletsedwa* (i.e. Do's and Don'ts)
- Guidelines on School Health and Nutrition, Ministry of Education

4.2 Research tools

The preparation of a survey questionnaire followed very closely the ToRs, as well as ongoing consultations with ProBEC. It was essential that the questionnaires be simple to

administer and contain only essential questions. Due to the newness of the area of enquiry, four field trials were conducted by the consultants, with the necessary modifications made. Refer to annex 10.8.

Other tools included guiding questions for the stove users and for the stove manufacturers for the qualitative aspects of the study. Refer to annexes 10.10 and 10.11.

4.3 Composition of the research team

The team consisted of 2 consultants: Mr Joseph DeGabriele and Mr Amulike Msukwa.

Four enumerators were recruited: Doreen Nyirenda, Justin Milonde, Christopher Phwandaphwanda, and Glyn Chitete.

4.4 Reporting mechanisms

The enumerators reported on a daily basis to the consultants. The consultants provided regular updates to the ProBEC National Monitoring and Evaluation Officer.

4.5 Timing of the field research

The field research commenced on 21st June and was concluded on 10th July. For the schedule of activities, refer to annex 10.6 (list of sampled schools and institutions) and annex 10.7 (persons and institutions consulted).

4.6 Target areas for the study

The following organisations using the rocket stoves in their school feeding operations were visited:

Table 1: Schools and Institutions targeted in the study

Organisation	Districts Visited by Research team	Number of Schools visited
Mary's Meals	Blantyre, Chiradzulu, Kasungu	- 15 schools 3 Nurseries in Blantyre - 1 schools 1 Nurseries in Chiradzulu - 1 school in Kasungu
GTZ BEP	- Zomba – 2005 – 06 programme - Dowa – 2006 – 07 programme	- 6 schools in Zomba - 14 schools in Dowa
WFP	Lilongwe, Kasungu	- 10 schools in Lilongwe - 10 schools in Kasungu
Private institutions	Blantyre, Lilongwe, Mzuzu, Rumphi, Ntcheu, Dedza, Nkhata Bay, Chiradzulu	- 20 boarding schools & institutions of higher education : 3 Blantyre , 3 Chiradzulu, 6 Lilongwe, 1 Mzuzu, 2 Rumphi, 3 Ntcheu, 1 Dedza, 1 Nkhata Bay
Stove manufacturers	Lilongwe, Mulanje, Mzuzu, Dedza	- All 4 certified stove manufacturers
Ceramics manufacturer	Dedza	- The only ceramics manufacturer in Malawi

A total of 85 schools and institutions were studied (quantitatively and qualitatively), 3 donors and all 4 stove producers. Ministry of Education was consulted at National, District, Zone and School levels. For full details refer to annexes 10.6 and 10.7.

4.7 Persons and institutions consulted

The same annex 10.7 lists the persons and institutions consulted.

4.8 Opportunities and constraints

After up to 3 years of implementing school feeding programmes using the rockets stoves, all 3 implementing institutions expressed interest in the outcome of the study and provided full cooperation.

As most schools closed by 1300 hours, the sampling of the schools within a district had to be done within a single zone or 2 zones at most. Given the distance between schools the alternative would have meant that the enumerators could each only complete one school a day.

5. Findings

This section describes the findings of the study relating to the impact of the rocket stove on the school feeding programmes implemented by 3 donors, as well as the impact of the rocket stove in private institutions.

5.1 School Feeding Programmes: Intervention Profiles

A description of the school feeding activities of Mary's Meals, GTZ BEP and WFP are briefly summarised below.

5.1.1 Ministry of Education

The school feeding programmes come under the Health and Nutrition in Schools technical working group, who have issued guidelines on school feeding. These guidelines cover issues such as the type of food to be provided, the amount of food, storage and preparation of food, care of equipment, and hygiene issues.

In theory, the school feeding programmes are to be "owned" by the Ministry, but the reality is different for different implementers. The identification of schools is done mostly by the donors through the MVACs prepared by the Ministry of Agriculture, identifying areas that are prone to low harvest. The donors then inform the Ministry of Education regarding impending activities. Donors such as WFP and GTZ BEP attend coordination meetings organised by the Ministry of Education and generally comply with the guidelines. On the other hand, Mary's Meals' identification process includes "the urban poor" as well as areas indicated to it by a private donor, the Illovo Sugar Corporation. Mary's Meals usually does not attend the coordination meetings, and does not follow all the guidelines as stipulated by the Ministry, for example the quantity of food to be allocated to each student.

One area that lacks integration is food hygiene and personal hygiene. While it was observed that some effort was made to improve food hygiene during the preparation and serving of the food, it was observed that personal hygiene (washing of hands before food preparation and before eating food) was non existent.

5.1.2 Mary's Meals

Although Mary's Meals operates school feeding programmes in 105 primary schools in 12 Districts, most of the activities are focussed in and around the Blantyre peri urban areas, with 60 schools in Blantyre and 5 schools in nearby Chiradzulu. 210,000 children receive a meal once a day during school days (on average for 185 days per year). In a few schools (such as Ndirande) the parents agree to cook meals over the weekend, and meals are provided to the children.

In addition, Mary's Meals operates feeding programmes in 43 Nursery schools. Between 3,000 and 5,000 children under the age of six receive 2 meals a day.

For the feeding programmes in the ***primary schools***, Mary's Meals has the following strategy:

- Kitchen and a secure storeroom for the food, stove and firewood
- Cooking and eating utensils (starter pack) of plates, spoons, buckets, etc
- A number of Rocket stoves with compatible 120 litre stainless steel pots fitted with lids (an average of one stove per 330 to 350 children registered in a school)
- The cooking is done by volunteers
- A monthly supply of firewood, 0.5m³ per stove (community provides extra if required).
- About 70g of Likuni phala per child per day
- Training the committee members on the use of the rocket stove
- Monitoring services

Mary's meals has purchased 610 stoves with 120 litre stainless steel pots, fitted with lids, and 32 double stoves with 50 and 20 litre pots. In all schools, the stoves are fired once, and there is only one cooking session per day. The first stoves were introduced in 2004 in Goleka School, and have been used almost daily since. In Nkolokoti School with an enrolment of 7323 children, 114 teachers and 20 kitchen volunteers in 2007 has been using 24 stoves for 13 months (both schools were included in the sample).

Mary's Meals has to date distributed 32 double stoves in its ***nursery schools***. The double stoves come complete with stainless steel pots of 50 and 20 litre capacities. The larger pot is used to cook fortified Likuni phala for breakfast and nsima for lunch, while the smaller pot is used for lunch time relish. The nurseries operate on a budget, and the committees purchase firewood from this budget.

Refer to annex 10.2 for a complete list of primary schools which have a feeding programme supported by Mary's Meals.

5.1.3 GTZ BEP

GTZ BEP has been involved in school feeding, only targeting schools in vulnerable areas, during the "hunger months" (November through to March). The targeting is done through the Malawi Vulnerability Assessment Committee's (MVAC) recommendations in coordination with the Ministry of Education, EDMU. (See annex 10.4).

Between 31st October 2005 and March 30th 2006 GTZ BEP had a school feeding programme in the following districts: Zomba Rural, Blantyre Rural, Balaka, Machinga and Mwanza. In Zomba Rural the programme targeted 24 schools in 3 zones – 22,071 children.

For the 2006-07 academic year GTZ BEP is operating in 317 schools in 3 Districts (Dowa, Ntchisi and Mzimba), with an enrolment of 128,158 pupils in August 2006 to 146,333 pupils in January 2007.

The implementation strategy of GTZ BEP is as follows:

- Only one rocket stove per school
- Pots provided are of ½ drum – i.e. recycled 220 litre drums of steel construction – no lids are provided
- The cooking is done by volunteers
- Fire wood to be supplied by the school
- Training done by GTZ BEP at cluster level for head teacher, teachers, village head, PTA member
- 100 – 110 g Likuni phala per child per day

The reason for the introduction of the rocket stove is to save fuel wood for the communities. Unlike WFP and Mary's Meals, GTZ BEP is only a short term input, and the investment in fuel efficient stoves in the schools is at a different level.

5.1.4 World Food Programme

The targeting is done by WFP through MVAC, and WFP operates in 10 districts. The highest concentration of activities are in Kasungu (44 schools), Lilongwe Rural West (33 schools) and Mangochi (34 schools) (see annex 10.5).

The programme targets a total of 441,884 children in 489 schools. To June 2007, 549 stoves have been purchased and distributed to 240 schools, with an enrolment of 229,472 children. 1000 additional stoves have been ordered and are under production.

The implementation strategy is as follows:

- Construction of kitchen and secure store for the food, stove and firewood
- Rocket stoves (at least one per school, but the target is at least 3 per school)
- Initially some school were not provided with pots, while some schools were provided with half drums. Now all schools are being supplied with the correct stainless steel pots.
- The cooking is done by volunteers
- Firewood is supplied by the community
- Training on stove use by monitors to some canteen committee members.
- 100 – 110 g Likuni phala per child per day

The following table summarises the strategies and activities of 3 donors during 2006 – 2007 school year

Table 2: Summary of donor interventions in school feeding programmes

	Mary's Meals	GTZ BEP	WFP
Number of districts operating in	- 12 districts - since 2003	- 5 districts in 2005-06 - 3 districts in 2006-07	- 10 districts - since 2003
Number of schools operating in	- 105 schools - 43 nurseries	- 24 schools 2005-06 - 317 schools 2006-07	- 489 schools
Enrolment – children benefiting from school feeding	- 210,000 primary school children all eating meals prepared by rocket stove - up to 5000 nursery children	- 146,895 primary school children , low adoption of rocket stove	- 441,884 primary school children - 229,472 children eating meals prepared by rocket stove
Number of stoves purchased by organisation	- 610 stoves of 120 l capacity - 32 double stoves in nurseries	- 24 (2005-06) - 317 (2006 – 07)	- 549 purchased - 1000 on order
Days that meals are cooked -	- most schools cook during school days only, 180 – 190 days per year. - very few schools cook during the weekend	- 5 months of the year`including holidays but no weekends; 110 days per year.	- most schools cook during school days only, 180 – 190 days per year.
Number of stove firings and pots cooked	- stoves are fired only once per day - pots are filled once per day	- low adoption of rocket stoves.	- when school don't have enough rocket stoves, pots are filled twice
Type of pots used	- supplies stainless steel pots with lids	- supplies half drums with no lids	- now supplying stainless steel pots with lids
grams of Likuni phala / child	- 70 g/ primary school child. - 1 pot for 330 – 350 children - Nursery children receive fortified porridge and lunch of nsima and relish.	- 100 – 110 g / child - 1 pot for 250 children	- 100 g / child - 1 pot for 250 children

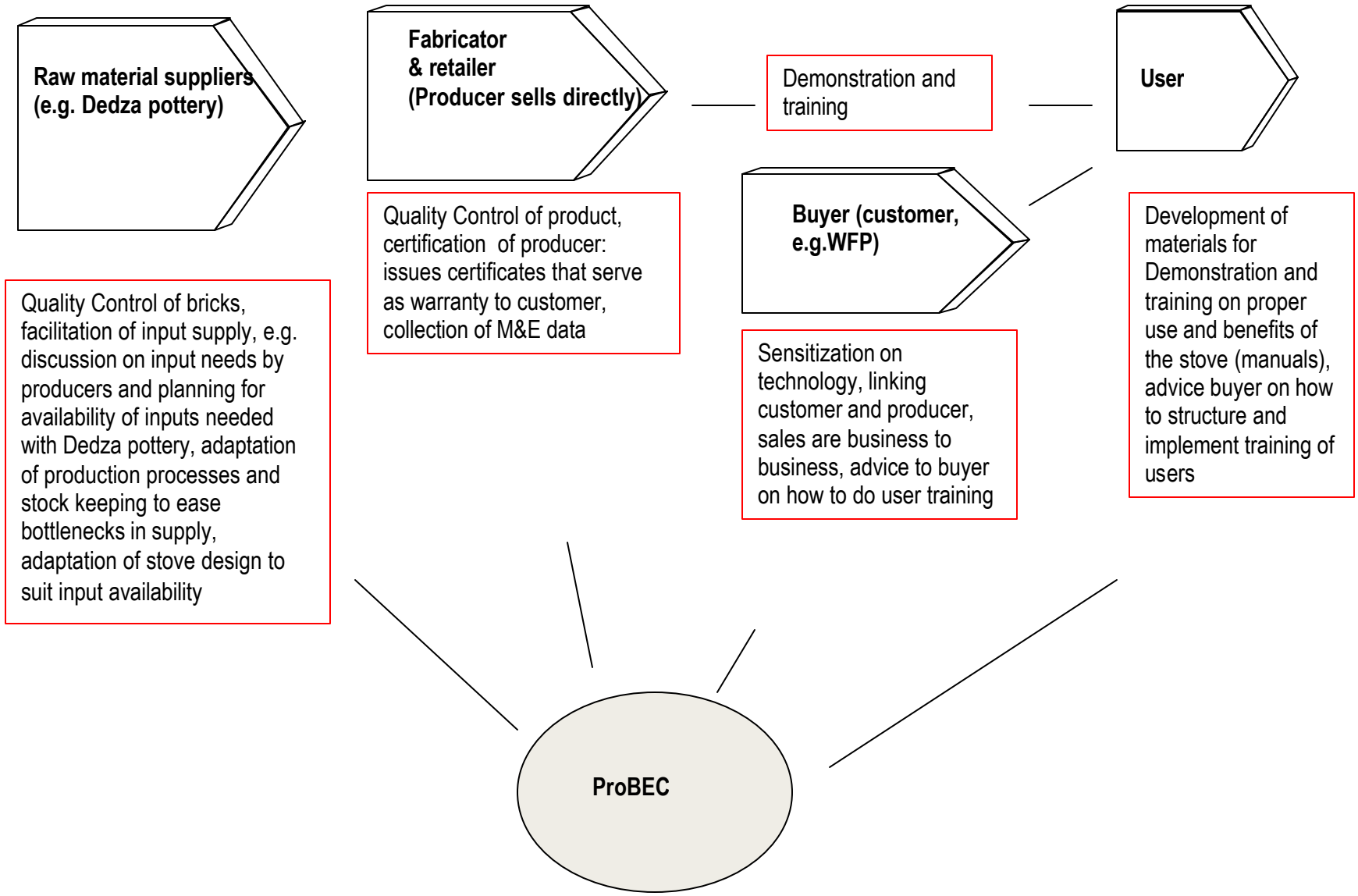
5.2 Private institutions

The rocket stove has been purchased by several private institutions. The team included a sample of these institutions in the study, mainly secondary schools and institutes of higher learning as well as orphanages. Districts included: Blantyre, Mzuzu, Rumphi and Lilongwe. Farms, estates, and prisons were not included in the study.

5.3 ProBEC

The Programme for Biomass Energy Conservation is based in Mulanje. Its responsibilities and activities in relation to the materials suppliers, the stove producer, the clients and the users, may be summarised in the scheme below:

Figure 1 Roles of ProBEC in relation to suppliers, fabricators, clients and users



5.4 Usage of the stoves

This section describes the findings on usage of the rocket stove.

5.4.1 Correctness of the ledger

ProBEC provided the team with a list of stoves used by Mary's Meals, WFP, GTZ BEP and the private sector. By and large the list of donor supported schools with stoves was accurate. The WFP kept very detailed information, including the school enrolment, the number of stoves, including serial numbers, and the condition of each stove.

All the manufacturers keep detailed and accurate records (serial number, capacity, name of client and date purchased). Refer to annex 10.12. However, the study team found that the listing of private schools and institutions having purchased rocket stoves (which was supplied by the manufacturers) had one problem as the location stated by the purchaser was often changed.

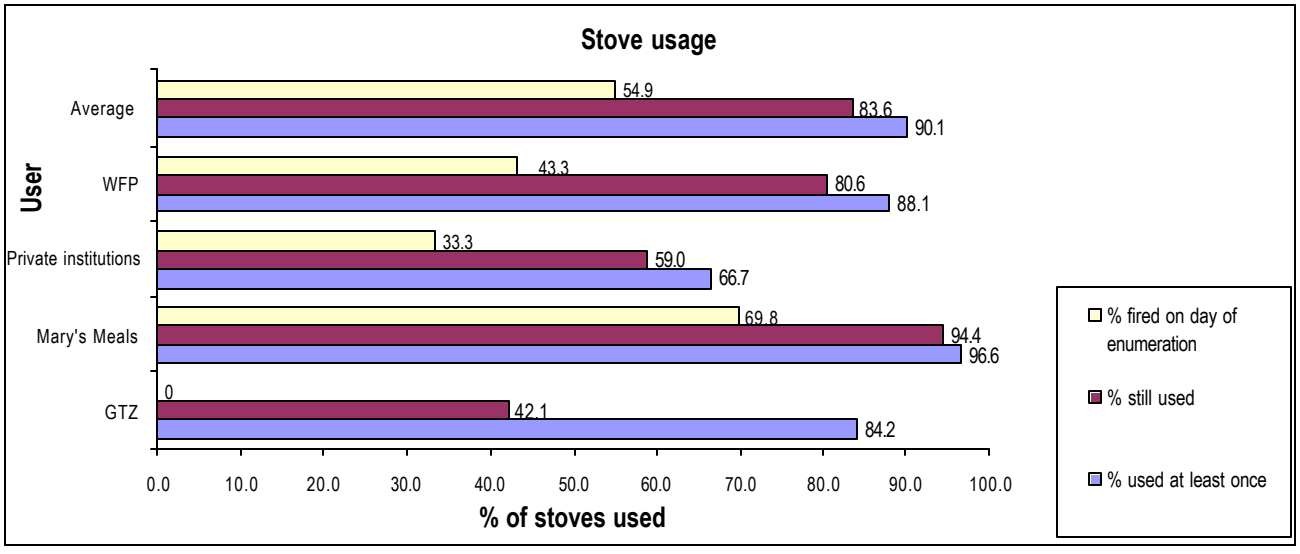
5.4.2 Stoves that have been used after delivery

There is quite a difference between the different donors and the private institutions regarding the percentage that used the stove at least once, that reported to have used the stove regularly and that were observed to have used the stove during the enumeration. On average:

- 90.1% of the stoves were used at least once
- 83.6% of stoves are reported to be used regularly
- 54.9% of stoves were observed to be used on the day of enumeration:

A breakdown by sponsoring organisation and private client follows in the graph below.

Figure 2 Stove Usage



The highest usage rates are observed in schools supported by Mary's Meals and WFP. Lowest rates are observed in GTZ BEP supported schools; in part this is because both GTZ programmes are officially completed (the funding was a 2 year intervention), but discussions

and observations in both Zomba and Dowa show conclusively that the rocket stoves have never been regularly used in these school. Although some school feeding programmes were still operating, no rocket stoves were seen to be used.

The rate for private institutions is also low, in part because institutions with big orders (such as Elma with 10 stoves) had returned the stoves, and there was reluctance on the part of the cooks to use the stoves.

5.4.3 Reasons for giving up the stoves

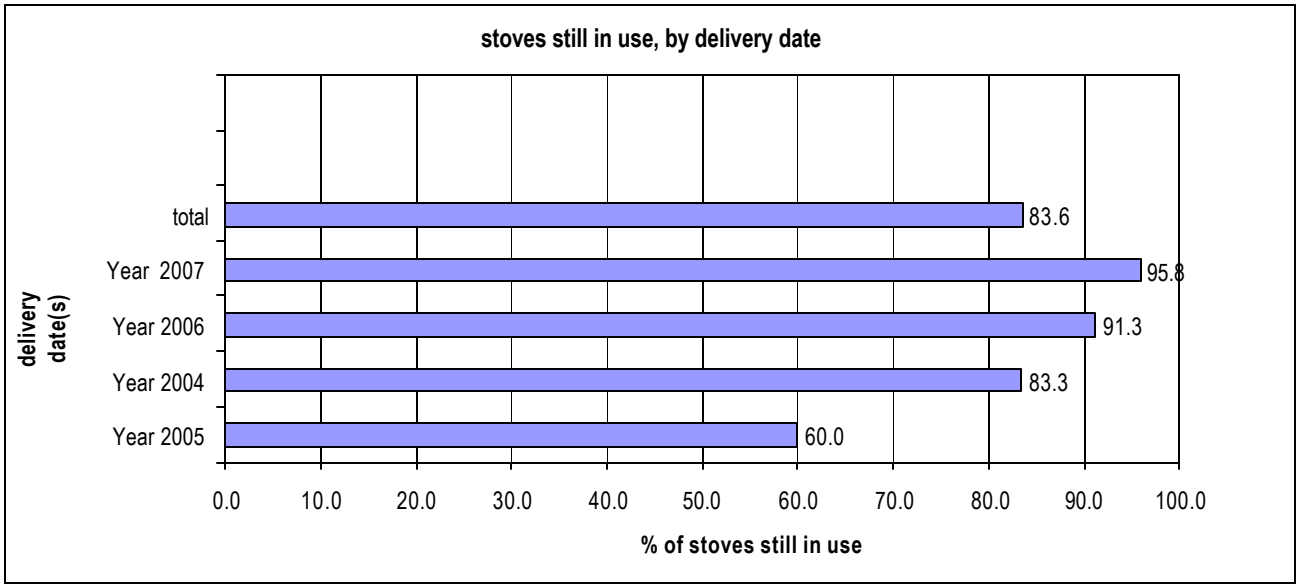
The reasons given by the users at school and institutional level are related to the disadvantages of the stove (see section) and were highlighted during the qualitative sessions, namely:

- ***Poor performance***. The highest percentage reporting that the stoves are still used record no instances of poor performance of the stove, while 25% of respondents of GTZ BEP sponsored schools and private institutions report poor performance.
- A ***large enrolment*** and ***not enough stoves***. Many of the respondents of the GTZ BEP supported schools said they abandoned the stoves because they still had to use mafua as they had to cook a number of pots but had only one stove.

5.4.4 Average age of the stoves in use

The following table illustrates the percentage of stoves reported to be still in use by date of delivery. It was not possible for many of the schools to determine the month in which the stoves started being used. From the sample of 304 stoves, 290 could be attributed dates and 48 of the stoves observed were purchased in 2007, 160 stoves in 2006, 70 stoves in 2005, and 6 stoves in 2004. Multiple dates mean that some schools took additional delivery of stoves in different years (only 6 samples, so not indicated on the graph).

Figure 3: Percentage of Stoves still in use, by delivery date



Stoves delivered after 2006 are almost all reported to be in functioning order, while those delivered in 2004 are over 80% functioning and those delivered in 2005 are 60% functioning. This lends credence to the assumption that the rocket stoves have a useful life of over 3 years. Note that the 2005 and 2006 figures are corrected for the low use in GTZ BEP schools.

5.5 Durability of the stoves

Although the stoves are perceived by clients and users as being fragile, it was observed that even stoves with apparently a lot of damage were functioning and according to some of the users without noticeable drop in performance.

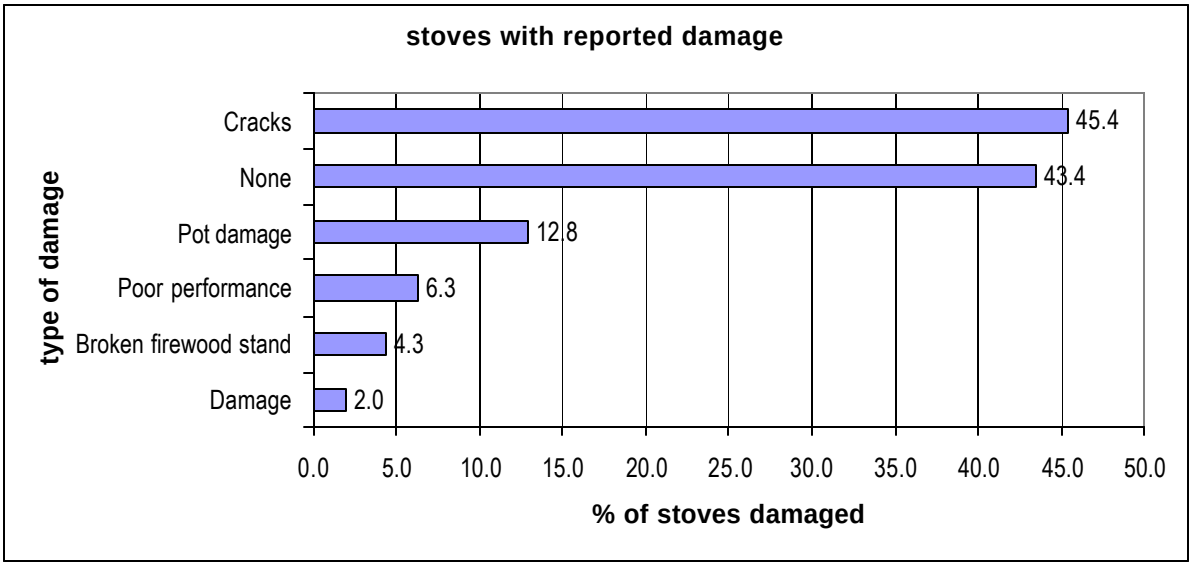
Efforts are being made to improve durability, namely to the fire box and the top insulation. Ken Steel report that "refcast" from South Africa is stronger than Dedza tiles and they been using this on some of the stoves since 2005.

5.5.1 Damage to the stoves

Observations from the study

The following problems or damage was observed to the stoves during the evaluation:

Figure 4: Percentage of stoves with damage (observed during study)



The most common damage is cracks to the top insulation and fire chamber – almost half the stoves. As observed above, many stoves still perform well.

An almost equal number of stoves were observed to have no damage at all.

One of the concerns of ProBEC was damage to the fire chamber, and the study observed the size of the damage, as illustrated in the diagram below (also refer to annex 10.8, the survey questionnaire).

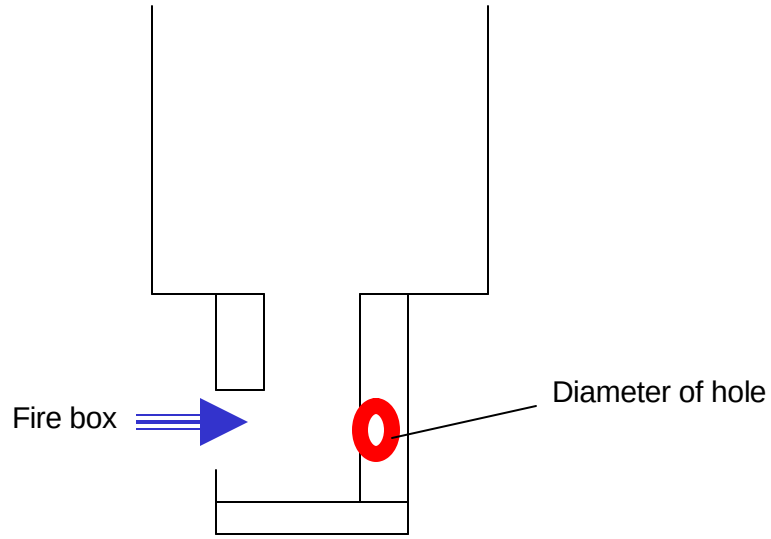
A total of 259 stoves were observed for the size of damage to the fire box, the results are as follows:

Table 3: Frequency of damage to fire box, by size

Size of hole	% of stoves observed
No damage	89.2
3 cm	0.8
6cm	1.9
9cm	1.2
12 cm	0.4
greater than 12 cm	6.6

The figure below refers to the hole in the firebox:

Figure 5: Fire box damage



Again, it was observed that stoves with a complete brick removed are claimed to be working as well as when they were new.

Damaged brick in fire box > 12cm but stove was reported to still perform well

Loose ceramic tiles - but stove was reported to still perform well

WFP Reports, June 2007

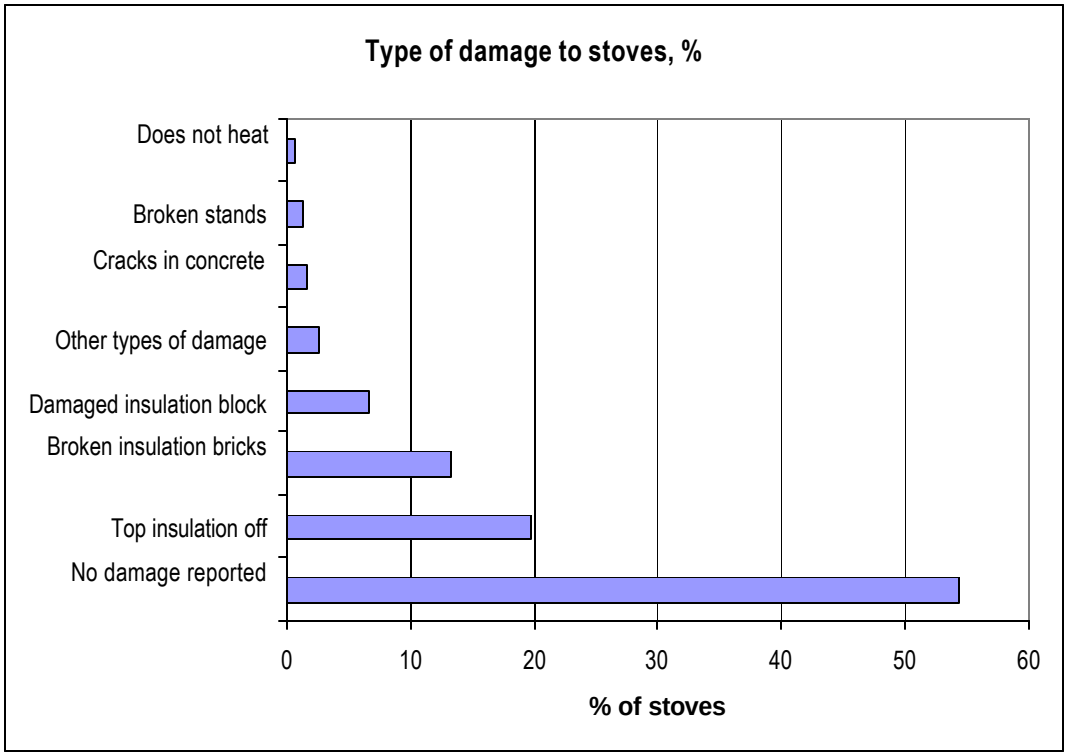
The WFP report of June 2007 details the damage to 251 out of the 549 stoves in use at the schools. A break down by district (table 4) shows that over 45% of stoves are observed to have some damage, although the vast majority of damage is superficial and 98.7% of the stoves are functional. In Kasungu over ¾ of the stoves show some damage, while in Nkhata Bay less than 7% show any damage.

Table 4 Number of stoves in WFP, and % damage, by district

District	Number of stoves distributed	Number of stoves damaged	% of stoves showing damaged
Kasungu	182	141	77.5
Lilongwe	81	11	13.6
Mangochi	41	5	12.2
Thyolo	35	23	65.7
Nkhata Bay	31	2	6.5
Dedza	28	16	57.1
Ntcheu	31	11	35.5
Salima	29	16	55.2
Nsanje	71	17	23.9
Chikwawa	20	9	45.0
TOTAL	**549**	**251**	**45.7**

Only 7 stoves (1.3%) are reported to be not in use because of reported damage or poor performance. From this detailed report of 549 stoves, the type of damage is as depicted in the following graph:

Figure 6 Type of damage to stoves, %



WFP Monitoring records – Kasungu

The above table 3 indicates that Kasungu has the highest percentage of reported damage to the stoves. The following table is compiled from data obtained from the WFP records in Kasungu district.

Table 5: Frequency of observed damage to stoves in Kasungu (WFP)

Type of damage	CH Welding services	Ken Steel	Total	% of total stoves
No damage observed	3	32	35	22.9
Damaged fire chamber	3	20	23	15.0
Damage (not specified)	6	14	20	13.1
Damaged top insulation – with insulation off	0	3	3	2.0
Top insulation off	9	63	72	47.1
Total	**21**	**132**	**153**	**100**

The most common damage is to the top insulation, again almost half of all stoves. Only a quarter of stoves are observed to have no damage at all, compared to half in the graph

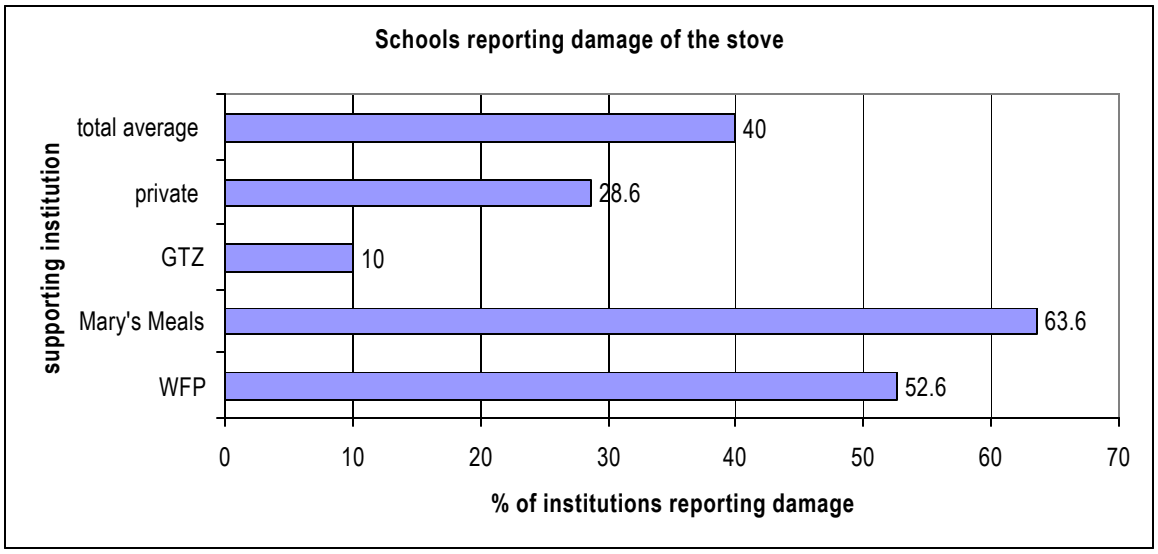
above. This may be because the stoves in Kasungu have already been heavily used for several years.

5.5.2 Reporting damage to the stove

During the study it became clear that the users' interest and ability to report damage to the stove directly influences the impact the stove has on the school feeding programme.

The graph below illustrates the percentage that users reported complaints of damage to the supplier (i.e. donor or manufacturer). The high percentage of reports from Mary's Meals and WFP do not indicate poorer quality stoves, but a greater interest in using the stoves and benefiting from them. The users of stoves supplied by Mary's Meals are required to report damage directly to the producer.

Figure 7: Frequency of schools and Institutions reporting damage to supplier or producer



5.5.3 Maintenance work carried out

Only 4.8% of institutions visited reported that someone had been trained in stove maintenance – and this is probably meant "care for the stove"

A few schools reported to have experimented with repairs, notably to the top insulation. For example in Kasungu, some schools use clay from an ant hill.

So far any problems with the stoves – especially under guarantee – have been attended to by the producers, often after very long delays and unsatisfactory repairs.

Discussion with the producers reveals a reluctance to engage in decentralised repair systems – possibly out of self interest. But clearly, if the number of stoves is to continue to expand, producers will not have the capacity to attend to rectifying damage to stoves under guarantee as well as repairs to the aging stove population.

For long term sustainability, especially bearing in mind the capacity of the producers, independent, localised maintenance systems need to be set up. This system is to the benefit

of the clients (Donors, Ministry of Education) who should be responsible for setting it up. The role of the producers is to provide the technical training which can be paid for by the clients.

5.5.4 Budget provision for maintenance

None of the schools or institutions had budgetary arrangements for the maintenance of stoves. Any maintenance or repairs was carried out under guarantee. However a few respondents claimed that they were aware of the guarantee to the stove (15%) and the stainless steel pot (7%). The low awareness is because the clients are not making the users aware of this privilege.

5.5.5 Materials used in the stove

Stoves

The stand of the stoves is made from mild steel that appears to be durable though showing signs of surface rust. The comprehensive records of WFP indicate less than 3% suffering damage to the stand.

The top insulation, as well as the ceramic bricks and tiles used in the firebox are very fragile and suffer damage on transportation (from the factory to the school, or repeated carrying from the stores to the kitchens). In many cases, some of the damage did not affect performance, in spite of the perceptions of the users.

Pots

Theoretically, the rocket stoves are designed to be manufactured around any available pot. Two types of pots were observed to be supplied and in use. Pots made from half drums, with 120 litre capacity; these are relatively cheap, and have been purchased by school, with process quoted between K750 K2000, including a lid. Other pots are stainless steel pots with lids; these pots are expensive and often cost more than the stove (process quoted were K35,000 for a 110 litre pot).

Without entering into the engineering aspects of the pots, the pattern is clear: stoves supplied with stainless steel pots have a much greater level of acceptance than those supplied with half drums. The perception is that stoves with stainless steel pots perform well, while those with the half drums do not. This may be in part because the half drums are not sturdy and may deform around the circumference, causing uneven gaps between the skirt of the stove. (Refer to picture below).

Only Mary's Meals has from the beginning supplied stainless steel pots that are specifically designed for the rocket stove (single or double). WFP has recently started to replace the half drums with stainless steel pots.

Although the seam welding is done by arc rather than specialised TIG welding, most pots appeared to be durable. Only one pot was observed to be leaking at the seam joint. Some of the stainless steel pots were also observed to have surface rust.

Of concern is the quality of the lids previously supplied to Mary's Meals. Many of the older lids were made of galvanised mild steel which have deteriorated significantly so that they no longer form an effective seal. The problem has since been rectified, with the producer supplying stainless steel lids.

Damaged Lid – no longer providing an effective seal

Using a half drum with the rocket stove means that the gap between the drum and the skirt is > 30mm as drums become deformed gaps can become bigger than recommended

5.5.6 Quality control

Quality control measures are limited to inspection of the dimensions of the rocket stove, including materials used and production quality by ProBEC staff at the producers' workshops prior to dispatch to the clients. Stoves that pass the dimensional tests are issued with a certificate and a guarantee. (Refer to figure 4 above).

It appears to date that individual stoves are not performance tested on delivery to the schools. While the perception of poor performance can also be related to poor use by the cooks, if the users are trained at school level by firing each and every stove, then three of the main challenges will have been addressed: user training in correct use of the stove, user perception on the performance of the stove, and assurance of the quality and performance of each and every stove. It is the responsibility of those supplying the stoves to the schools to ensure this.

5.6 Beneficiaries of the stove

This section outlines the number of children benefiting from school feeding programmes that use the rocket stoves, as well as the impact the stoves have on the users, namely the cooks and school administration.

5.6.1 Children fed from the stoves

It is difficult to accurately quantify the number of beneficiaries of the stoves as the sample is non probability, but estimates can be obtained. Some programmes are no longer fully operational (e.g. GTZ BEP ceased operations in March 2007, though some schools remaining with excess stocks are still preparing meals) the estimates take into account the following:

- Total enrolment targeted (by donor) in *schools using rockets stoves to cook the food*
- Average % of stoves being used (by donor)

Table 6: Beneficiaries of the school feeding programmes using the rocket stoves

Donor	School enrolment (using rocket stoves)	% use of rocket stoves	Number of beneficiaries of school feeding through use of the rocket stove
Mary's Meals – School feeding	210,000	94.4	198,245
Mary's Meals U6 Nursery	3000 – 5000	32 / 43 nurseries. 100% use	2200 – 3700
WFP	229,472	80.6	184,954
GTZ BEP	Programme expired	Low use	Not applicable

Meals for over 385,000 school children are cooked on the rocket stoves.

5.6.2 Frequency of cooking meals

Most schools fire the rocket stoves and fill the pots only once per day, and only cook one pot. The following table assumes an average of 185 school days per year, which is about 50% of the days of a year (this varies from year to year).

- The total number of children targeted for school feeding by WFP, Mary's Meals and GTZ BEP (for 2007) is 798,779 children.
- A staggering 72 million meals per year for over 381,000 children are cooked on the rocket stoves.
- 47.7 % of all school meals are cooked on the rocket stove.

Table 7: Frequency of cooking meals

	Days when food is cooked	Frequency of cooking per day	Number of days meals cooked per year	Total number of meals cooked per year on rocket stove
Mary's Meals	• During school days only for most schools • A few schools (e.g. Ndirande) cook during weekends	• Once per day	• 185 -days	• 36.7 million meals
Mary's Meals, U6 nurseries	• During school days only	• Mostly twice per day	• 185 days	• 1.1 million
WFP	• During school days only	• Once per day	• 185 days	• 34.2 million
GTZ BEP	• during emergency periods, extended for 5 months , November – March • During school days only • Some schools cook during Christmas holidays	• Once per day	• 110 days	• n/a

5.6.3 Food requirements of the children

According to the WFP, the provision of 100g of Likuni Phala provides 380 Kilo Calories, which is 18% of the daily calorie intake of a child. On a yearly basis, the WFP provides 9% of the calorie needs of a child.

GTZ BEP prepare on average between 100 – 110 grams per child, so that this represents between 18 – 20% of the daily requirements.

Mary's Meals provide 70g of phala per child, representing only 13% of the daily calorific requirements. Many of the nursery school children are provided with breakfast and lunch (nsima and relish such as vegetables, beans or fish). The calorific values are not established.

5.7 Correct use of the stove

This section examines proper use of the stove as relating to appropriate firewood and kitchen practices. Observations relate to both the quantitative survey and the more detailed qualitative field visits.

The indicators refer to the fact sheets on good firewood and kitchen practices.

5.7.1 Firewood practices

The table summarises the good firewood practice.

Table 8: Firewood practices

Indicator of good Firewood practice	Average % observed to comply
Small pieces of firewood used	68.7
Is firewood dried before use	68.7
Is stock of firewood stored in dry place	67.5
Place to store firewood during rainy season	57.8
Is surplus firewood removed	63.9
Is excess firewood removed to use for further cooking	67.5

On average about two thirds of schools and institutions displayed good practice. Fewer schools had a place to store firewood during the rainy season because GTZ BEP and WFP did not support the construction of firewood shelters. In some WFP schools the supply firewood was coordinated by schools so that the need for storage space was minimised. For some schools, the supply of firewood was coordinated so that there was an overlap between the end of one supply and the delivery of fresh firewood. This allowed a few days for the fresh supply to be chopped and dried.

Good! - Storing firewood to keep it dry

Bad! – overfilling the pot

5.7.2 Kitchen practices

The main kitchen practices refer to covering the pot and monitoring the heat. Covering the pot ensures better hygiene and faster cooking, thus saving wood, and the monitoring of the fire wood helps economise use.

Table 9: Kitchen practices

	Pot observed covered while cooking, %	Is heat monitored while cooking, %
WFP	50	94.1
Mary's Meals	100	100
GTZ BEP	0	60
private	100	90.9

100% of the pots in Mary's Meals and Private institutions are covered because all the pots are supplied with lids – but also because of good practice displayed by the cooks.

GTZ BEP does not provide lids to the drums, so none of the pots are covered, and WFP have only started to supply pots with lids.

As for donor supported school feeding programmes only Mary's Meals Under 6 nurseries cook food such as beans, but these are not soaked as they are bought the same day required.

Regarding the kitchen practices in the 11 private institutions where rocket stoves are still used for cooking more than 90% cut ingredients in small pieces and cooked food in minimum liquid, but less than 40% said that they soaked food such as beans.

The following tables compare the firewood and kitchen practices by donor support. (For the indicators refer to the IFSP fact sheets.)

Table 10: Firewood practices, by donor

Indicator	Mary's Meals school feeding	GTZ BEP	WFP
Provision of firewood: quantities, type, delivery	- 0.5³ firewood per stove per month supplied by donor - blue gum sourced from plantations in Mulanje - delivered as logs cut in 1 m lengths	- firewood supplied by school children on an ad hoc basis - quantities not quantified - foraged local wood	- firewood supplied by communities through canteen committees on village basis – 1 m³ per village per term - foraged local wood
Facilities to store and dry firewood	- adequate storage space to secure and dry the firewood	- as programmes were ending no firewood stocks were observed	- firewood stocks were left in the open and only immediate requirements stored in the kitchen
Is dry firewood used?	- On delivery firewood is not dry - Green firewood is used for 2 days - After splitting dried firewood is used for rest of the month	- No cooking on rocket stoves directly observed - Rocket stoves reportedly used only during the rainy season when dry firewood is difficult to source	- As fire wood is stored in the open, there is a problem during the rains.
Size of firewood	- the wood is cut into suitable length and width	- the wood is cut into suitable length and width	- the wood is cut into suitable length and width
Amount of firewood used in stove – 3 sticks to start	- yes - for experienced cooks - no - for inexperienced cooks	- No cooking on rocket stoves directly observed	- yes for experienced cooks - no for inexperienced cooks
Removing surplus firewood	- yes for experienced cooks - no for inexperienced cooks	- No cooking on rocket stoves directly observed - NO when cooking on mafua	- yes for experienced cooks - no for inexperienced cooks

Table 11: Kitchen practices, by donor

Indicator	Mary's Meals school feeding	GTZ BEP	WFP
Cooking time	- NO. For under 6 nurseries lunches beans are not soaked	- Not applicable	- Not applicable
Cooking for one longer period	- Not applicable. Stoves are fired once and only one pot per stove is cooked because enough stoves are supplied.	- YES. When stoves are used, 2 pots are cooked one after the other.	- YES. When stoves are used, 2 pots are cooked one after the other.
Cooking with the custom made stainless steel pot –	- Yes – all schools were observed to be cooking on the custom made pot.	- NO. All schools were provided with half drums – the gap between the pots and the drums is over 30mm. - NO. Many schools bought additional pots – half drums.	- NO. Some schools supplied with half drums - NO. Some schools not provided with any pot and purchased half drums. - YES. Many schools are now being supplied with the custom made pots.
Cooking with the lid	- YES. All pots are supplied with correct lids. - NO. Some lids have deteriorated and do not seal effectively.	- NO. No lids have been supplied. - YES. A few schools have purchased additional half drums supplied with lids.	- NO. the half drums were supplied without lids. - YES. The new pots are supplied with lids.
Monitor the fire	- YES. Experienced cooks monitor the fire. - NO. Inexperienced cooks do not monitor the fire. - YES. Experienced cooks train the inexperienced cooks.	- NO rocket stoves were observed to be fired. - NO. The mafua fires were not monitored.	- YES. Experienced cooks monitor the fire. - NO. Inexperienced cooks do not monitor the fire. - YES. Experienced cooks train the inexperienced cooks.
Don't over cook the food	- The Likuni phala is cooked for over 2 hours as it is not the quick-cook type.	- Likuni phala is cooked for 30 minutes when quick cook type is supplied.	- Likuni phala is cooked for 30 minutes when quick cook type is supplied.

5.8 Training in stove operation

The following figure indicates the strategies in place by the various donors as well as the private schools and institutions in training on stove use.

Figure 8: Who was trained to operate the stove

As can be expected, private institutions focused the training on the cooks. There are significant differences between the donors, with both Mary's Meals and GTZ BEP emphasising training of the school feeding programme committee members (who are also cooks), while in schools supported by Mary's Meals there are also efforts to train cooks who are not committee members. Both WFP and GTZ BEP also spend a lot of effort to train teachers in stove use.

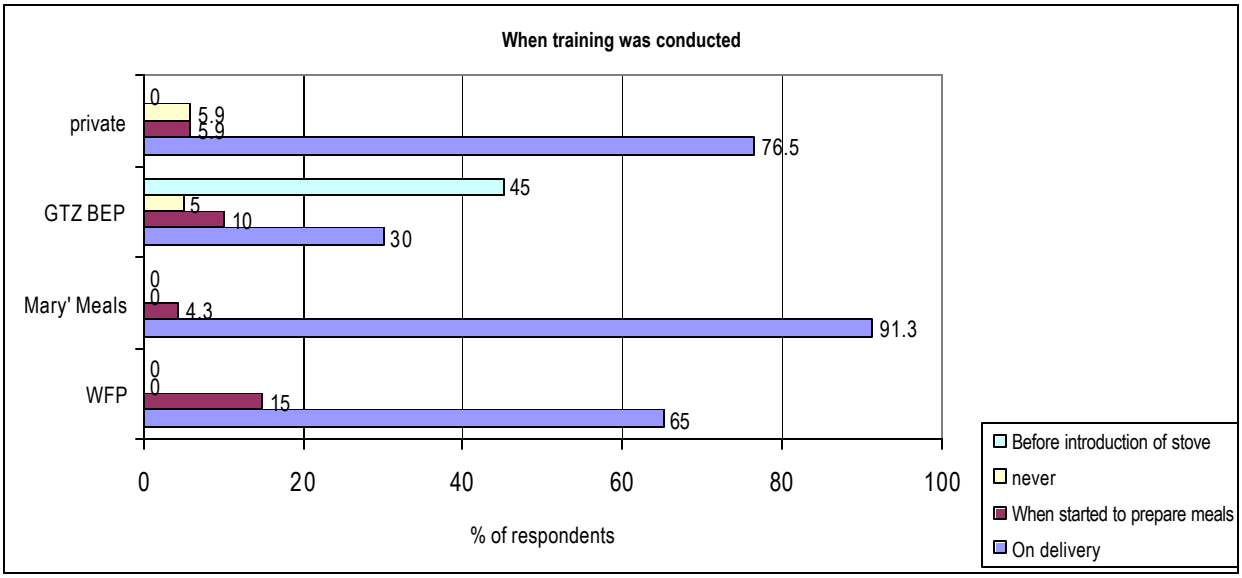
There are significant differences on who demonstrated the operation of the stove. For Mary's Meals and WFP it was through the donor (i.e. monitors) at more than 85%, while as expected for private buyers it was by the producers. For the GTZ BEP supported schools it was reported that the PEA conducted 25% of the training and the donor the rest. In fact almost all the training was conducted by the PEA at cluster level.

Table 12: Who demonstrated the use of the stove?

	colleague	producer	ProBEC	donor	PEA	headmaster
WFP	0	0	0	**85**	0	0
Mary' Meals	4.3	4.3	0	**87**	0	0
GTZ BEP	0	0	0	**55**	**25**	5
private	0	**70.6**	5.9			

Also relevant was the timing of the training. Again with Mary's Meals and the private sector, the training was done on delivery of the stove – so it was of a practical nature. With GTZ BEP almost half of the training was done before the delivery of the stove away from the school and at cluster level.

Figure 9: timing of the training



5.9 Benefits and disadvantages of the rockets stoves

The following tables summarise the advantages and disadvantages of the rocket stoves according to the cooks and administration and are ranked in order of frequency of replies. Note that the questionnaire did not code any "answers" so that all the replies are unprompted.

Table 13: Advantages of the stove according to cooks

	Advantage of the rocket stove as described by the cooks	Frequency of response, %
1	Cooks the food quickly	89.2
2	Firewood savings	75.9
3	Less smoke	54.2
4	Women experience less accidents and burns due to the stability	31.3
5	Ease of monitoring the pots –	24.1
6	Cooks hygienically – no wood and particle falling into pot due to lid	21.7
7	Better quality food – i.e. rocket stove cooks better	19.3
8	Ease of cleaning the pots	13.3
9	Food does not burn -	10.8
10	Cooking is easier as pot does not move as the pot is stable –	8.4
11	Rocket stoves are easier to ignite	6

Table 14: Advantages of the rocket stove according to administration

	Advantages of the rocket stove as described by administration	Frequency of response, %
1	Firewood savings	63.9
2	Cooks quickly	55.4
3	Less smoke	36.1
4	Cooks hygienically – no wood and particle falling into pot due to lid	25.3
5	Women experience less accidents and burns	10.8
6	Good quality food – i.e. rocket stove cooks better	9.6

Table 15: Disadvantages of the stove according to cooks

	Disadvantages of the rocket stove as described by cooks	Frequency of response, %
1	Too heavy to carry from store to kitchen	33.7
2	Easily damaged	27.7
3	Poor performance	7.2

Table 16: Disadvantages of the stove according to administration

	Disadvantages of rocket stoves as described by administration	Frequency of response, %
1	Easily damaged	33.7
2	Too heavy to carry between stores and kitchens	26.5
3	Some cooks don't know how to use stoves	8.4

The following ***advantages*** may be commented upon:

- *Speed of cooking* – indicates the concern of cooks not to spend a long time cooking.
- *Saving of firewood* - is the main concern of the administration as they must organise firewood from the community when it runs out
- That the stove *produces less smoke* - is the concern of all.
- The *safety* of the cooks is also of concern in that due to the stability of the stove and pots there are less burning accidents.
- Issues of *hygiene* are also ranked highly by all.

The following ***disadvantage*** may be commented upon:

- When the cooks are inexperienced or the half drums are used, *the stoves perform poorly.*

5.10 Wood savings

The fuel wood consumption and savings are estimated through the financial records and diaries of the following institutions. The fuel consumption of 4 institutions were analysed

in order to assess fuel savings before and after the introduction of the fuel efficient stoves. Savings ranged from 57% to 71% when measured in volume of wood, and between 80 % and 84% when measured in money spent.

Mary's Meals provides 0.5m³ of fuel wood per stove per month and many schools find this amount sufficient. This means that with the proper use of a rocket stove, 0.5m³ of fuel wood is sufficient to cook a meal for up to 7700 children (based on 22 days a month). This works out as 0.017 m³ of firewood per child per year.

Emmanuel College International Teacher Training College in Blantyre have kept records before and after introduction of rocket stove in 2005 which is a twin rocket stove cooking.

Before the rocket stove – the college was spending MK12,000 per month on firewood for 40 students. Now the college is spending MK2250 –per month for same number of pupils – despite the increased cost of firewood.

- *Before:* *MK300 per student per month*
- *After:* *MK56 per student per month*
- *% savings* *over 80% financial savings*

Chikumbutso Orphan Care in Blantyre and supported by Mary's Meals introduced the twin rocket stove in 2005. In 2005 the orphanage cooked meals for 70 children and in 2007 it caters for 110 children with breakfast, lunch, as well as a feeding programme for non residential children (total 110 children). Firewood expenditure based on a 6 month period before rocket stove was MK9000 while currently they spend MK2250 for 6 month.

- *Before:* *MK129 per child per month*
- *After:* *MK20 per child per month*
- *% savings* *over 84% financial savings*

Goleka Primary School in Chiradzulu has a feeding programme (sponsored by Mary's Meals) started in 2004 and they started to cook using 6 rocket stoves in 2006. From the school records, they used 84 *mendulo* (local unit of measuring firewood) for 2110 pupils, while now they use 36 *mendulo* for 2099 pupils.

- *before –* *used 0.04 mendulo of firewood per pupil per year*
- *after –* *use 0.017 mendulo of firewood per pupil per year*
- *% savings* *over 57% savings in wood*

Champhemvu Primary School in Kasungu started school feeding (sponsored by WFP) in 2003 and used 36 oxcarts of firewood per year for 940 pupils, before the introduction of the rockets stoves. Now since the introduction of stoves in 2006 the school consumes 13.5 oxcarts per year for 1214 pupils.

- *before –* *used 0.038 oxcarts of firewood per pupil per year*
- *after –* *use 0.011 oxcarts per pupil of firewood per pupil per year*
- *savings* *over 71% financial savings in wood*

5.11 Performance of the rocket stove

One of the producers (Ken Chilewe) made the following comments on the reports by the users that some stoves do not perform well –taking a long time to cook food.

- The users remove the firewood stand and load too much firewood resulting in reduced air for burning the wood
- Users do not clean rocket stoves (do not remove ashes) and this affects aeration and firewood burning process
- The users do not monitor the fire closely by periodically pushing the firewood into the chamber when the stoves are fired so that sometimes the firewood burns outside the chamber instead of inside
- Institutional politics: some cooks in the institutions have established long terms relationships with firewood suppliers. The introduction of rocket stoves is seen as a threat to such businesses and benefits

On the report that most of the schools in Zomba (GTZ BEP) complained that the stoves performed poorly, Ken Chilewe's comments were as follows:

- GTZ BEP bought the stoves and supplied their own pots, i.e. half drums:
- The drums do not fit stoves properly as the gap is too big, creating unequal distribution or loss of the heat generated by the fire
- The half drums are smaller than the required size and can move from side to side during cooking (According to ProBEC, this is because the stoves are designed with a bigger gap to accommodate damage and deformation of the drums)
- The half drums are used with out lids during cooking

*Different quantities of firewood being used: by **novice** on the left and by **expert** on the right. Firewood stand in place.*

Good kitchen practices: using the custom-made pot and cover while cooking – notice the small gap between pot and stove -

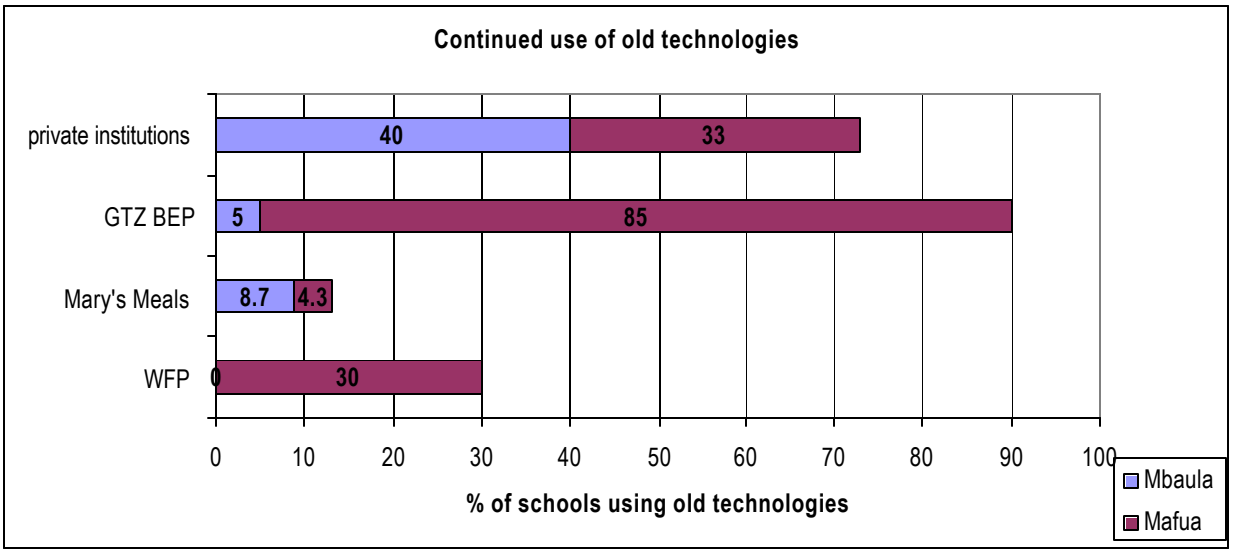
5.11.1 Types of technologies used before the stove

The main technology used before the introduction of the rocket stove was the 3 stone cooking stand (mafua) with 53% of all schools, followed by the Mbaula used in 14.4% of schools, while 26.6% of schools did no cooking at all (due to completion of activity).

5.11.2 Technologies still in use

Some schools use other technologies in addition to the rocket stove. Almost 35% of all schools still use mafua, and almost 11% still use the Mbaula. A break down according to the donor support is illustrated below:

Figure 10: Continued use of old technology



The impact of the strategy of Mary's Meals and WFP in achieving high stove use means fewer schools using parallel or alternative technologies to the rocket stove, while in GTZ BEP supported schools, 90% of respondents use or used other technologies. Note that use of Mbaula is mainly restricted to urban areas.

The continued use of old or other technologies in the private institutions also highlights the lack of impact the rocket stoves have made in being the technology of choice.

6. Clients

This section outlines the comments of the main clients regarding the production and use of the rocket stoves.

6.1 Mary's Meals

Operation of the stoves

- The main concern is that the stoves are sometimes operated by inexperienced cooks, thus reducing efficiency.

Producers

- Concerns about quality – that the producers are unable to maintain quality for large orders, especially the top insulation.

- Concerns about the quality of the pots – especially considering the price – and that the seams are not TIG welded.
- The quality of the lids has improved

ProBEC

- Would like ProBEC to research on the cost effectiveness of using coal which is readily available in Blantyre
- To research changing the dimensions of the pot to reduce the gap between the stove and skirt, and increase the ratio of the height / diameter in order to increase efficiency, by making the pots higher.

6.2 GTZ BEP

Operation of the stoves

- Many users have not accepted the stoves, complaining they are too heavy, there are too many rules to operate them properly, and that they still smoke.
- The stoves are not used because the few committee members who were trained did not pass on their skills.
- The stoves are more suited to permanent kitchens.

Producers

- As many stoves were damaged in transit to the schools – GTZ BEP tried to repair on site, but the Mulanje workshop did not approve of these repairs
- The high cost of the stoves. Is it cost effective to spend MK25000 on a stove for a school feeding programme lasting 5 months?

6.3 WFP

Operation

- The stoves are very heavy to move from store to kitchen and can be damaged
- Need to investigate stove fixed permanently in the kitchen
- Need to train more people in stove repairs and spares to be more easily available – to make the stoves more sustainable

Producers

- WFP considers that the price of the stoves is high
- Some stoves perform poorly – don't get hot enough, or take too long to cook
- Reports from warehouse that some stoves have been delivered damaged , especially mortar
- Damaged stoves that are returned to the producer take too long to be returned – and some repairs have not been adequate
- The pots can perforate from intense heat
- Considering the price the warranty period by some producers is too short
- producers needs to keep some stocks to respond to demand of WFP – would like 4 week delivery period, but delivery is mostly 8 weeks, with only Mulanje and Dedza delivering on time – problem is also delivery time from Dedza pottery

7. Stove Manufacturers

This section profiles the 4 certified producers and the producer of the ceramic components.

7.1 Ken Steel - Mulanje

Ken Chilewe started stove production in 2004, following an order from the then IFSP. The design for the rocket stove was supplied by ProBEC. A total of 2372 rocket stoves of different sizes since 2004 from 10 litres to 250 litre capacity have been produced and sold. The main clients include Donors (WFP, UNICEF, Concern Universal, Mary's Meals, and GTZ) and Private Clients (Private Schools, Orphanage Centres, Hospitals, Prisons, individual households). Ken Steel provides a 12 month guarantee on stoves and 24 months on pots.

The producer faces the following challenges

- Materials ordered from Dedza do not come in time
- Refcast ordered from South Africa is very expensive
- Institutions already using electricity are reluctant to adopt rocket stoves – Cooks come up with various excuses for not using the stoves
- Rocket stove users do not follow operating instructions – resulting in breakage to the ceramics and poor performance

7.2 CH Welding Services – Lilongwe

CH welding started production of rocket stoves in 2005. The Manager attended training in Mulanje ProBEC where he learnt about design, materials, production, operation and maintenance, cost estimation. The training was adequate, as any ongoing changes have been advised to CH Welding during quality control inspections at their premises. The main change to stove design has been the removal of the wood loader.

The main clients are WFP and UNICEF. The stoves with 110 litre capacity retail for MK24300 while the 5 litre capacity stoves are MK5300. The stoves come with a 6 month guarantee – but no claims have been made. The producer has no links with the users of the stoves.

The main challenges are a lack of capacity to fabricate the steel skirt and stainless steel pots – these are outsourced. Another challenge is to meet production deadlines due to the minimum 6 week production lead time of the ceramic components by Paragon Ceramics.

7.3 Take Pride Engineering – Mzuzu

Started production in 2005, and has produced 80 stoves to date, for the following clients: the WFP, GTZ BEP, private schools and households. Take pride faces similar challenges in accessing the ceramics on time in order to meet their own delivery dates. Being in the north means escalated transport costs and lack of access to technical support by ProBEC. The producer has little contact with clients once the stoves have been delivered.

7.4 Umodzi Garage – Dedza

Umodzi's main clients include WFP with 47 already sold and 334 under production and GTZ BEP.

Main challenges include the poor quality of the ceramics and have enquired about the use of refcast (available from Bestobell at MK7000/25kg) but need technical assistance on its application. They are also concerned that despite improving quality their prices are pushed down. Another problem is the long delivery time of the ceramics (they must deliver stoves to clients within 45 days but the delivery time for the ceramics is 42 days). Another challenge is poor communication by ProBEC. Umodzi reported that after submitting a bid to WFP based on the tender specifications, they were informed belatedly that the specifications had changed, giving one of their competitors an unfair advantage.

Mr Mlombwa, the proprietor commented that the stoves do not work well without the correct fitting pots. As the stainless steel pots are very expensive to produce (MK40,000 for 110 litre pot) he suggested that the stoves should be designed around cheaper aluminium ones of 100l capacity that are more readily found locally, or they can be purchased by the organisations.

Table 17: Production of Rocket Stoves

Size of pot, litres	Ken Steel Mulanje (2004 to April 2007)	CH welding Lilongwe (Nov 2005 – June 2007)	Take Pride Engineering Mzuzu	Umodzi Dedza
<50 l including household	397	8	11	
50 (UNICEF)	407	100		
110 (WFP, GTZ BEP)	997	136	53	88, and 334 under production
120 (Mary's Meals)	427			
>120 l	144	1	16	2
Total	**2372**	**245**	**80**	**424**

7.5 Uncertified producers

- ***Rumphi***

Phwezi Private Secondary school had originally bought 3 rocket stoves from Take Pride Engineering in Mzuzu, and they were satisfied with the performance. They were approached by an uncertified producer with the offer to manufacture 8 stoves for the school but none of these 8 stoves have functioned.

- ***Assemblies of God – Lilongwe***

Purchased 4 rocket stoves from Ken steel, and performed well (apart from smoke and minor breakage). One of the pastors with engineering qualifications and based in Luchenza reproduced the design with some modifications – and manufactured 4 stoves – these proved superior to the original stoves so that the Assemblies transferred the original stoves to the outstations and use these modified stoves. He also manufactures stainless steel pots of superior quality to the original as they do not rust. (cost MK 85000 for 200 litre stove and stainless steel pot).

7.6 Paragon Ceramics

Paragon Ceramics produces and supplies the ceramic bricks, tiles, liners for the firebox and the HTM for the mortar and top insulation.

Commenting on the concerns about poor durability, the company replied that the two requirements of durability and the insistence of light weight are not compatible. The price and durability could be improved if ProBEC specified standard kiln bricks. To do this the stove would have to be designed around these standard sizes available.

Responding to the producers complaints of the 6 week delivery time for the bricks and tiles, Paragon responded that this is the minimum time needed to air dry the products. On the other hand the company cannot afford to keep stocks as the design of the stove has changed several times.

Paragon ceramics would consider a proposal from ProBEC to develop a module to train representatives from the clients of the rocket stove in undertaking repairs to the stoves.

8. Lessons learned

Analysis of the qualitative and quantitative data indicates that the impact of the rocket stoves – i.e. acceptance, correct and sustained use - depends on the following variables. Note that the variables are interrelated and the absence of one variable may lead to the low acceptance of the stove despite the presence of all other variables.

a. Training the correct target group

It is essential that the people trained in the use of the stoves are those who will be operating them. For school feeding programmes that work on volunteer cooks from a number of committees, it is also necessary to train sufficient numbers from each committee.

b. Training by demonstrating and practicing

Training in stove operation should be of a practical nature and done by actually lighting the stove and cooking a pot of Likuni phala, or other food for the private institutions. The training should be done on site – at the school kitchen.

c. The correct functioning of each and every stove

A critical aspect in the impact is the confidence the users have in the quality of a stove. Many users abandoned stoves either because of superficial damage to the insulation, or poor performance.

As such each stove needs to be demonstrated on site for performance and the best way to do this is to fire each stove during the training, and to ensure the users can operate each stove satisfactorily. ProBEC may develop guidelines stating the maximum time it takes to boil an amount of water. This can be part of the user guide and manual

d. Motivation to use the stove

In those schools where stoves were used, the cooks and administrative staff were motivated to adapt their cooking practices especially because of savings of time and fuel. This motivation had been supported by the properly functioning stove.

In some schools, it was reported that the cooks were not motivated by fuel savings as this was not of benefit to them.

e. Provision of an adequate number of pots

When the sponsor provided only one stove, or too few stoves, the impact of the stoves on the programme was very low.

In those schools where sufficient stoves and pots were provided to cook all the Likuni phala in one session, motivation and impact was high.

f. Provision of the custom made pots with fitting lids.

Most of the schools that did not accept the rockets stoves had been provided half drums as pots, and without any lids. In most cases the users complained that the stoves were too slow.

Highest impact was observed in those schools that were provided with stainless steel, custom made pots, fitted with lids. It was observed that in these schools the stoves performed well, cooking quickly and using less firewood.

g. On going monitoring and supervision –

There is also a strong correlation between correct stove use and the presence of ongoing monitoring by the donor and the district coordinator. This is especially so when the monitor acts as a link between the users and the donor or producer, to report any damage to the stove or poor performance.

Table 18: What strategies affect impact?

Intervention Strategy	Low Impact	High Impact
a. WHO to train	• No one trained • When only head teachers, village leaders and PTAs are trained.	• When all members of the canteen are trained at school level. • Each time a participating village took the lead in cooking, at least one person is proficient in using the rocket stove – peer training • When the monitors and coordinators are also trained in stove use
b. How to train	• When training is only on a theoretical level	• When the participants learn by using the stoves to cook a meal • Peer to peer training during the cooking sessions; cooks experienced in stove use are positioned near learners
c. The correct functioning of each and every stove	• When the stoves are just deposited at a school • When stoves are delivered with damage • When stoves perform poorly on first use	• When stoves are used during the training and performed well – cooking quickly, using less firewood and producing less smoke • When users are aware of the guarantee period and take action if necessary • When committees report damage or poor performance of the stove to the producer or donor • When the producer or donor takes action to repair or replace the stove • When the producer or donor gives feed back on complaints
d. What motivates users?	• When firewood is easily accessible • When cooks prefer traditional technology or electricity	• When firewood is expensive • When the volunteer cooks are busy at home and want to save time cooking
How many stoves and pots are required to do the job?	• When few stoves and pots are supplied in relation to enrolment	• When sufficient stoves and pots are provided to cook for all the children in one session
e. *What type of pots should be supplied?*	• Use of half drums • Cooking without lids	• Cooking with custom made pots • Cooking with lids
f. *What type of monitoring and supervision*	• Irregular or no monitoring	• Regular monitoring and support by the donor, supplier or district

9. Specific recommendations

The following specific recommendations may be considered in order to improve the impact and effectiveness of the rocket stoves.

a. Training the correct target group

While monitors, coordinators and PEAs may be trained as trainers, the cooks must be trained in the correct operation of the stove. If the committee operates on a schedule, ensure that each group has at least one person trained in stove operation.

b. Training by demonstrating and practicing

The training of the trainers and of the cooks is to be of a practical nature; that is a meal must be cooked.

c. Performance testing of each rocket stove

As part of the training, each stove it to be fired and tested on site at the school. There are to be a guidelines in the maximum time required for bringing a specified volume of water to the boil.

d. Advocacy

Each rocket stove is to be fired on site with the users and its performance - time to cook and use of fire wood - compared with traditional stoves. This should be the role of the donors as part of the training.

e. Training to include maintenance

There is to be some training in simple maintenance as many cooks perceive that a damaged stove will not perform correctly. To improve the operation and maintenance capacity at district and local level – using the VLOM and Advanced repair model for the Afridev hand pump, including availability of spares.

f. To design an extension system

Some of the donors (e.g. WFP and Mary's Meals) have high staff turnover, leading to a loss of institutional knowledge. An extension system based on the District administration may be developed in order to affect the initial training and ongoing training of the stove users, as well as monitoring and evaluation.

g. Redesign of kitchens

Supporting donors may reconsider the design of kitchens to allow the secure anchoring of the stoves to avoid the daily carrying to the stores, taking into account security, weather proofing and adequate light and ventilation for the cooks.

h. Provision of custom made pots with fitting lids.

The stoves only perform best if used with the (more expensive) durable stainless steel pots and lids that do not deform like the half drums. Obviously such an investment depends on life span of programme and the budget. ……

i. Provision of an adequate number of pots

The correct number of stoves and pots are to be provided in order to cook all the food in one session.

j. On going monitoring and supervision

The field monitors are to provide ongoing support to the cooks in the operation of the stove during their field visits.

10. Conclusion

When the correctly used, the rocket stoves provide significant advantages, namely in savings in cost, fuel, and time.

However, correct use of the stoves depends significantly on the initial and ongoing training provided to the users.

The perception the users have of the stoves is not always a positive one, and the firing and testing of each stove will go a long way towards advocacy of the effectiveness of the stoves.

The stoves and the custom made pots are not cheap. The decision on whether to purchase a stove and a custom made pot will need to take into account the following operational factors, amongst others:

- The commitment and capacity of the organisation implementing the school feeding programme to provide initial and ongoing training, as well as supervision on correct use of the stove
- The financial resources available by the organisation to implement the main recommendations made in this report
- The duration of the school feeding programme in a particular school

11. Annexes

10.1 Terms of reference

Terms of Reference for ProBEC study on institutional rocket stoves in school kitchens

Preamble

Programme for Biomass Energy Conservation (ProBEC) has promoted the production, installation and use of Rocket Stoves in large kitchens e.g. schools. Particular emphasis was given to the promotion through school feeding programmes of organizations like World Food Programme WFP, Basic education programme (GTZ-BEP), Mary's Meals and UNICEF.

In order to establish the number of people assisted with access to modern energy through this type of intervention, ProBEC intends to empirically verify some of the underlying assumptions (see appendix 1 below) though a stratified sample survey in June 2007.

Objectives of the studies

Assess the…

- usage
- durability
- beneficiaries
- proper use
- wood savings

…of the stove. (see list of questions below)

Scope of work

- Stratified sample by business approach (20) and donor based approach (60), and by time of delivery-(20 stoves each for WFP, GTZ BEP, Mary's Meals [Blantyre]) and 20 stoves of individually run schools which directly purchased stoves by Rocket Stove producers. For WFP if possible sample 10, 5 and 5 schools for period 2004, 2005 and 2006 respectively. A purposive sampling will be done for the districts and those with the highest density of institutional rocket stoves need to be selected. A total of 2 to 4 districts have to be selected.
- Conduct participatory sessions with users (cooks, institution management team)
- Document the findings
- Present findings to key partners (WFP, GTZ BEP, UNICEF, Mary Meals) and ProBEC
- Present findings to ProBEC Regional Manager

(Mary Meals will have a Ph.D student doing a research on this topic in July for 6 weeks who will cooperate with ProBEC Team.)

Timing of study
Results to be presented by latest mid July, 2007.

Usage: Verification of the link between stove production figures / delivery register / use of stoves in schools

1. Has the stove recorded to be delivered really been delivered at the place indicated in the register, ar when was it delivered?
2. Was the stove which was delivered really been used at some point in time?

3. Is the stove still in use?
4. If not: Why did they stop using it?
5. Explore kitchen and firewood management practices currently being used and how they affect use o the stove (see appendix 2 below)

Results:

- Correctness of Ledger
- % of stoves which were used after delivery
- % of stoves which are still use (today)
- Reasons for giving up using stove
- Average age of stoves still in use
- %age of stoves still in use by duration of service (1-6 months; 7-12;13-18; 19-24; 25-30; 30-36; above)

Durability of stoves:

6. Have they observed any signs of damages of the stove? Which ones?
7. Did anyone so far do any maintenance work on the stove?
8. Do they make any budget provisions or arrangements for the maintenance of the stove?
9. If stove is no longer used: for how long did you use the stove?
10. Observation of the material of the stove used?
11. Availability of quality control skills and its effectiveness? Who does the quality control and when?

Results:

- % of stoves with damages
- % of damages stoves still in use
- % of damaged stoves maintained
- Average lifespan of damaged stoves (not used any longer)
- %age of users with maintenance concept

Beneficiaries per stove:

12. How many times per day is the cooking pot belonging to this stove filled (full?) and fired?
13. How many different children per day receive how many meals per day from this stove?
14. What percentage do these meals in the school represent in the total amount of cooked meals per da for these children? Are there different cases to be distinguished (e.g. orphans, boarding pupils, day pupils…)? Can we quantify an average?

Results:

- Average number of pupils reached per stove per day?
- Average % of School meals in daily cooked meals per pupil (cases? Weight of cases?)
- % of days per year where food is offered to the children

Proper use of stove:

Consultant observes cooking in canteen

15. Is there a facility to store and dry firewood?
16. Are they using dry firewood?
17. Is the firewood split in suitable sizes?
18. Amount of firewood in stove is reasonable?

19. Lid is placed on cooking pots?

As long as wood savings verify the 50% savings, the use of the techniques is not necessarily required from DGIS perspective. In the viewpoint of BMZ indicators, however, the techniques are an integral part of the package.

Wood savings per stove/per institution:

20. What kind of stove was used before the Rocket Stove? (take picture if baseline technology is still available)

For schools where all food is now prepared on Rocket stoves

21. How much firewood did the school use before the introduction of Rocket stoves (in kg/bundles/truck loads/money spend…)
22. How much firewood does the school use since all old stoves have been replaced by Rocket stoves?
23. Are there any other benefits of using the Rocket stove beyond the firewood use reduction?
24. Are there disadvantages of using the Rocket stove? Which ones?

For schools where baseline stoves and Rocket stoves are used side by side:

25. How much firewood do the cooks use for preparing the same amount of food/same size cooking pot with same food on the old stove and on the Rocket stove (in kg/bundles/truck loads/money spend…)
26. Which other differences between the 2 stoves can be observed?

Result:

- Wood savings by stove/by school in a qualitative measure
- Other benefits and disadvantages of use or rocket stove

Appendix

So far we work with a lot of assumptions when calculating the figures that we report to DGIS. The objective of the study is to substantiate the guesses and replace them with researched facts.

Example: 100 litre pots

Indicator	**Assumption so far for school feeding stoves**	**Means of verification / Issue to be researched**
Average annual production	Based on the list of stoves produced that we get from the producers We assume so far that a stove sold is a stove used.	Figures from the producers, to check whether they are correct. We need to verify if the sales is translating into stoves delivered? 1. Has the stove sold reached the school? 2. Have the stoves delivered been used at all? 3. Are the stoves delivered still in the location and are they in used? If not used any longer: 1. For how long has it been used (duration)? 2. Reason for stopping to use it
Lifespan	3 years	Get actual figures from Observations from the field and reports from the users and get different cases of durability and conditions of stove. Has the stove been maintained? If yes: When, how often, by whom, what? Are there plans for maintenance? Are there funds for maintenance?
Size of pot (volume)	100 l	Should be reflected in the lists of certificates / stoves produced
Number of firings/meals per day, Usage pattern per year	Each stove used once per day throughout the year on weekdays	User pattern: Is the stove being used throughout the year? Or only temporary during relief interventions? If yes, for how many months in the last years?
Number of kids served from one pot filling	Ca. 3 kids per litre 50 litters = 120 kids 100 litres = 250 kids	Find out how many kids really get served and how big the portions really are. Do kids get only one portion or are there kids (like orphans) who do get two portions?
Number of meals per day	One meal per day	Find out actual number of meals per stove
Proper use of stoves, firewood savings	No assumption made there as not part of the formula	Get indication of firewood consumption before and after stove

10.2 Areas of intervention by Mary's Meals

Summary school feeding programmes supported by Mary's Meals

No	District	Number of schools with stoves
1	Blantyre	60 schools + 32 nurseries
2	Chiradzulu	5
3	Zomba	7
4	Thyolo	4
5	Mulanje	2
6	Dowa	2
7	Neno	1
8	Karonga	1
9	Mzuzu	3
10	Kasungu	1
11	Mchinji	1
12	Mwanza	1
Total		**88 schools + 32 nurseries**

10.3 Areas of intervention by GTZ BEP

Summary of GTZ BEP 2005 – 06 school feeding programme

GTZ BEP was involved in school feeding 2005 – 2006 in Zomba Rural, Blantyre Rural, Balaka, Machinga, and Mwanza.

GTZ BEP coordinated school feeding programmes in 3 zones in Zomba rural for 5 months from 31st October to 30th March, Monday to Friday, including some school holidays

Summary of GTZ BEP interventions in Zomba 2005-06

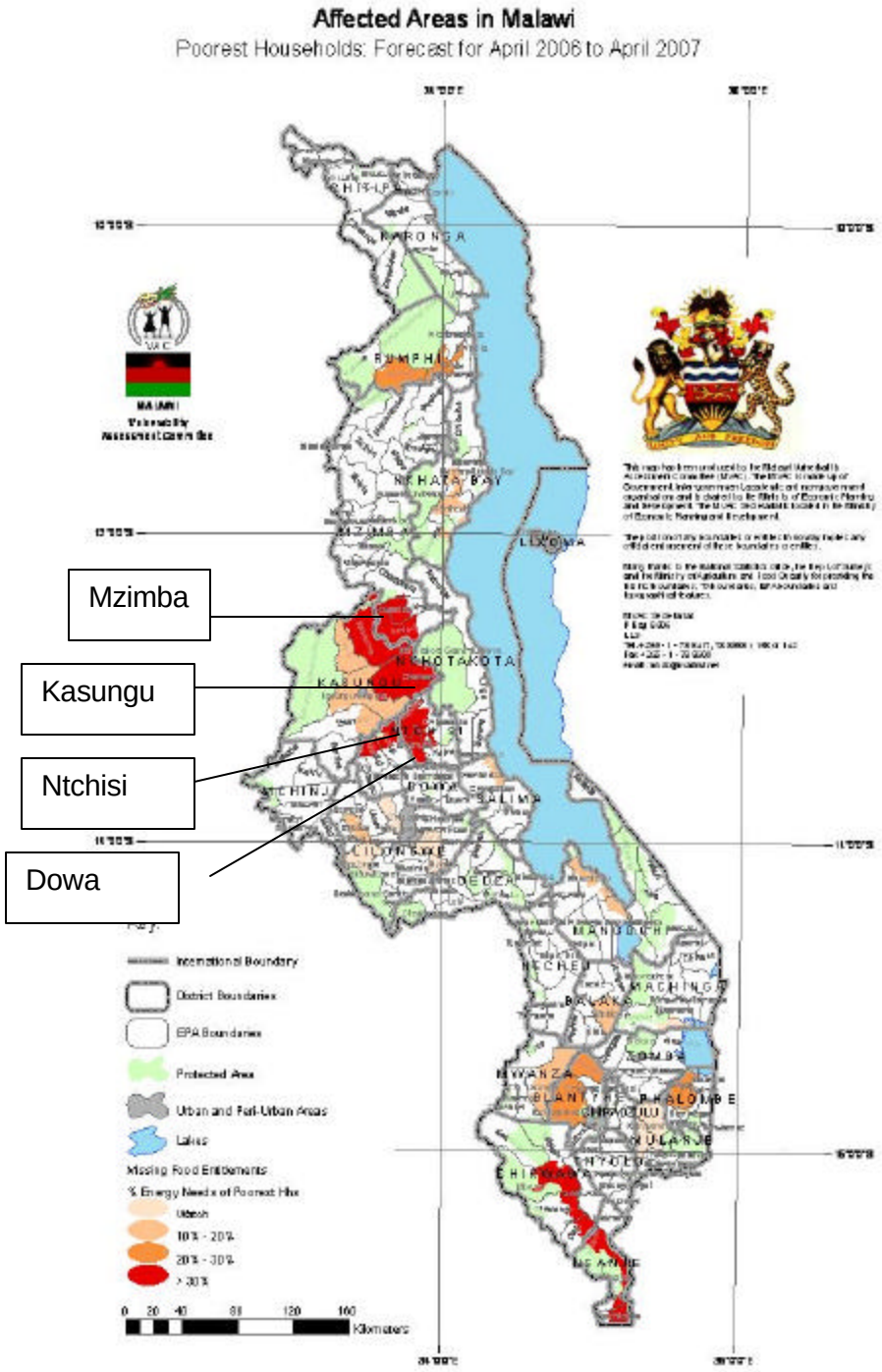
GTZ BEP intervention area	Number of schools	School enrolment	Number of 25 kg bags per day
Ntonda Zone	12	13537	56
St Paul Zone	7	3532	17
St Martin Zone	5	5002	23
Total	**24**	**22071**	**96**

Summary of GTZ BEP 2006 – 07 school feeding programme

No	District	Number of schools with feeding programme	Number of schools with stoves	Enrolment Jan 2007
1	Dowa	93	93	56884
2	Ntchisi	116	116	52469
3	Mzimba	108	108	37542
Total		**317**	**317**	**146895**

10.4 MVAC Map – 2006- 2007

Malawi Vulnerability Assessment Committee's report on the poorest households



10.5 Areas of Intervention by WFP

Summary of school feeding programmes supported by WFP (2006 – 07)

District	Number of schools with stoves	Number of stoves distributed
Kasungu	44	166
Lilongwe	33	73
Mangochi	34	41
Thyolo	9	36
Nkhata Bay	10	31
Dedza	24	27
Ntcheu	20	25
Salima	21	21
Nsanje	13	13
Chikwawa	7	7
Total	**215**	**440**

Summary: Data from WFP Reports dated June 2007

Data on schools with school feeding programmes provided with rocket stoves

District	Enrolment	Number of stoves distributed	Number of stoves damaged
Kasungu	32671	182	141
Lilongwe	36302	81	11
Mangochi	36662	41	5
Thyolo	12330	35	23
Nkhata Bay	5514	31	2
Dedza	21603	28	16
Ntcheu	23666	31	11
Salima	15878	29	16
Nsanje	26843	71	17
Chikwawa	18003	20	9
TOTAL	**229472**	**549**	**251**

10.6 List of sampled schools and institutions

The following table lists all the schools and institutions included in the study.

	Date	District	Name of donor	Name of school / institution	Name of enumerator
1	21-Jun-07	Lilongwe	WFP	Mphandula School	A.V. Msukwa
2	22-Jun-07	Lilongwe	WFP	Mdzobwe School	Joe DeGabriele & A.V. Msukwa
3	27-Jun-07	Chiradzulu	Mary's Meals	Mkwanda Under Six School	Joe DeGabriele & A.V. Msukwa
4	27-Jun-07	Chiradzulu	Mary's Meals	Goreka School	Joe DeGabriele & A.V. Msukwa
5	27-Jun-07	Blantyre	Mary's Meals	Mbayani under 6 School	Joe DeGabriele & A.V. Msukwa
6	27-Jun-07	Blantyre	business	Blantyre Secondary School	Joe DeGabriele & A.V. Msukwa
7	27-Jun-07	Blantyre	business	ELMA	Joe DeGabriele & A.V. Msukwa
8	28-Jun-07	Blantyre	Mary's Meals	Nkolokoti Primary School	Joe DeGabriele & A.V. Msukwa
9	28-Jun-07	Blantyre	Mary's Meals	Nanjiriri Primary School	A.V. Msukwa
10	28-Jun-07	Blantyre	Mary's Meals	Chikapa under 6 school	Joe DeGabriele
11	29-Jun-07	Blantyre	Mary's Meals	Chigumula Primary School	Christopher Phwandaphwanda
12	29-Jun-07	Blantyre	Mary's Meals	Chikumbutso Orphan Care (under six)	Christopher Phwandaphwanda
13	29-Jun-07	Blantyre	Mary's Meals	Namatapa Primary School	Christopher Phwandaphwanda
14	29-Jun-07	Blantyre	Mary's Meals	Mpingwe Primary School	A.V. Msukwa
15	29-Jun-07	Blantyre	Mary's Meals	Chisombezi Primary School	A.V. Msukwa
16	29-Jun-07	Blantyre	Mary's Meals	Bangwe CCAP School	Doreen Nyirenda
17	29-Jun-07	Blantyre	Mary's Meals	Misesa Primary School	Doreen Nyirenda
18	29-Jun-07	Blantyre	Mary's Meals	Naizi Primary School	Doreen Nyirenda
19	29-Jun-07	Blantyre	Mary's Meals	Mzamba Primary School	A.V. Msukwa
20	30-Jun-07	Blantyre	business	Emmanuel International College	A.V. Msukwa
21	30-Jun-07	Chiradzulu	business	Virgo Fidelis (MaryView)	Christopher Phwandaphwanda
22	30-Jun-07	Chiradzulu	business	Nursing Home (Mary View)	Christopher Phwandaphwanda
23	30-Jun-07	Chiradzulu	business	Mary View Novitiate	Doreen Nyirenda
24	30-Jun-07	Blantyre	business	Blantyre Teachers Training College	Doreen Nyirenda
25	2-Jul-07	Blantyre	Mary's Meals	Ndirande LEA (Kachere) Primary School	A.V. Msukwa
26	2-Jul-07	Blantyre	Mary's Meals	Ndirande Matope Primary School	A.V. Msukwa
27	2-Jul-07	Ntcheu	business	New Era Girls Secondary School	Doreen Nyirenda
28	2-Jul-07	Blantyre	Mary's Meals	Chitsime Primary School	Doreen Nyirenda
29	2-Jul-07	Blantyre	Mary's Meals	Holy Ghost Orphan Care (Under 6)	Doreen Nyirenda
30	2-Jul-07	Blantyre	Mary's Meals	George 1 Under 6	Doreen Nyirenda
31	2-Jul-07	Blantyre	Mary's Meals	Ndirande Hill Primary School	Christopher Phwandaphwanda
32	2-Jul-07	Blantyre	Mary's Meals	Makata Primary School	Christopher Phwandaphwanda
33	2-Jul-07	Ntcheu	business	New Era Boys Secondary School	Christopher Phwandaphwanda
34	29-Jun-07	Zomba	GTZ	Zaone Primary School	Joe DeGabriele
35	29-Jun-07	Zomba	GTZ	Havala Primary School	Joe DeGabriele
36	29-Jun-07	Zomba	GTZ	St Pauls Primary School	Joe DeGabriele
37	29-Jun-07	Zomba	GTZ	Sekwere Primary School	Joe DeGabriele
38	29-Jun-07	Zomba	GTZ	Ntonda Primary School	Joe DeGabriele
39	29-Jun-07	Zomba	GTZ	Matandwe Primary School	Joe DeGabriele
40	25-Jun-07	Rumphi	business	Phwezi Secondary School	Glyn Chitete
41	27-Jun-07	Mzimba	business	Mzuzu Polytechnic	Glyn Chitete

42	26-Jun-07	NkhataBay	business	Tukombo Secondary School	Glyn Chitete
43	3-Jul-07	Lilongwe	WFP	Kapinga Primary School	A.V. Msukwa
44	3-Jul-07	Lilongwe	WFP	Kaphulika Primary School	Glyn Chitete
45	3-Jul-07	Lilongwe	WFP	Kasambwe Primary School	A.V. Msukwa
46	3-Jul-07	Lilongwe	WFP	Mphambano Primary School	Christopher Phwandaphwanda
47	3-Jul-07	Lilongwe	WFP	Katsumwa Primary School	Justin Milonde
48	3-Jul-07	Lilongwe	WFP	Kanyambwe Primary School	Justin Milonde
49	3-Jul-07	Lilongwe	WFP	Kabudula Primary School	Doreen Nyirenda
50	3-Jul-07	Lilongwe	WFP	Kabuthu Primary School	Christopher Phwandaphwanda
51	3-Jul-07	Dowa	GTZ	Madisi Primary School	Joe DeGabriele
52	4-Jul-07	Dowa	GTZ	Mphudzu Primary School	Doreen Nyirenda
53	4-Jul-07	Dowa	GTZ	Kabwinja Primary School	Doreen Nyirenda
54	4-Jul-07	Dowa	GTZ	Magantha Primary School	Doreen Nyirenda
55	4-Jul-07	Dowa	GTZ	Nambamba Primary School	Doreen Nyirenda
56	4-Jul-07	Dowa	GTZ	Chandawe Primary School	Christopher Phwandaphwanda
57	4-Jul-07	Dowa	GTZ	Chizolowondo Primary School	Christopher Phwandaphwanda
58	4-Jul-07	Dowa	GTZ	Mtiti Primary School	Christopher Phwandaphwanda
59	4-Jul-07	Dowa	GTZ	Simbi Primary School	Justin Milonde
60	4-Jul-07	Dowa	GTZ	Mkhobola Primary School	Justin Milonde
61	4-Jul-07	Dowa	GTZ	Nauchi Primary School	Justin Milonde
62	4-Jul-07	Dowa	GTZ	Mtanila Primary School	Glyn Chitete
63	4-Jul-07	Dowa	GTZ	Chikwawe Primary School	Glyn Chitete
64	4-Jul-07	Dowa	GTZ	Mkuyu Primary School	Glyn Chitete
65	5-Jul-07	Kasungu	Mary's Meals	Chankhanga Primary School	A.V. Msukwa
66	5-Jul-07	Kasungu	WFP	Chisumbu Primary School	Christopher Phwandaphwanda
67	5-Jul-07	Kasungu	WFP	Chisuwe Primary School	Christopher Phwandaphwanda
68	5-Jul-07	Kasungu	WFP	Kambulu Primary School	Doreen Nyirenda
69	5-Jul-07	Kasungu	WFP	Katundu Primary School	Doreen Nyirenda
70	5-Jul-07	Kasungu	WFP	Juni Primary School	Glyn Chitete
71	5-Jul-07	Kasungu	WFP	Lingadzi Primary School	Glyn Chitete
72	5-Jul-07	Kasungu	WFP	Chulu Primary School	Glyn Chitete
73	5-Jul-07	Kasungu	WFP	Kasamba Primary School	Justin Milonde
74	5-Jul-07	Kasungu	WFP	Champhemvu Primary School	Justin Milonde
75	5-Jul-07	Kasungu	WFP	Demera Primary School	Justin Milonde
76	6-Jul-07	Lilongwe	business	Mitundu Secondary School	Doreen Nyirenda
77	6-Jul-07	Lilongwe	business	Moma Girls Secondary School	Doreen Nyirenda
78	6-Jul-07	Lilongwe	business	Dzuka Girls Secondary School	Christopher Phwandaphwanda
79	23-Jun-06	Rumphi	business	Our future Private Secondary School	Glyn Chitete
80	6-Jul-07	Lilongwe	business	Likuni Seconadry School	Glyn Chitete
81	2-Jun-07	Ntcheu	business	Kings Foundation secondary School	A.V. Msukwa
82	9-Jul-07	Lilongwe	business	Assemblies of God	Justin Milonde and A.V. Msukwa
83	9-Jul-07	Lilongwe	business	Lilongwe Technical College	Justin Milonde

10.7 List of persons and institutions consulted

Date	Institution	Place	Persons Consulted	Interviewer
19 & 20 June	CH Welding services	Lilongwe	- Mr Dambalika and Mr Banda stove producers	J DeGabriele, A Msukwa
21 June	WFP Office	Lilongwe	- Irene Kumwenda, School Feeding Programme Assistant - Matilda Zande , Procurement - Oswald Jumali, Grace Matewere, Davis Luhanga, Field Monitors	J DeGabriele, A Msukwa
21st June	WFP school feeding Lilongwe	Lilongwe	- Mrs Kasalika, Deputy Headmistress Mphandula Primary School	A Msukwa
22nd June	WFP school feeding Lilongwe	Lilongwe	- Mr S.G. Malenga (Headmaster, Mdzobwe Primary School), Mr Kagwa (Deputy Headmaster, Mdzobwe Primary School)	J DeGabriele, A Msukwa
24-Jun	Take Pride Engineering	Mzuzu	- Mr Mkandawire – stove producer	Glyn Chitete
26 June	GTZ BEP office	Lilongwe	- Anne Ntambo – National School Feeding Coordinator	J DeGabriele
26th June	Private school	Mzuzu	- Matron, Tukombo Girls Secondary School	Glyn Chitete
27 & 28 June	Mary's Meals office	Blantyre	- Florian Suedi – Operations manager - Angela Mpando – Assistant Country Director - Peter Nkata Country Director - Neria – Field Monitor	J DeGabriele, A Msukwa
27 June	ELMA High School	Blantyre	- Principal	J DeGabriele, A Msukwa
27 June	Mary's Meals School feeding	Blantyre	- Mkwanda Under 6 Nursery Attendants (2), - Mbayani Under 6 Attendants	J DeGabriele, A Msukwa
27 June	Mary's Meals School feeding	Chiradzulu	- Headmistress, Goreka Primary School	J DeGabriele, A Msukwa
28 June	Mary's Meals School feeding	Blantyre	- Headmaster, Mzamba Primary School	J DeGabriele, A Msukwa
28 June	Mary's Meals School feeding	Blantyre	- Mrs Wandale, Headmistress Nanjiriri Primary School	J DeGabriele, A Msukwa
28 June	Mary's Meals School feeding	Blantyre	- Mr Levison Mpoya, Headmaster Nkolokoti Primary School	J DeGabriele, A Msukwa
29 June	GTZ BEP Zomba	Zomba	Headmaster , Zaone Primary School	J DeGabriele
29 June	GTZ BEP Zomba	Zomba	Headmaster, Havala Primary School	J DeGabriele
29 June	GTZ BEP Zomba	Zomba	Headmaster, St Pauls Primary School	J DeGabriele
29 June	GTZ BEP Zomba	Zomba	Headmaster and teachers Sekwere Primary School	J DeGabriele

29 June	GTZ BEP Zomba	Zomba	Headmaster, Deputy headmaster, PEA and Zone school feeding coordinator Ntonda Primary School	J DeGabriele
29 June	GTZ BEP Zomba	Blantyre	Headmaster Matandwe Primary School	J DeGabriele
29 June	Mary's Meals School feeding	Blantyre	- Headmaster, Chisombezi Primary School	A Msukwa
29 June	Mary's Meals School feeding	Blantyre	- Mrs Mwasinga (Headmistress, Mpingwe Primary School)	A Msukwa
29 June	Private school	Blantyre	- Tutor, Emmanuel International College	A Msukwa
30 June	Ken Steel	Mulanje	- Ken Chilewe – stove producer	A Msukwa
2 July	Mary's Meals School feeding	Blantyre	- Headmistress, Ndirande Matope Primary School	A Msukwa
2 July	WFP school feeding Lilongwe	Blantyre	- Headmaster, Ndirande LEA School	A Msukwa
3 July	WFP school feeding Lilongwe	Blantyre	- Headmaster, Kasambwe Primary School	A Msukwa
3 July	WFP school feeding Lilongwe	Blantyre	- Mr Chimdidi (Headmaster) and Mr Kalata (School committee chairman) – Kapinga Primary School	A Msukwa
3 July	GTZ BEP school feeding Dowa	Dowa	- Dowa School feeding programme coordinators – Mrs Banda and Mrs Tembwe Dowa District Education office	J DeGabriele
4th July	WFP school feeding Kasungu	Dowa	- Mrs Phiri – District school feeding coordinator Kasungu District Education office	J DeGabriele
4th July	WFP Kasungu office	Dowa	- M Bulirani – Field Monitor	J DeGabriele
5 July	Mary's meals school feeding Kasungu	Kasungu	- Headmaster Chankhanga Primary School, - Mr Banda (PTA Chairman Chankhanga), - Mr S.S. Mchama (Committee Member, Chankhanga Primary School)	A Msukwa
9 July	Private college	Lilongwe	- Pastor Dr Lwesha Assemblies of God, Lilongwe	A Msukwa
18 July	Proprietor Umodzi Garage	Dedza	- Clement Mlombwa – Stove producer	J DeGabriele
18 July	Paragon Ceramics	Dedza	- C Stevens – managing Director; M Phiri – Sales, Kavalo – production	J DeGabriele
27August	Ministry of Education EDMU	Lilongwe	- Mrs Dorothy Nkhonje	J DeGabriele

10.8 The Survey Questionnaire

Survey Questionnaire for ProBEC study on impact of rocket stoves in school kitchens and institutions

1. Enumerator ……	**2.** Date ……..
3. District ……	**4.** City / village ……
5. Name of school ……	

6. Enrolment of school, institution, or programme (can tick more than 1):

	Enrolment figures (2007)
Day pupils	
Boarding pupils	
Number of staff mem bers	
Average Number of kitchen staff / workers	
Other ……	

7. What type of meals is prepared?

School feeding programme 1	Breakfast 2	Lunch 3	Supper 4	Other 5

8. When are meals offered to students?

1 School days only:	2 School term and weekends	3 Every day, including holidays	4 During relief periods	5 other

9. If there is a school feeding programme, what year was it introduced? ……..

10. Which organisation supports the school feeding programme?

WFP 1	Mary's Meals 2	GTZ 3	Other 4

11. The Rocket Stoves were purchased by

donor 1	school / institution 2	Other 3

12. Delivery dates of rocket stoves ……

13. Total number of rocket stoves observed on premises ……

14. Total number of <u>pots</u> matching the rocket stove observed on premises ……

15. size of pots matching the rocket stove

Either

a. capacity in litres……. (number of pots……..)

OR

b. pot diameter (cms) ……. (number of pots……..)

16. where are the rocket stoves and pots kept when not in use (at night)

In secure store 1	In Kitchen 2	Other 3

17. Number of rocket stoves that have been used at least once ……

18. Number of rocket stoves that are still in use …….

19. Number of rocket stoves observed by enumerator to have been fired that day ……

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20. History:Total number beneficiaries before introduction of rocket stoves, and since ……

	Year	For school feeding programme: Number of beneficiaries (enrolment)	Other schools / institutions: enrolment
A	2007		
B	2006		
C	2005		
D	2004		

21. What kind of stove/s was used before the Rocket Stove was introduced?

1. Mafua	2. Mbaula	3. Gas	4. Electric	5. other

22. In addition to the rocket stove, what other kinds of stoves are still used?

6. Mafua	7. Mbaula	8. Gas	9. Electric	10. other

23. Who has been shown how to use the rocket stove?

Teacher 1	School feeding programme Committee member 2	Cooks 3	No one 4	Others 5

24. When were they shown how to use the stove?

On delivery of stove 1	When started to prepare meals (i.e. started work) 2	Never 3	Other 4

25. who demonstrated the use the rocket stove

- € a colleague 1
- € the rocket stove producer 2
- € ProBEC staff 3
- € the donor / agency for the school feeding programme 4
- € no one 5
- € other……...6

Firewood management

26. what units does the school / institution use to measure amounts of firewood used:

- € money spent 1
- € tonnes 2
- € ngolo 3
- € mendulo 4
- € mtolo 5
- € other 6

27. On average how much firewood does the school use in a year since all / some old stoves replace by Rocket stoves?

	Year	Enrolment	Units of firewood contributed or purchased in 1 year (indicate units)	Amount of firewood used for cooking in 1 year (indicate units)
Before introduction of Rocket stove				
After introduction of rocket stove				

28. Firewood management practices assessment (cooks and workers)

Criteria for assessment (observation)	1=Yes; 2=No
i. Are smaller pieces of firewood used?	
ii. Is firewood dried very well before use?	
iii. Is a stock of firewood stored in a dry place?	
iv. Is there a place to keep sufficient firewood dry during the rainy season?	
v. When the food is boiling, is surplus firewood removed?	
vi. Is firewood that is not completely burnt after cooking used for further cooking?	

Kitchen management: (cooks and workers)

29. Number of pots cooked per day using a rocket stove (indicate if different pot sizes)

……

30. Number of pots cooked per day using other stoves (indicate if different pot sizes)

……

School feeding programmes only

31. Kitchen management practices assessment (cooks)

Criteria for assessment (observation)	1=Yes; 2=No
i. Is the pot covered while cooking?	
ii. Is the heat of the fire monitored during cooking?	

Boarding schools / institutions only

32. Kitchen management practices assessment (cooks)

Criteria for assessment (observations)	1=Yes; 2=No
i. Are all ingredients and tools together before the fire is started?	
ii. Are all ingredients in small pieces?	
iii. Are beans, pigeon peas etc soaked before cooking?	
iv. Is the stove used for one continuous longer period of cooking	
v. Is the stove used for several short periods of cooking	
vi. Is food cooked in the smallest possible amount of liquid?	
vii. Is the pot covered while cooking?	
viii. Is the heat of the fire monitored during cooking?	

33. What are the benefits of using the Rocket stove?

1 cooks	**2 Administration**
A	A
B	B
C	C
D	D

34. What are the disadvantages of using the Rocket stove?

1 cooks	2 Administration
A	A
B	B
C	C

Durability of stoves: (cooks and school administration)

35. Has anyone from the school or institution been trained in maintenance? Yes / No

36. Are the users aware of a guarantee attached to the stove and cooking pot?

Stove Yes / No

Pot Yes / No

37. Have the users reported any damage or poor performance of the rocket stove to the supplier (donor or producer)?

- € Yes, reported Damage to stove 1
- € Yes, reported damage to pot 2
- € Yes, reported Poor performance 3
- € No 4

38. Did the supplier attend to the complaint during the guarantee period? Yes / no

39. What damage can now be observed to the rocket stoves, if any?

Type of fault	Number of stoves with fault
Cracks or holes in the bricks or tiles 1	
Damage to the metal work of the stove 2	
Poor performance of stove 3	
Damage to pot 4	
None, 5	
Other, 6	

40. If there is damage on the chamber, what is the diameter of the hole?

Diameter of hole, cm	Number of stoves with hole damage
0	
3 cm	
6 cm	
9 cm	
12 cm	
More than 12 cm	

41. Has any maintenance ever been done on the stove? Yes / no

42. What type of maintenance ……

43. Who carried out the maintenance ……..

44. Is there a budget or arrangement for stove maintenance? Yes/ No

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45. Respondents interviewed:

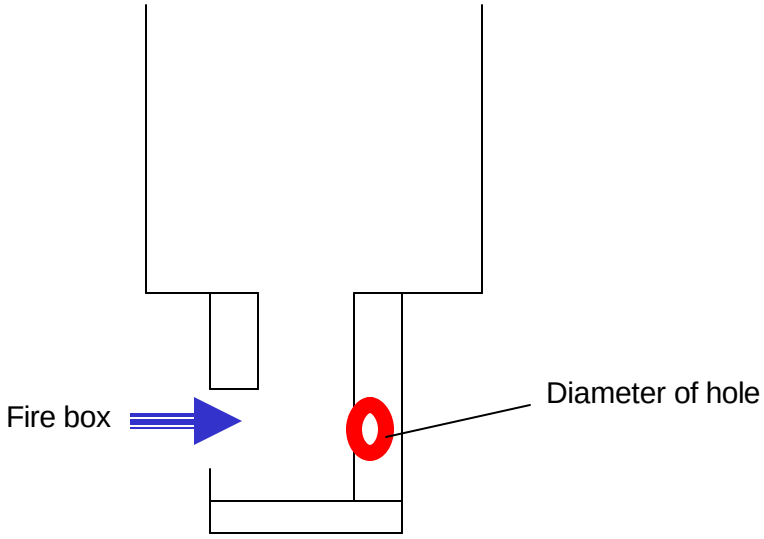
Cooks 1;	Teachers 2	Administration 3	Others 4

46. What has been observed:

- € Stove, 1
- € Kitchen, 2
- € Store room for stove, utensils, pots, etc , 3
- € Storage of fire wood, 4
- € Cooking process, 5
- € Feeding process, 6

10.9 Indicator for condition and damage to rocket stove

A rocket stove showing the extent of damage as indicated by the hole in red as measured by the scale c
matrix 1 below:



Extent of damage of the stove as an indication of the current condition of the stove

Measurement	Measurement in cm
A	0
B	3
C	6
D	9
E	12
F	>12

Damaged brick in fire box > 12cm but stove was reported to still perform well

10.10 List of guiding questions for users

User guiding questions:
for ProBEC study on impact of rocket stoves in school kitchens and institutions

Usage: Verification of the link between stove production figures / delivery register / use of stoves in schools

1. Previous cooking technology
2. Reasons for considering rocket stove
3. Identification of manufacturer:
4. Technical support on use and maintenance of the rocket stove
5. Purchasing process
6. Number of rocket stoves purchased and Size of pots
7. How did they calculate the number and size of the stoves?
8. Purchase price
9. Dates of purchase
10. Delivery time
11. Condition of stoves and pots delivered

Usage of stove

12. training on how to use the stove?
13. training on how to maintain the stove?
14. Performance of the stove
15. Awareness of any guarantee for stove and pot
16. Was the guarantee used?
17. Have all the stoves all been used?
18. Are all the stoves being used?
19. If not: Why did you stop using it?
20. Have they observed any signs of damages of the stove or pot ? Which ones?
21. Did anyone so far do any maintenance work on the stove?
22. Do they make any budget provisions or arrangements for the maintenance of the stove?
23. If stove is no longer used: for how long did you use the stove?
24. Observation of the material of the stove used?

Firewood Practice

25. Storage and drying of firewood
26. Preparation of firewood

Kitchen Practice

27. use of pots
28. Do the cooks like the stoves? Why?
29. If other technologies are used at the same time, why?

Beneficiaries per stove:

30. How many times per day is the cooking pot belonging to this stove filled (full?) and fired?
31. How many different children per day receive how many meals per day from this stove?
32. What percentage do these meals in the school represent in the total amount of cooked meals pe day for these children? Are there different cases to be distinguished (e.g. orphans, boarding pupils, day pupils…)? Can we quantify an average?

Wood savings per stove/per institution:

33. Source of firewood
34. Amount of firewood or energy used:
    - € Before rocket stove
    - € After rocket stove

35. Estimated savings……..

Benefits and user satisfaction

36. What are the benefits of the rocket stoves?
37. What are the disadvantages?
38. What improvements would you like on the rocket stoves?
39. Overall satisfaction with the rocket stove?
40. Would you consider buying other rocket stoves?
    - € Addition

    - € Replacement

10.11 List of guiding questions for stove manufacturers

Stove Manufacturer Guiding Questions

1. Manufacturer:
2. Start of business:
3. Range of products:

Stove production:

4. Start of rocket stove production:
5. Training in production:
    - How was training conducted?
    - Areas covered in training
    - Quality of training?
    - Ongoing training of staff

6. Challenges in production:
    - Skills
    - Materials
    - Quality control
    - Pricing / profitability

Production and sales:

7. Who are the main clients:
    - Donors
    - Private clients
    - Do you have a rocket stove at home?
8. how many stoves have been produced? (see ledger)
    - range of stoves (sizes)
    - Donors
    - Private clients

Customer relations:

9. Marketing and promotion?
10. training on stove use, care and maintenance
11. After sales service – maintenance

Experience in stove manufacturing

12. Comments on design provided (technical design, manufacturing, size…..)
13. Comments on materials used
14. Comments on durability of stove
15. Comments on technical support from ProBEC
16. Are they requested to provide support to customers? (type, cost, how financed)
17. Any feed back form customers?

10.12 List of Rocket Stove Sales by Manufacturer

Ken Steel – Mulanje

Stove type/ (capacity in litres)	Total number sold from 2004 to April 2007
household	264
restaurant	76
20 litres	14
25 litres	8
29 litres	1
30 litres	5
40 litres	2
45 litres	1
50 litres	407
60 litres	8
66 litres	1
75 litres	2
78 litres	1
80 litres	14
110 litres	997
120 litres	427
150 litres	39
165 litres	4
170 litres	1
200 litres	3
220 litres	56
245 litres	3
250 litres	38
Total	**2372**

Examples of standard price before factoring in transportation costs are

- 100 liters rocket stoves = MK25000
- 200 liters rocket stove = MK39000
- Twin household rocket stove = MK9000
- Small household rocket stove = MK6000

CH Welding Services Lilongwe

Date	Client	Stove Serial No. (CH ###)	Quantity	Size (liters)	Value (MK)
10.11.05	GTZ ProBEC	1,2	2	5	10000.00
09.12.05	Mrs Gourtler	3	1	5	5000.00
27.12.05	Mr Nundwe	4	1	5	5000.00
15.01.06	Mrs Chimponda (GTZ)	5	1	5	5000.00
09.02.06	Mrs Mtambo	6	1	5	5000.00
10.02.06	GTZ BEP	7 to 16	10	110	230000.00
02.06.06	WFP	17 to 42	26	110	598000.00
17.08.06	Mr Goodman	43	1	200	40000.00
14.11.06	GTZ BEP	44 to 103	60	110	1458000.00
02.02.07	UNICEF	104 to 153	50	50	765000.00
02.02.07	Mr Steve, GTZ	154,155	2	5	5000.00
30.03.07	UNICEF	155 to 205	50	50	765000.00
15.06.07	GTZ BEP	206 to 245	40	110	972000.00
	Total		**245**		**4863000.00**

Take Pride Engineering, Mzuzu

Size of stove, litres	Number produced
200	4
110	53
150	12
Household	11
Total	**80**

Umodzi Garage – Dedza

Client	Capacity litres	Number produced
WFP	110	47 and 334 currently being produced
GTZ BEP	110	30 stoves
Aisha Orphanage	110	4
Littleways construction	110	4
Lilongwe Islamic school	200, 110	2, 3
Total production after delivery of current order		**426**

10.13 Observations made by the study team

Specific observations made by consultant and enumerators	Name of institution
- Number of pots cooked for porridge in a day is based on the days enrolment. - Firewood contributed by villages surrounding the school	- Mphandula Primary School
- Number of pots cooked is dependent on number of volunteers reporting for the day	- Mpingwe, - Naizi,
- Number of pots cooked increase during hunger months (January and February)	- Mpingwe
- No records of firewood amount used	- Most schools
- Units of firewood amounts have no standard units of measure	- Mphandula, - Kabuthu
- Contribution of firewood also done by school children	- Goreka,
- Smaller Portions of phala than recommended amounts	- Nanjiriri, - Mphandula, - Mdzobwe
- Good amount of phala (about 400 ml) given to pupils	- Ndirande Matope
- Reduction of enrolment with time due to opening of other schools nearby that have school feeding programs	- Nanjiriri Primary School, - Mpingwe
- Use of meal cards	- Nanjiriri Primary School
- Wish by some cooks to have household stoves in their homes	- Namatapa Primary School
- Good coordination between teachers and committee	- Namatapa, - Chisumbu
- High absenteeism on Fridays	- Namatapa, - Misesa,
- Low Volunteer attendance for cooking / sometimes no cooking due to lack of water at school (drawn very far)	- Mpingwe, - Chitsime,
- Volunteers want some form of incentives (payment of some kind)	- Mpingwe, - Naizi, - Mzamba, - Ndirande LEA, - Chitsime
- Porridge issued at the time pupils knock off to avoid disturbing classes. - School provides money for firewood if it runs out	- Chisombezi
- Urgent need for training in use of rocket stove – (stoves not used properly)	- Misesa, Nursing Home (Mary View),
- Some pupils do not get porridge due to shortage of cups	- Mzamba
- Energy Conservation offered as a course. One of the staff members was keen to meet ProBEC staff	- Emmanuel College for teachers
- Stoves are not being used – just kept. (Those for BTTC possibly disposed away to Kapeni School??)	- Blantyre Teachers College, BSS, Mzuzu Polytechnic
- Cooks use more firewood at a time than required - During rainy season the number of volunteers decrease as they first go to work in their gardens - Introduction of school feeding has resulted to increased consumption	- Ndirande LEA

Specific observations made by consultant and enumerators	Name of institution
in school water bills – hence need to drill borehole	
- All staff members seen taking phala during break time	- Ndirande Matope
- Pots used are very small compared to rocket stove size - A lot of smoke observed from the kitchen - Smearing of the pots with ash before cooking	- George (under 6)
- Report of very low absenteeism due to school feeding program	- Ndirande Hill, - Mzamba, - Kapinga
- Very dedicated committee that at times sources its own firewood - Good coordination between teachers and school committee. Teachers play a role food testing and distributing porridge to pupils	- Makata
- The school committee sells sacks and uses money for other necessities – pots, salt etc	- Kapinga, - Mphambano
- School said to have received a rocket stove guiding manual	- Phwezi, - Kasambwe
- No cooking for sometime because flour was finished	- Kabudula, - Kambulu
- Mafua used over pits and alleged to be more efficient	- Madisi
- Headmaster and a teacher who were trained leave classes everyday and explain to volunteers on use of rocket stove	- Mphudzu
- Stove brought already damaged - No training received on rocket stove usage, only received a manual	- Katundu
- Take home ration is provided pupils	- Kasamba
- No firewood shade seen	- Most of the schools supported by WFP and GTZ BEP
- Stoves purchased as backups for electricity	- Mitundu, - BSS,
- Stove too big for students enrolled in 2007 so not being used	- Moma Girls Secondary School
- One of the Assemblies of God engineers made better stoves than the original ones	- Assemblies of God
- Three rocket stoves were bought by an institution from one of the known producers. Some one comes in and takes a picture of the stoves and makes rocket stoves for the institution. At Phwezi the rocket stoves made by the second producer showed poor performance and were abandoned	- Phwezi Secondary School