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Poverty Reduction Aspects of Successful Improved Household Stoves Programmes Project 7368

Final Summary Report

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ENERGY FOR SUSTAINABLE DEVELOPMENT

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Contents

Glossary

Etb	Ethiopian Birr
ICS	Improved cook stove
Injera	Staple Ethiopian bread
GoE	Government of Ethiopia
KCJ	Kenyan Ceramic Jiko – Kenyan improved charcoal stove
Ksh	Kenyan Shillings
Lakech	Ethiopian improved charcoal stove
Mirte	Ethiopian improved injera baking stove
NGO	Non Government Organisation
TMS	Traditional metal stove
Ugsh	Ugandan Shillings

Approximate exchange rates:

Kenya : September 2000, of Kenya Shillings (Ksh) 60 to US$1.00.
Uganda: September 2000, approximately Uganda Shillings (Ush) 1600 = US$1.00.
Ethiopia: September 2000, approximately Ethiopian Birr 8 per US$.100.

EXECUTIVE SUMMARY

Background

Programmes and projects to improve household wood and charcoal stove efficiencies have been launched throughout the developing world over the past 20 years. The main driver for promoting these stoves has been to reduce environmental degradation resulting from the removal of trees for charcoal and fuel wood production. In addition there are health benefits for families from the reduction or removal of smoke in their homes. Unfortunately many programmes have failed to establish sustainable improved stove production primarily through lack of sufficient attention to consumer tastes and market dynamics. Consequently in many countries, governments, donors and consumers have become sceptical about the potential for improved biomass stoves to reduce household expenditures, lead to better living standards, and ease pressure on fragile environments.

The objective of this project was to identify the key success factors for sustainable stove production and supply through determination of the poverty impacts of successful, commercially based, improved household biomass stove programmes on producers, consumers and others associated with the household fuel and stove supply and end-use business. ESD, working with consultants[1] in Ethiopia, Kenya, and Uganda set out to determine and quantify the financial savings to households, the perception consumers have of improved stoves and other benefits. The employment, business development and income generation aspects of successful improved urban household stove programmes in these three countries were also quantified using a livelihood based approach. The team intends to disseminate the results of this project to as wide an audience of national and international stakeholders as possible. The results will also be used in a follow up project in Uganda to pilot commercial, improved household stove manufacture.

The project was divided into phases that involved:

- **identifying the number, type and distribution** of stove and improved stove producers in Addis Ababa, Nairobi and Kampala;
- **carrying out extensive interviews**, with a carefully balanced sample of both improved and traditional stove producers, and others engaged in the urban stoves business;
- selecting and **interviewing households** regarding improved stoves; and,
- carrying out **technical tests** on existing traditional and improved stoves to gauge their performance relative to performance as perceived by both producers and users.

The project was based upon the success of improved charcoal stoves in Kenya and Ethiopia, where millions of stoves have been sold, and the success of the "Mirte" injera (flat bread) stove in Ethiopia. Around 1.5 million "Kenyan Ceramic Jiko" stoves have

[1] Megen Power in Ethiopia, Energy Alternatives Africa and Rural Technology Enterprises in Kenya, and Renewable Energy Development Centre in Uganda

been sold in Kenya since 1981 on an unsubsidised, commercial basis. They are freely available in shops, market stalls and supermarkets throughout the country. A similar number of "Lakech" charcoal stoves have been sold in Ethiopia commercially since 1991 and they are owned by 65% of households in Addis Ababa. The price of the stove has fallen from around $10 originally to as low as $1 now. The Mirte stove in Ethiopia has been a more recent success having sold around 90,000 since 1995. Cooking injera is one of the major consumers of primary energy in Ethiopia and the Mirte stove can reduce biomass consumption by half.

The team sought to explore what impact these commercially successful stoves had on the livelihoods and poverty status of both those who produce the stoves, and those who use them, with the primary focus on people engaged in the business. It must be admitted that the study did have a producer bias as this is where the largest impact was expected and least previous work had been done. It was felt that, while attention had been paid in the past concerning the technical and commercial features that figured in the success of the stoves, little or no attention had been paid to the poverty impact of these stoves on those engaged in their production and sales, or their use. Stove consumers, however, were not neglected in the work and all groups surveyed were selected and results disaggregated by income and gender.

Uganda was included in the project primarily because, despite numerous activities to promote improved stoves in the past, little commercial success has been observed (i.e., levels of improved stoves penetration have been very low relative to the efforts put in, and relative to that of neighbouring Kenya, and Ethiopia). In a sense, Uganda provided the project with an excellent "control" to examine dynamics in a pre-successful improved stove situation, with particular attention to stove producers and stove users. An added benefit of including Uganda is that under the EU funded IGAD Regional Household Energy Programme which has just commenced, a commercial pilot along the lines of the programmes in Kenya and Ethiopia can now be implemented in Uganda. The work of this study will directly feed into the planning and implementation of this pilot which is to be observed by other country representatives from throughout the IGAD region.

Project Findings

1. Successful commercial stoves lead to improved producer livelihoods

The work has shown that, in the case of Kenya and Ethiopia, the commercial success of improved stoves has led to **poverty reduction** amongst most people engaged in the improved stoves business. It has **effected substantial positive livelihood changes** (e.g., improved diet, improved health, improved housing, improved education) for the majority of those engaged in the business.

It should be noted that in almost all cases, those who are engaged in improved stove production began their improved stoves work as some of the poorest, least economically enfranchised urban dwellers in the three countries. Metal working and traditional ceramics (in Ethiopia), are low prestige activities, and, in the case of basic metal working, provide urban dwellers with ease of entry, but, traditionally, very poor

returns on labour. **The most fundamental finding of the project** is that improved stoves in Kenya and Ethiopia have offered these metal workers the means to improve their returns substantially, thereby improving their livelihoods and opportunities, and offering those engaged in the business new economic and social opportunities.

This finding is also a crucial factor in why these stove programmes have been successful and sustainable without continued government support.

2. Successful commercial stoves lead to improved urban consumer livelihoods

In both Kenya and Ethiopia the use of the stoves has led to real financial savings for lower income groups which are not insignificant. While it is clear that the use of a charcoal stove does not lift people out of poverty on its own, it is one of many sensible livelihood choices which contribute to a more stable existence, see Table i) below.

Table i) Household savings from using improved charcoal stoves as a percentage of total income in Ethiopia, Kenya and Uganda

Income group	Ethiopia	Kenya	Uganda
Very low	5.6%	4.0%	2.2%
Lower		5.2%	1.0%
Middle	2.4%	2.3%	0.6%
Upper	0.9%	1.5%	0.4%

In Uganda, there are no statistically significant poverty alleviation aspects for producers and those engaged in the business of urban "improved" stoves. There are a wide variety of "improved" stoves in the country, unlike Ethiopia and Kenya, and their technical performance and quality are mixed, as past test results and those conducted during the course of this project have shown.

The Mirte stove in Ethiopia significantly benefits users and it can be claimed that it does have an important poverty reducing impact on low income users, see Table ii).

Table ii) Savings from using Mirte stove as a percentage of total income in Ethiopia

Income group	Commercial Mirte	Domestic Mirte
Lower	25%	16%
Middle	6.5	4.6%
Upper	3.3%	3.3%

These findings of financial benefit to low income users are in addition to physical livelihood benefits. There is growing evidence of the detrimental health effects of unimproved biomass stoves. A very recent study (published in January 2000) from the University of Nairobi, demonstrated statistically significant reductions in the prevalence of acute respiratory infection and conjunctivitis among women and children under five in households using the improved stoves versus those who did not. Other

significant livelihood improvements consistently identified by household surveys, including those carried out by this project, are increased safety in terms of reduced fire risk and risk of burns from the use of improved stoves.

3. Consumer perception - a key to success

The consumer perception in Uganda is very different from that in Uganda and Kenya. The vast majority of "improved" stove users fall within the lowest income quartile, while relatively wealthy urban dwellers (the upper income quartile) do not buy the stoves, and show no interest in them. Over a third of the lowest quartile consumers have purchased "improved" stoves motivated, primarily, by anticipated fuel savings. Contrary to the experience in Kenya and Ethiopia, higher income urban Ugandans seem to view the versions of "improved" stoves in their markets as inferior products, things for low-income consumers.

In the case of Kenya and Ethiopia, improved urban stoves were introduced initially through donor-supported programmes. Their improved stove projects targeted upper income consumers during the first phase of stove commercialisation as a way to achieve sustainable commercial penetration. That is, the projects adopted strategies that the stoves should be produced and sold on as commercial a basis as possible, with few, if any, external subsidies to the sector. To achieve those objectives required commercial acceptance by those most able to afford the initial high costs of new stoves. That is, the projects' strategies targeted wealthier urban consumers as a means to subsidise the start up, initially high costs of product development and production, until scale and market economies could be achieved.

The logical outcome of this approach was to sell high quality, and initially expensive, improved stoves to upper income groups. This succeeded remarkably well in both Kenya and Ethiopia, and as the stoves became commercially accepted, and as more producers entered the market place, the prices of these stoves dropped dramatically. Today, improved charcoal stoves in Kenya and Addis Ababa sell for less than one twentieth their original costs, in real terms. Today, improved charcoal stoves sell in Nairobi and Addis Ababa for less than "traditional" stoves.

Such strategies have not been adopted in urban Uganda. Rather, stove programmes have trained up artisans, helped to subsidise their production and sales, and then, when the programmes ended, left producers to fend for themselves. Without developing good market and commercial skills, without achieving commercial independence based upon market success, Ugandan urban improved stove producers have not been able to penetrate the market on a large scale. The status of the improved stoves has stayed low.

While there continues to be demand from low-income urban dwellers (who are looking for fuel savings to improve their livelihoods), the margins are as low as in Kenya and Ethiopia (mature improved stoves markets), while the volumes are very low. Consequently, there have been few demonstrable poverty alleviation benefits from improved stoves in Uganda, compared to Kenya and Ethiopia. This provides strong guidance to those wishing to promote improved stoves, not only in Uganda, but

elsewhere in the developing world.

4. Success leads to fierce competition - but quality can fall

The success of these stoves in Kenya and Ethiopia, and the benefits of being in the marketplace, have led to intense competition, price cutting, and unfortunately, reduction in product quality. While consumers do not perceive a drop in stove efficiency, they do note a drop in overall quality (appearance, robustness, etc.), and stove tests carried out by the project team do show a decline in efficiency performance. This has been more pronounced in Ethiopia than in Kenya, where the improved stoves market is more established (since the mid-1980s) and more mature.

Indeed, interviews of producers in Ethiopia, particularly women clay liner producers, show that their returns on production have fallen over the past few years, as has their economic power vis-à-vis stove assemblers in the marketplace. If this trend continues, it is apparent that the socio-economic improvements they have enjoyed through the improved stove business will disappear, and leave them in as vulnerable a position as they were prior to entering the improved stove business.

However, the expectation is that the market will turn round in Ethiopia, as it has in Kenya, and return to a quality and value product (there are signs of this already happening). An issue to be dealt with below is whether selective interventions by government or other donors can assist in this process?

5. What can government and donors do to help?

It could be claimed that with a commercial sector approach being taken there is no role for government or donors. This is fundamentally not the case and neither of the programmes in Ethiopia or Kenya would have been successful without substantial government and donor backing over several years. Government and donors must be involved with specific tasks at key stages and maintain a supportive role on a continuing basis where necessary. These tasks include:

i) At early stages in a programme, assistance with identifying suitable stove designs and testing , if necessary;
ii) Assistance with household trials and kitchen performance tests to ensure the most suitable stove designs are being promoted;
iii) Identifying suitable stove entrepreneurs and training them in manufacture, quality control, business management;
iv) Assistance given to the entrepreneurs with marketing and promotion of the new stoves and raising their market profile;
v) Provision of revolving fund or other forms of small credit for stove entrepreneurs to build up their businesses;
vi) Monitoring the stoves market and biomass fuels market to identify any strengths and any developing weaknesses;
vii) Provision of market support to stove producers and assistance with producer organisation where necessary, if it is deemed that this will assist the market in terms of quality and availability of stoves at a reasonable price.

1. SUMMARY OF PROJECT OBJECTIVES, ACTIVITIES AND OUTPUTS

1.1 Project Description

Programmes and projects to improve household wood and charcoal stove efficiencies have been launched throughout the developing world over the past 20 years. Most have failed to establish sustainable improved stove programmes primarily through lack of sufficient attention to consumer tastes and market dynamics. Consequently in many countries, governments, donors and consumers have become sceptical about the potential for improved biomass stoves to reduce household expenditures, lead to better living standards, and ease pressure on fragile environments.

However, several stove programmes have enjoyed major commercial success over the past decade. Hundreds of thousands of Kenya Ceramic Jiko (KCJ) stoves and an adapted form of the Jiko, the Lakech stove, designed to achieve a 25% saving in charcoal consumption, have been sold through the urban marketplaces of Kenya and Ethiopia without subsidies, totally on commercial grounds. Several million KCJs have been sold since USAID and the Kenyan Ministry of Energy stopped supporting the project in 1985. An estimated 1.5 million Lakech stoves have been sold in Ethiopia since 1992, over a million since the World Bank and GoE support stopped in 1995. Both stoves currently sell for 1/20th their original prices.

Once these stoves achieved commercial success and sustainability, government and donors did not follow up or monitor their progress in meeting the set objectives. This lack of follow up meant that, while they were remarkably successful in a business sense, and extremely popular with customers, there was no accurate information on how much fuel these stoves actually saved and therefore no accurate indication of the contribution they made to alleviating the poverty of poorer households. There has been a widespread assumption that the KCJ saves fuel, but virtually no work was carried out to verify this in Kenya since the mid 1980s, until the present work was carried out. In Uganda, in contrast with the situation in Kenya and Ethiopia, although 18 donors and NGOs have been involved in stove projects since 1984, very little progress has been made and there have been no real 'success stories'. This has primarily been due to the fact that stove initiatives have been driven by donors' and NGOs' pre-conceived ideas of what consumers want and what is good for them, rather than by real attention to consumer demands and preferences, or by any real attention to the dynamics of the market place. Nevertheless, tens of thousands of so-called 'improved' stoves have been disseminated in Uganda since 1986, often on highly subsidised terms. These three countries have offered the possibility to study in detail the poverty reducing, employment, and SME informal sector development effects of household improved stove programmes. The current project has enabled researchers to revisit these stoves, those who fabricate them, and those who utilise them, to determine the poverty and energy efficiency impacts of earlier introduction and promotional programmes. The results of this work provide valuable insight both for these three countries and those active in promoting and producing improved stoves

there, but also in other countries and other programmes throughout the developing world.

1.2 Project Rationale

The project rationale has been that by examining the poverty reducing effects of improved stove entrepreneurship and urban improved stove use in two countries where the commercialisation of improved stoves has been successful, a link could be made between these poverty reducing effects and the success of the stoves. Uganda has served essentially as a "control", where commercialisation on a wide scale has not taken off. It was also studied in order to make a direct comparison with Kenya and Ethiopia, where "improved" stoves have been a major commercial success. By identifying the measurable benefits emanating from the stoves businesses the study will be able to make recommendations on the conditions which have to be in place in similar countries for sustainable commercial production of improved stoves to be established.

Little work on the poverty reducing aspects of improved urban stoves has been done to date, and most was done a long time ago. Aggregate estimates of household savings from improved stoves have been made (World Bank Technical Paper 242, 'What makes people cook with improved biomass stoves'1994, ORAU/USAID 'Energy efficient stoves in East Africa', various articles in 'Boiling Point', etc.). There have been economic studies of the affects of rural household energy programmes, for example, "Micro- and macroeconomic benefits of household energy conservation measures in rural areas of Kenya" by Helga Habermehl, GTZ/HEP, 1994. This will be useful for comparison with this project which focuses on urban stove programmes. Also "The economics of improved stoves programs", Fred Hitzhusen, ESMAP Draft Report, 1991. Work has been done on how to monitor success of stove programmes " Measuring successes and setbacks: how to monitor and evaluate household energy projects" GTZ/HEP & ITDG, 1996 and "Guidelines for planning, monitoring and evaluating cookstove programmes" S. Joseph, 1990, FAO. However these monitoring and evaluation studies and guidelines have not looked in depth at the complete poverty reduction impact. Micro-household estimates of fuel savings, payback periods for stoves, etc. have been made on various projects in their early stages, often with no follow up. Little time series information exists at macro or micro levels.

There is also a lack of focused study on the employment and income effects of large-scale successful programmes on existing traditional stove producers and on existing and new improved stove producers. Work on urban fuel suppliers was carried out in Ethiopia (BFSMR, World Bank-ESD), 1988; Kenya (CIDA-Bess), 1989; Uganda (EC-ESD), 1995.

1.3 Project Purpose

The major objectives of this research project is to determine poverty reduction impacts of improved stoves on producers (through income generation and other non-quantifiable benefits) and consumers (through savings made on fuel expenditure due to the use of improved stoves and other household benefits). Specific objectives include:

- *Record the history of development, strategies adopted and other factors that contributed to the commercialisation of fuel efficient cook stoves.*

- *Document all of the socio-economic and cultural benefits accruing to improved stove entrepreneurs and consumers.*

- *Disseminate lessons learned from successful improved stove programs internationally to improve the awareness of donors and other stakeholders.*

- *Evaluate current status of the improved stoves industry and draw conclusions and recommendations for further actions as necessary.*

1.4 Project workshops and meetings

- Project Kick off meeting with all core project partners in Nairobi, July 8-9 1999
- Kenya first stakeholders workshop, Nairobi, October 15th 1999
- Kenya second stakeholder workshop, Nairobi, April 14th 2000
- Ethiopia first stakeholder workshop, Addis Ababa, November 5th 1999
- Ethiopia second stakeholder workshop, Addis Ababa, June 25th 2000
- Uganda first stakeholder workshop, Kampala, November 8th 1999
- Uganda second stakeholder workshop, Kampala, 2nd November 2000
- Project mid-term planning and evaluation meeting, Kampala, UMay 3rd - 4th 2000
- Final regional partner workshop, Addis Ababa, June 24th 2000

1.5 Outputs

• Detailed description of the key poverty reduction benefits gained by improved stove entrepreneurs in Kenya, Uganda, and Ethiopia.

• Detailed description of the key reasons why consumers purchase improved stoves in Kenya, Uganda, and Ethiopia.

• Detailed description of the financial expenditures on cooking fuels and financial savings accruing from the utilisation of improved stoves in Kenya, Ethiopia, and Uganda.

• Detailed description of the charcoal savings and thermal efficiency of improved stoves from Uganda, Kenya, and Ethiopia.

• Action plans for promoting the continued commercialisation of high quality fuel efficient stoves in Kenya, Ethiopia, and Uganda

1.6 List of project documents produced and supplied to DfID

1. Project kick off workshop proceedings July 1999, Nairobi, Kenya

2. First National Stakeholder meeting minutes Kenya (October 1999), Ethiopia (November 1999), Uganda (November 1999).
3. Case study reports Ethiopia, Kenya, Uganda
4. Second national stakeholder meeting minutes, Ethiopia, Kenya (April 2000), Uganda (November 2000)
5. Stove test reports Ethiopia (March 2000), Kenya (July 2000), Uganda (August 2000)
6. Minutes of final project meeting Addis Ababa June 2000
7. Minutes of 3rd Ethiopia National Stakeholder meeting, Addis Ababa, June 2000
8. Country reports on poverty elimination effects of fuel efficient stoves, Ethiopia, Kenya, Uganda.
9. Final Summary report (this document)

2. STUDY METHODOLOGY

Various methods to generate data on socio-economic conditions and status of improved stove producers were applied across all three countries. These included census surveys, sub-sample surveys, detailed case studies, biomass fuels price measurement, and laboratory stove performance tests. Each country carried out surveys, case studies, and stove performance tests. The number of samples for each survey and stove performance test varied slightly, but not substantially, according to the local circumstances. Surveys of users of improved and unimproved stoves across all income categories were also carried out in all three countries.

2.1.1 Census Surveys

Based on literature review, key informants and personal observations, **census surveys** were carried out both on improved stoves producers and consumers in Addis Ababa, Nairobi, and Kampala. Owing to the highly decentralised nature of the business, coupled with high turnover of people engaged in it, complete enumeration of producers with basic information such as annual sales volume, number of employees by gender, size of business, among other factors proved difficult in Ethiopia and Kenya. However in Kampala the census surveys were easier since producers were fewer. Initially, it was envisaged that the survey would include those producers who had exited the improved stove business. However, it was almost impossible to trace such producers. Hence, they were not included in Kenya, Ethiopia, and Uganda.

In the case of Ethiopia there were four categories of stove entrepreneurs identified. These were producers of the Lakech (improved charcoal stove), Domestic Mirte (biomass injera stove), Commercial Mirte and those who produce all three stoves. For enumeration of all producers Addis Ababa was divided into three parts (Central Mercato, North Eastern and South Western). Three team members conducted the census independently. Therefore, the producer census survey was conducted through existing contacts and key informants. On the other hand, since all liner producers live in a small village in the outskirts of Addis (Legadadi), this did not pose any difficulty to cover the entire group (i.e. all producers were interviewed).

In Kenya, there were four sub-groups of artisans producing the Kenya Ceramic Jiko; liner producers, cladders, assemblers, and marketers. Producers representing each of these sub groups were interviewed in addition to those who had overlapping specialties. The producer census survey was conducted in more than 10 of the major improved stove production sites in Nairobi.

In Uganda, all of the major sites of improved stove and traditional stove production were visited and a near complete enumeration of the producers was undertaken.

In Ethiopia and Kenya, the consumer's census survey were entirely based on review of literature, previous studies of improved stoves, and records of improved stoves sales.

In addition to serving as a sampling frame for the sample survey, results of the census survey were useful in highlighting in broad terms the nature of the industry and in understanding the penetration rates of the improved stoves. Please refer to the detailed country reports which are Annexes to this report for a detailed description of improved stove production in each country.

2.1.2 Sub Universe Sample Surveys

In all countries, the initial census surveys served as a basis from which to select a sample of producers and consumers for the more detailed poverty reduction questionnaires. The main criteria used in the selection of the sample were specialisation (cladder, liner, assembler, and marketer), age (new and old), and size (large and small) of businesses in each category of producer.

The **sub universe improved stove producer survey** concentrated on the temporal changes of the producer's access and ability to afford health care, food, school fees, clothing, family obligations, land, housing, livestock, furnishings, electronic goods, support groups, community membership, and role in society.

The **sub universe consumer survey** focused on the amount of money households spent on fuels for cooking, how much they saved, if anything, from using improved stoves, and reasons why they liked or disliked improved stoves.

In Kenya, a control group was later included to compare the financial savings and expenditure on charcoal by households using improved stoves versus traditional metal stoves. Additionally, a control group of traditional stove producers in Kenya was interviewed using the same format as the sub universe producer survey. In Ethiopia and Uganda this was not done due to lack of resources.

For the **consumer sample survey** in Addis Ababa, the city was divided into three parts based on assumed wealth ranking. These are high, medium, and low-income households. Again, with these income categories, consumers were classified by types of stoves they used; i.e. Lakech, Domestic Mirte and Commercial Mirte and some combination of the three. Within each income group and type of stove used by households, enumerators moved house-to-house interviewing until they reached the required sample size. In Nairobi, the consumer survey was broken down into four parts representing four socio-economic groups from very poor to middle income groups. The same was done in Kampala.

Two **follow up surveys** were conducted in Kenya: one to verify if the KCJ had any meaningful financial savings for poor households and the second to provide a control group to compare if there were any marked differences in poverty reduction benefits from producing improved stoves versus traditional stoves.

2.1.3 Case Studies

To capture a detailed account of the inter-temporal dynamics that had taken place for improved stove producers within the marketplace, extensive **case studies** were carried out. Ten producers per country, representing a wide range of experiences and circumstances were interviewed using a very **detailed check list** of key poverty reduction and business issues. In order to ensure maximum accuracy and to maintain uninterrupted flow of discussion and minimise the interview time, the interviews were tape-recorded for analysis and write-up at a later stage. A team of highly experienced professionals who were familiar with the improved stove producers and their business led the interviews. The stories and experiences of over 30 stove producers were eloquently captured and described in the country reports and are included herein as appendices.

2.1.4 Laboratory Testing

In order to evaluate the fuel efficiency and energy savings of improved stoves from each country, water boiling tests were carried out. In Ethiopia, controlled cooking tests, durability tests, and light tests were also conducted in addition to the water boiling tests. Between 5 to 10 improved stoves of each type were tested against traditional metal stoves from each country.

3. ANALYSIS AND COMPARISON OF RESULTS

The detailed findings from the surveys are presented in Appendix 1 below. In this section the results are discussed and compared to draw out conclusions that can be used to define the qualities of successful improved stove programmes.

3.1 Consumer perception and adoption of fuel efficient stoves

The results show considerable variation in the perception of fuel efficient stoves in the target countries and between the income classes within those countries.

The perception of fuel efficient stoves in urban Ethiopia was good across all income classes. They chose them for reasons of fuel economy, reduced smoke, speed, convenience, durability and safety. Stoves are low cost in Ethiopia due to well developed commercialisation. However, this has led to a fall in quality which has been noted by consumers, and as this study's test results clearly demonstrate. Despite the quality problems with the Lakech charcoal stove, over 90% of consumers of the stove are still happy about fuel saving characteristics of the stove. Similarly, a majority of consumers of the two models of the Mirte stove have also reported that they have economised on their fuel consumption due to the stoves. It was also known that the stoves that consumers compared their improved stoves with were traditional charcoal stoves and kerosene stoves for the Lakech, while the electric mtad and open fire were compared with the Mirte biomass injera stove.

In Kenya, the Kenyan Ceramic Jiko is purchased mostly due to its ability to reduce cooking time, produce high quality meals, reduce charcoal consumption, minimise accidents, and ease of cleaning and maintenance. Its physical appearance is not a major concern or reason for a family to buy or not to buy the stove. There are many sub-quality versions of the KCJ on the market which do not have the tensile strength and resilience of the original model, nor do they have a liner with as much resistance to cracking and breakage, yet consumers still continue to believe that the stove has more benefits than disadvantages.

The consumer perception findings in Uganda differed from those in Kenya and Ethiopia particularly in the variation across income groups. In the Uganda consumer survey 100 households in 4 income categories were interviewed, none of the highest income group owned a fuel efficient charcoal stove while 95% of them owned unimproved stoves, the lowest percentage of improved stove owners of all the income groups. 33% of the lowest income group owned the improved stove, far higher than all other income groups. Consistently the lower income group gave the stove the highest ratings for a range of categories; fuel consumption, durability, smoke, cleanliness, smoke production; as income category increased the rating tended to decrease. Higher income groups either do not know about the improved stoves benefits or do not really seem to care about them.

The tables below show the responses in each country to a number of attributes of the stove. In Table 3.1 responses from Ethiopia and Kenya are compared, and apart from the answers to the question on aesthetic appeal the responses are remarkably similar. The explanation for this specific difference may come from the fact that the Lakech in Ethiopia is widely used for the traditional coffee ceremony which is part of Ethiopian entertaining and hospitality, and gives the Lakech a high status.

Table 3.1 Consumer perception in Kenya and Ethiopia

Response	**Kenya**	**Ethiopia**
Increases speed of cooking	62%	69%
Reduces indoor air pollution and smoke	70%	55%
Increases safety when handling the stove	82%	83%
Increases convenience for cooking	77%	81%
Is more durable	40%	66%
Improves the taste of food	81%	60%
Is easier to clean and maintain	80%	56%
Has more aesthetic appeal and appearance	28%	71%
Sample size	**100**	**160**

The data from Uganda is in a slightly different format.

Table 3.2 Consumer perception in Uganda

Expensive	11%
Never heard of	4%
Not thought about	37%
Breaks easily	13%
Affordable	6%
Cooks fast	1%
Fuel saving	17%
Durable	10%
Hard to light	1%
Sample size	**87**

Despite the different data format, the clear difference between the results in Kenya and Ethiopia with those from Uganda comes through. Only 17% of respondents in Uganda thought their "improved stoves" to be fuel saving while in Ethiopia 92% and in Kenya 90% thought the equivalent charcoal stove saved fuel. It is worth noting the difference in attitude between the upper, middle and lower class income groups in Uganda to the improved stove. In Uganda the stove is more widely valued among the lower income groups. In Kenya and Ethiopia this is not the case with the stove being appreciated across all income groups. This perception is an important disadvantage to improved stove development in Uganda as it reduces the market share it can obtain

and reduces the status of the stove if it is perceived as something for those on low incomes to use.

3.1.1 Gender focus of consumers

Results of the consumer universe surveys showed that there are an estimated 460,000 consumers of improved stoves in Addis Ababa. Interviews were conducted with 161 consumers (73 Lakech consumers and 88 Mirte consumers) to collect information that was used to assess impacts of the stoves on improved stove consumers. All of the respondents were women who were either wives, or daughters, or relatives or housemaids.

In Ethiopia cooking is traditionally among women's responsibilities. Results of this survey indicated that while half of the cooks that used improved stoves were wives, 29% were housemaids, 16% were daughters and the remaining 5% were relatives.

With regard to making the decision to purchase improved stoves, wives made the decision in almost 80% of the cases. The role of husbands, daughters and friends in making the purchase decision was only in 7%, 7% and 6% of the cases respectively. According to results of the survey, the most important reason that made consumers decide to purchase improved stoves was to save cooking fuel which claims considerable portions of the household budget.

In Uganda it was noted that across all income categories the decision related to the choice of stove types bought were mostly made by wives and/or women at 33% and -80% respectively, this varied from category 1 to category 4. This proportion increased by category. It is important to note that most of the persons in category 1 were either single or divorced and therefore constituted the household heads and 67% of these were women.

Regarding fuel purchasing in Uganda, in the low income category the household head (83%) did the procurement. It is noteworthy to say that the majority of household heads in this category were single women/widows. Wives featured prominently (60%) in the second lowest income category. This group constituted a working class where the man worked and women were housewives. In category 3 children featured prominently 48%. The housemaids featured prominently in category 3 and 4 at 26% and 60% respectively. This clearly implies that much of the kitchen planning in these groups, especially category 4, is relegated to the housemaids.

Summarising it appears that stove purchasing is generally a female decision and usually the domain of the dominant woman in the household. Fuel purchasing is again the domain of women and in lower income households decided by the dominant woman. In higher income households this task is left to children and housemaids in general.

3.2 Financial impact of fuel efficient stoves on consumers

3.2.1 Improved charcoal stoves

The impact of the improved charcoal stoves, as far as delivering significant financial savings to consumers, was predicted as being low in all three countries when the study was being planned. This was largely borne out by the findings which show 5% savings of total income being achieved in Kenya and Ethiopia among the low income households using the stove. While not a large saving in terms of cash saved each week it is approximately the cost of a couple of meals.

Table 3.3 Household savings from using improved charcoal stove as percentage of total income in Ethiopia, Kenya and Uganda

Income group	Ethiopia	Kenya	Uganda
Very low		4.0%	2.2%
Lower	5.6%	5.2%	1.0%
Middle	2.4%	2.3%	0.6%
Upper	0.9%	1.5%	0.4%

Table 3.3 indicates that the savings using the improved charcoal stove as a percentage of income is greater in Kenya and Ethiopia than in Uganda. However, the savings for Uganda have been calculated from charcoal use (measured in the household) with unimproved stoves compared to the likely savings using an improved stove of known efficiency. The Ethiopia and Kenya results are from responses provided by the interviewed households using the stove. It is very likely that the Kenyan and Ethiopian users over estimated their savings.

3.2.2 Mirte stove in Ethiopia

The financial impact of the Mirte injera stove, used for cooking traditional Ethiopian injera bread using biomass fuel, is different from the charcoal stove which is used similarly in all three countries. The injera stove appears to have a significant financial impact and thus an important poverty impact on lower income groups.

Table 3.4 Savings from using Mirte stove as percentage of total income in Ethiopia

Income group	Commercial Mirte	Domestic Mirte
Lower	25%	16%
Middle	6.5	4.6%
Upper	3.3%	3.3%

The Mirte is a highly efficient cooking device saving 40-50% over the open fire (as shown in numerous household and laboratory tests conducted since its commercial introduction in 1994). The commercial mirte is not truly a household appliance. Rather it is used by low-income women bakers to bake injera at home for commercial sale. The estimated savings of 25% of their income clearly shows the importance of this stove in making their business profitable. For domestic cooking only, the 16% saving is highly significant in alleviating poverty and enabling poor people to afford to cook their staple food. This is without evaluating the worth of other benefits such as safety, smoke removal, and cleanliness.

3.3 Other Medical and Health Benefits of Improved Stoves for Consumers

For decades, the World Health Organisation, international health workers, and aid agencies have recognised that the prevalence and severity of Acute Respiratory Infections (ARI) among women and children below the age of 5 in less developed countries is influenced by indoor air pollution among other risk factors. Indoor air pollution is mainly due to high levels of particulate matter (respirable suspended particles) and gaseous material (carbon monoxide, nitrogen dioxide, formaldehyde, benzene, and polyaromatic hydrocarbons to name just a few) generated by incomplete combustion of biomass fuels that are used for cooking and heating.

The concentrations of these indoor respirable pollutants have been found to be extremely high in households in developing countries. For example, indoor households respirable suspended particles measured over a 24 hour period in several studies in developing countries registered ranges of 1000 micrograms per square metre to 9000 micrograms per square metre with peak levels reaching 21000 micrograms per square metre. These levels are significantly higher than the 100 to 150 micrograms per square metre that the WHO recommends and still much higher than the 260 micrograms per square metre that the US Environmental Protection Agency recommends.

The high levels of indoor air pollution in households are due to many factors that include inadequate ventilation and incomplete combustion of biomass fuels, and use of large amounts of biomass fuels for cooking and heating. Strategies for ameliorating indoor air pollutants include increasing ventilation and improving efficient burning of biomass fuels (charcoal and firewood) with improved stoves.

A very recent study (published in January 2000) conducted by E.M. Wafula, M. Kinyanjui, L. Nyabola and E.D Tenambergen from the Department of Paediatrics and Child Health, College of Health Sciences at the University of Nairobi, demonstrated statistically significant reductions in the prevalence of ARI and conjunctivitis among women and children under five in Kiambu District who used improved stoves versus those who did not.

The study found that ARI among children aged below five years was significantly lower among children from households using improved stoves than those among children from households using traditional three stone stoves. Prevalence of ARI among children from improved stove households was 23.1% versus 59% for children living in households with three stone fires.

Similarly the prevalence of ARI among women using improved stoves versus those using three stone fires for cooking and heating was significantly lower. In this case the prevalence of ARI was 13.5% and 38% for women cooking on improved stoves and three stone fires, respectively.

It was also discovered that the prevalence of conjunctivitis was significantly lower among children aged less than five years from households with improved stoves than that among those from the traditional three stone fires. Prevalence rates were 12.4% and 40.9% among children in households cooking on improved stoves and the three stone fire, respectively.

As for women staying in households with improved stoves versus those living in households with three stone fires, the former group had a significantly lower incidence of conjunctivitis (4%) versus the latter group (12%). Lastly the influence of the type of stove on the prevalence of ARI and conjunctivitis among children and women was maintained even after controlling for mothers level of education, socio-economic status of the household, and the type of kitchen, using logistic regression model analyses.

The medical teams study from the University of Nairobi provided empirical evidence that the probability of having ARI within the households with traditional three stone stoves was 2.6 times greater than for households with improved stoves for children under five and 2.8 times greater for women aged between 15 and 60. This represented a reduction in prevalence of ARI among family members using improved stoves (over traditional three stone fire stoves, which had also been in the household previously) by 61% for children under 5 and 64% for women between15 and 60.

The study also showed that the chances of having conjunctivitis within the households with the traditional three stone stoves was 3.3. times more than that within households with improved stoves for children under 5, and 3 times for women aged 15 to 60. This represented a reduction in prevalence of conjunctivitis among residents by improved stoves (over traditional three stone stoves, which had also been in these households previously) by 70% for children and 67% for women.

3.4 Poverty impact of fuel efficient stoves on stove entrepreneurs

A wide range of indicators of change of livelihood were looked at in the country surveys and studies. Full details can be found in the country reports and summary results in Appendix 1. Here is a list of some of the indicators examined although not necessarily in all three countries

Food intake	Housing circumstances
Ability to give extended family support	Ownership of household durables
Electrical equipment	Access to credit
Ability to pay education expenses	Income
Ability to pay healthcare expenses	Acquisition of new land/ property
Acquisition of new livestock	Access to clean water

Membership and position in community/neighbourhood organisations

To make comparison between the effects of stoves business on stove entrepreneurs in all three countries we will compare results for some of the key indicators.

3.4.1.1 Food intake

In Ethiopia 48% of producers rated food intake as better after getting involved with the improved stoves business and 17% rated it as much better with one third stating it was the same. In Kenya stove entrepreneurs witnessed a 76% raise in their ability to afford 'better' nutrition and food intake from previous levels of 'inadequate' or 'adequate'. Of all sub groups of entrepreneurs, marketers had the highest increase in nutritional improvements (92%) and cladders the lowest (63%).
In Uganda results were not as favourable. On the positive side 25% of those who had never had food readily available in the house had moved to a position of always having food available and 50% who had formerly only sometimes had food available now always did. 50% of those who had formerly never had food readily available in the house still found themselves in that position.

Table 3.5 Food situation improved after taking up stoves business

Ethiopia	65%
Kenya	76%
Uganda	29%

3.4.1.2 Housing circumstances

Housing improvements are an important poverty amelioration benefit associated with entering and remaining in the improved stove business for entrepreneurs. Although

absolute wealth cannot be predicted by any one socio-economic factor, housing does have a weighted influence and association with personal financial security. Thus, it was assumed that the quality of housing, as partially inferred by the degree of ownership, would reflect the producer' level of financial independence and affluence.

In Kenya 45.8 % of the producers were able to gain the financial security and independence to move from family housing to rental accommodations and private residences. More than a third of the producers were able to rent their own accommodations while 13.6% bought small houses either for accommodations in Nairobi or on their land up country. A tiny fraction of the producers (3%) remained with their families and a slightly larger fraction (8%) remained in their private residences. The largest bulk of the producers (33.4%) could afford rental housing during the period of their involvement in improved stove production.

A summary of Ethiopian findings are that housing conditions have improved among 52% of the producers after the business, either by way of owning or affording to rent their own housing units. Furthermore, there were 46 new housing structures (with 1 to 3 rooms) constructed by 27 producers (nearly half of them liner producers) between 1992 and 1999.

In Uganda significant improvements in housing circumstance were not noted. The results were mixed. Some 14% of those formerly renting and 33% who formerly stayed with their family now owned their own homes. However about 80% of those renting remained renting and 50% who formerly owned their own home had reverted to staying with their families.

3.4.1.3 Income

A starting point for evaluating the relative income of stove entrepreneurs is comparison with similar professions. In Kenya an average employee in the manufacturing sector earned US$191 per month in 1998 while an average improved stove producer earned US$229 -- a 17 percent increase in wage earnings over general manufacturing jobs. An average owner of a liner production business earned 40% more than an average person employed in the manufacturing sector. More importantly, in Nairobi, an average improved stove producer earned 2.3 times more than the average minimum wages of a Grade I Skilled Artisan, a person capable of producing relatively sophisticated metal and wooden products in 1998 - US$101.[2]

In Ethiopia comparison was made with incomes before and after people entered into the stove business. Average monthly incomes of producers of the Lakech, Mirte and mixed categories grew by factors of 3.1, 2.5 and 2.1 relative to previous activities, respectively.

Incomes in Uganda are highly linked to the manufacturing activity engaged in. Those making linings and all clay stoves were earning around US$300 per month, whereas cladders and assemblers were earning much less in the region of US$100 per month.

[2] Information on manufacturing sector incomes obtained from "Kenya Economic Survey 1999".

This puts all entrepreneur groups in the income class classified as the second lowest, i.e.- poor.

3.4.1.4 Healthcare expenses

In Ethiopia the number of producers who reported that they can "never" and "very rarely" afford to pay for their own medical care before the new business decreased by 74% and 66% respectively. On the other hand, the number of those who can afford to pay "sometimes", "very often" and "always" has grown by 153%, 107% and 185% respectively after the new business. Ability of producers to cover costs of medical care for their families has also improved with the new business. For instance, while the number of producers who can "never" or "very rarely" afford to pay for their family medical care went down by 88% and 47% respectively, the number of those who do so "sometimes", "very often", and "always" grew by 283%, 100% and 157% respectively, after the business.

In Kenya 60% of the stove entrepreneurs improved their ability to afford their own medical expenses. 40% reported no change.

In Uganda 73% of the respondents said that their ability to pay for medical services had improved; given that previously they had difficulty paying for these medical services and now these services were readily affordable. However, some 27% sometimes could and other times couldn't afford to pay for these services.

It is interesting that while for some social indicators the stove entrepreneurs in Ethiopia and Kenya seem to fare better than their Ugandan counterparts in the area of health care the situation seems to be similar across all three countries.

Table 3.6 Country results for the ability to pay medical expenses

Ability to pay medical expenses %	**Ethiopia**
Improved	52
Same	36
Worse	12

Ability to pay medical expenses %	**Kenya**
Never to Always	32
Never to Sometimes	7
Sometimes to Always	21
Not able to afford before or after	41

Ability to pay medical expenses %	**Uganda**
Never to Always	40
Never to Sometimes	53
Never to Never	7
Sometimes to Always	73
Sometimes to Sometimes	27
Sometimes to Never	0

Always to Always	67
Always to Sometimes	33
Always to Never	0

3.4.1.5 Education expenses

This is also an indicator where an improvement in ability to pay has been seen among producers in all three countries, see Table 3.7 below. In fact in Uganda and Kenya no decline has been noted by any producers whereas in Ethiopia 8% showed a decline.

Table 3.7 Country results for the ability to pay childrens' school fees

Ability to pay school fees %	**Ethiopia**
Improved	50
Same	42
Worse	8
Total	**100**

Ability to pay school fees %	**Kenya**
Never to Always	43
Never to Sometimes	28
Sometimes to Always	18
Sometimes to sometimes	12
Not able to afford before or after	0
Total	**100**

Ability to pay school fees %	**Uganda**
Never to Always	52
Never to Sometimes	37
Never to Never	11
Total	**100**
Sometimes to Always	33
Sometimes to Sometimes	67
Sometimes to Never	0
Total	**100**
Always to Always	100
Always to Sometimes	0
Always to Never	0
Total	**100**

3.4.1.6 Conclusions on poverty impact of fuel efficient stoves on stove entrepreneurs

The indicators studied show strong evidence that the improved stoves business does provide significant livelihood improvements for producers and entrepreneurs in Kenya and Ethiopia. The business is tough and competitive with declining prices and quality leading to ever lower margins for those engaged in the business. However, producers and employees who are well organised and hard working can make a good living. The high perception of the product in Kenya and Ethiopia among all income groups of consumers means that demand in the marketplace for the product remains high.

The picture is more mixed in Uganda. Many of the poverty reduction indicators studied stove producers did not perceive a large improvement when they shifted into "improved" stoves production. The results were more mixed with some improving and others declining. Only in the two areas of ability to pay for healthcare and children's education did the Ugandan results mirror those in Kenya and Ethiopia. This is interesting as this does seem to indicate that there is some improvement from the business on the lives of the producers. A speculation on this would be that health care and education for children are two of the most important uses of any additional money, however small, that a new activity might bring. In Uganda they use any additional income for education and health care, thereby leaving no more for use in other areas. Further studies would be needed to confirm this.

3.4.2 Gender issues regarding stove producers

Stove production is dominated by men in all three countries surveyed, see Appendix 1.4. This was most notable in Kenya where 97% of stove producers were men and this high percentage covered all the main categories of claddersm, assemblers, liner producers and marketers. In Ethiopia and Uganda the difference was not so great apart from in the manufacturing of claddings which does seem to be a male preserve in all the countries. In Ethiopia liner production is an almost wholly female preserve which has basically arisen because the liners are produced by potters who are traditionally women in Ethiopia. In Uganda around 30% of liner and all-clay stove manufacturers are women. The most successful stove entrepreneur identified in Uganda is a women who is a very large producer of liners.

Women when they are involved in the stoves business earn less than men. Interestingly, in Ethiopia, despite a significant discrepancy in earnings between men and women it was women who had the largest increase in earnings as a percentage of former earnings when they took up stoves business. (2.4 times for women and 1.5 times for men).

3.5 Impacts on Traditional Stove Producers and Biomass Fuels Suppliers

The purpose of this activity was to see if there were any losers attributable to the uptake of improved stoves, namely traditional stove manufacturers and biomass fuel suppliers.

Results from survey and analysis work in Kenya and Ethiopia are given in Appendix 1.5. There are no separate results for this sector in Uganda, at the time of writing. It was not relevant to look into this effect in Uganda as there is not really any major production of improved stoves there at present. The manufacturers tend to make both traditional stoves and so-called "improved" stoves which means they have a clay liner but little else to define them as a true energy efficient design.

The Ethiopian and Kenyan results contrast but they have looked at things slightly differently. In Ethiopia the traditional stove makers have generally moved to making improved stoves so have benefited. Some make both thus keeping their options open. In Kenya the survey focused particularly on producers who did not make improved stoves and found that the benefits that improved stoves producers gained from the business were not matched by the unimproved traditional stove makers. In other words the margins in making traditional stoves were lower, so presumably the market was not as good. There could be scope for persuading these manufacturers to consider improved stove manufacture but the Kenyan study did not mention this. The poor conditions of the traditional stove producers were not attributed to the manufacture of improved stoves, the impression being given that it was ever thus.

Regarding biomass the Ethiopian study carried out some analysis on this aspect. The conclusion was that the dynamics of biomass marketing is complex and effected by many factors, including:

- *macro-economic policies e.g. subsidies, duties and taxes affecting inter-fuel substitution;*
- *price and availability of other alternative fuels;*
- *liberalisation of the biomass fuels trade*
- *prevalence of food (in)security situation in biomass production areas;*
- *changes in household income;*
- *various coping strategies and adaptation to scarcity;*
- *demographic changes.*

It is really not possible to note changes which may be attributable to energy efficient stoves on top of these other factors. In the Ethiopian case there has been recent fuel switching to biomass away from electricity and kerosene due to price increases in these fuels. Despite an increase in demand biomass prices have fallen reflecting an increase in supply. This has been driven by a relaxing of government restrictions and agricultural failure in rural areas leading to increased biomass fuel production as an income generating activity. Improved stoves actually have a positive part to play in this changing situation. They reduce the overall increase in biomass use and provide safe and healthier appliances for domestic use.

3.6 Efficiency tests on stoves

The efficiency tests on the improved charcoal stoves in all three countries show it is capable of making efficiency savings of around 24 – 30% and in some cases as much as 33%. It was seen in Ethiopia that a 4 year old Lakech can still deliver as good a

performance as those stoves quality tested 5 years ago when the stove was first disseminated.

However, stoves on the Addis Ababa market now are generally of a much poorer quality with performance falling to that of the unimproved TMS or offering lower efficiencies of around 15-20%. This decline in quality is due to the competitive market for the stoves which has driven prices down massively. With this price competition (actual "price wars"), quality has deteriorated over the past few years.

In Kenya too, performance seems to have dropped with savings of 24% rather than the 30-50% measured in the late 1980s. However, these historical Kenyan results seem high and while savings of 30-35% could have been achieved stoves delivering 25% savings are still performing reasonably well. The downward push of price and quality does not seem to have been quite so marked as in Ethiopia. In fact, given the fact that the Kenyan market for improved stoves is older, and therefore more mature, producers have probably weathered the first rounds of competitive pressure, and the quality has returned as an element of consumer preference. Even in Ethiopia, the market is now showing signs of maturing as illustrated by the range of various qualities of improved stoves at differentiated prices.

The fuel efficient stoves in Uganda are of a variety of different designs and differing efficiencies. Some are as efficient as the improved stoves in Kenya and Ethiopia and the quality of some of them is also good. Prices tend to be high and as there is no recognised design of energy efficient stove on the market, stoves which are not very energy efficient or of good quality can also be passed off as “improved”. This has the danger of devaluing the market in these stoves before it is even properly established. This high variation in quality and design could also explain why improved stoves have thus far failed to penetrate any segment of the more affluent urban consumer market, unlike the experience in Kenya and Uganda where improved stoves made their first big impact among high income urban households.

Table 3.8 Efficiency saving of present production of fuel efficient stoves over the traditional metal stove

Country	% saving of present production over TMS
Ethiopia	**0 – 24%**
Kenya	**24% Ave.**
Uganda	**16 – 28%**

4. FINDINGS AND RECOMMENDATIONS

4.1 Successful commercial stoves lead to improved producer livelihoods

The work has shown that, in the case of Kenya and Ethiopia, the commercial success of improved stoves has led to **poverty reduction** amongst most people engaged in the improved stoves business. It has **effected substantial positive livelihood changes** (e.g., improved diet, improved health, improved housing, improved education) for the majority of those engaged in the business.

It should be noted that in almost all cases, those who are engaged in improved stove production began their improved stoves work as some of the poorest, least economically enfranchised urban dwellers in the three countries. Metal working and traditional ceramics (in Ethiopia), are low prestige activities, and, in the case of basic metal working, provide urban dwellers with ease of entry, but, traditionally, very poor returns on labour. **The most fundamental finding of the project** is that improved stoves in Kenya and Ethiopia have offered these metal workers the means to improve their returns substantially, thereby improving their livelihoods and opportunities, and offering those engaged in the business new economic and social opportunities.

This finding is also a crucial factor in why these stove programmes have been successful and sustainable without continued government support.

4.2 Successful commercial stoves lead to improved urban consumer livelihoods

In both Kenya and Ethiopia the use of the stoves has led to real financial savings for lower income groups which are not insignificant. While it is clear that the use of a charcoal stove does not lift people out of poverty on its own, it is one of many sensible livelihood choices which contribute to a more stable existence.

In Uganda, there are no statistically significant poverty alleviation aspects for producers and those engaged in the business of urban "improved" stoves. There are a wide variety of "improved" stoves in the country, unlike Ethiopia and Kenya, and their technical performance and quality are mixed, as past test results and those conducted during the course of this project have shown.

The Mirte stove in Ethiopia significantly benefits users and it can be claimed that it does have an important poverty reducing impact on low income users.

4.3 Consumer perception - a key to success

The consumer perception in Uganda is very different from that in Uganda and Kenya.

The vast majority of "improved" stove users fall within the lowest income quartile, while relatively wealthy urban dwellers (the upper income quartile) do not buy the stoves, and show no interest in them. Over a third of the lowest quartile consumers have purchased "improved" stoves motivated, primarily, by anticipated fuel savings. Contrary to the experience in Kenya and Ethiopia, higher income urban Ugandans seem to view the versions of "improved" stoves in their markets as inferior products, things for low-income consumers.

In the case of Kenya and Ethiopia, improved urban stoves were introduced initially through donor-supported programmes. Their improved stove projects targeted upper income consumers during the first phase of stove commercialisation as a way to achieve sustainable commercial penetration. That is, the projects adopted strategies that the stoves should be produced and sold on as commercial a basis as possible, with few, if any, external subsidies to the sector. To achieve those objectives required commercial acceptance by those most able to afford the initial high costs of new stoves. That is, the projects' strategies targeted wealthier urban consumers as a means to subsidise the start up, initially high costs of product development and production, until scale and market economies could be achieved.

The logical outcome of this approach was to sell high quality, and initially expensive, improved stoves to upper income groups. This succeeded remarkably well in both Kenya and Ethiopia, and as the stoves became commercially accepted, and as more producers entered the market place, the prices of these stoves dropped dramatically. Today, improved charcoal stoves in Kenya and Addis Ababa sell for less than one twentieth their original costs, in real terms. Today, improved charcoal stoves sell in Nairobi and Addis Ababa for less than "traditional" stoves.

Such strategies have not been adopted in urban Uganda. Rather, stove programmes have trained up artisans, helped to subsidise their production and sales, and then, when the programmes ended, left producers to fend for themselves. Without developing good market and commercial skills, and without achieving commercial independence based upon market success, Ugandan urban improved stove producers have not been able to penetrate the market on a large scale. The status of the improved stoves has stayed low.

While there continues to be demand from low-income urban dwellers (who are looking for fuel savings to improve their livelihoods), the margins are as low as in Kenya and Ethiopia (mature improved stoves markets), while the volumes are very low. Consequently, there have been few demonstrable poverty alleviation benefits from improved stoves in Uganda, compared to Kenya and Ethiopia. This provides strong guidance to those wishing to promote improved stoves, not only in Uganda, but elsewhere in the developing world.

4.4 Success leads to fierce competition - but quality can fall

The success of these stoves in Kenya and Ethiopia, and the benefits of being in the marketplace, have led to intense competition, price cutting, and unfortunately,

reduction in product quality. While consumers do not perceive a drop in stove efficiency, they do note a drop in overall quality (appearance, robustness, etc.), and stove tests carried out by the project team do show a decline in efficiency performance. This has been more pronounced in Ethiopia than in Kenya, where the improved stoves market is more established (since the mid-1980s) and more mature.

Indeed, interviews of producers in Ethiopia, particularly women clay liner producers, show that their returns on production have fallen over the past several years, as has their economic power vis-à-vis stove assemblers in the marketplace. If this trend continues, it is apparent that the socio-economic improvements they have enjoyed through the improved stove business will disappear, and leave them in as vulnerable a position as they were prior to entering the improved stove business.

However, the expectation is that the market will turn round in Ethiopia, as it has in Kenya, and return to a quality and value product (there are signs of this already happening). An issue to be dealt with below is can selective interventions by government or other donors assist in this process?

4.5 Role of governments and donors

It could be claimed that with a commercial sector approach being taken there is no role for government or donors. This is fundamentally not the case and neither of the programmes in Ethiopia or Kenya would have been successful without substantial government and donor backing over several years. Government and donors must be involved with specific tasks at key stages and maintain a supportive role on a continuing basis where necessary. These tasks include:

- At early stages in a programme, assistance with identifying suitable stove designs and testing, if necessary;
- Assistance with household trials and kitchen performance tests to ensure the most suitable stove designs are being promoted;
- Identifying suitable stove entrepreneurs and training them in manufacture, quality control, business management;
- Assistance given to the entrepreneurs with marketing and promotion of the new stoves and raising their market profile;
- Provision of revolving fund or other forms of small credit for stove entrepreneurs to build up their businesses;
- Monitoring the stoves market and biomass fuels market to identify any strengths and any developing weaknesses;
- Provision of market support to stove producers and assistance with producer organisation where necessary, if it is deemed that this will assist the market in terms of quality and availability of stoves at a reasonable price.

4.5.1 Recommendations for African Governments

This study recommends that governments consider the encouragement of the manufacture of improved stoves because of the multiple benefits which flow from this activity. As well as the usually recognised environmental, air quality, health and safety benefits this study has shown that successful commercial programmes also deliver significant poverty reduction benefits to those who take up stove entrepreneurship. Often these people are on low incomes or unemployed and they are lacking many other options. The savings delivered by the stove also have a small but significant impact on those users on low incomes.

Governments wishing to increase the take up of fuel efficient biomass stoves in their urban areas should look at the existing improved stove production that may be currently occurring and ask the following questions:

i) Are those involved in the production of the stoves improving their livelihoods and reducing poverty impacts by engaging in this business?

ii) Are their businesses sustainable without outside inputs, e.g. grants, subsidies?

iii) Is the consumer perception of fuel efficient stoves across all income groups favourable?

Unless the answers to all these questions are yes it is likely that the stove industry is in need of commercial development and capacity building to enable it to become a self sustaining industry, and consumer awareness programmes to raise the profile of the stoves.

If there has been no improved stove production in the urban centres so far and traditional unimproved stoves are used for charcoal and wood use there is a good opportunity to introduce successful commercialised stoves production. In fact it may well be the case that this situation is better than one such as that found in Uganda where a succession of top-down, donor-driven, "improved" stove programmes have failed due to the lack of a focussed market led approach and consumer awareness campaign. It is harder to overcome a negative image that has been created by badly designed and implemented programmes than to introduce a new product which has not been seen before.

4.5.2 Recommendations for UK Government and other donors

The advice is similar to that for governments above, but as the range of circumstance can vary in the different regions donor organisations may be operating it is essential that a consistent approach is taken when dealing with the promotion of energy efficient stoves.

- **Rationale** - A clear reason for supporting improved stoves production must be present, this could be environmental protection, indoor air quality, home safety or

poverty alleviation for low income households (as has been demonstrated in the case of the Ethiopian mirte stove in this study) or a combination of these or others.

- **Verification and monitoring–** If an existing problem is to be mitigated by introducing or improving the availability of improved stoves there should be some way of measuring whether mitigation does take place, both in the short term by household trials, and in the long term, e.g. does the stove have an effect on environmental preservation, are stove efficiencies maintained in the future from those achieved at introduction?

- **Approach –** is a consistent private sector commercialisation process being followed which will lead to unsubsidised improved stove production supported by government only in terms of technical support, business training, credit provision and consumer awareness where possible? Are there other donor led, NGO sector initiatives present which will distort the market and make commercial production difficult for entrepreneurs. If so, such activities in urban areas should be discouraged. This does not mean dropping support for ongoing public and NGO sector stove programmes but re-orientating such programmes towards the private sector and the sustainable production of commercial stoves.

- **Ongoing programmes –** The study has identified different needs in places where successful commercialisation of improved stoves has already taken place and those where it has not. In places such as Ethiopia and Kenya the need is for the national government to continue to support the industry with training, provision of favourable market conditions, access to credit services, monitoring and quality control. Continued consumer awareness and promotion assisted by government or other bodies is also useful. Roll out of commercial production to other areas of the country is also a valid area for government or donor support. This will first be to other urban centres. It may also be worth investigating whether peri-urban and rural areas can provide a market for improved stoves. Donors can assist in all these processes either supporting government or stoves producers. Where support is considered for NGO activities it must be ensured that their aim is the commercial production of stoves by the private sector.

4.6 Specific recommendations for Ethiopia, Kenya and Uganda

In the country final reports (see Annex) detailed recommendations for the stove programmes in each country can be found. Below we summarise the main points with some cautionary comments from an overall perspective. In Ethiopia and Kenya the task is to maintain the good progress that has been made towards sustainable commercial production and low production costs while ensuring quality is also maintained. In Uganda the task is to develop the full commercialisation of a popular energy efficient charcoal stove that appeals to all income classes.

4.6.1 Recommendations for Maintaining the Commercial Viability of Improved Stoves in Ethiopia

The Ethiopian recommendations all make good sense. It is good to propose the use of a stove producers association to deliver certain types of key support rather than government agencies or donors as this ensures a commercial focus. The second two headings, policy support and rural household energy initiatives are more likely to come from donor/government initiatives.

4.6.1.1 Organise Improved Stoves Producers' Association:

- Provide access to credit finance
- Ensure Quality Control of Improved Stoves
- Provide Training and Technical Assistance
- Improve Firing Techniques
- Standardisation of Product Dimensions and Sizing
- Investigate Alternative Fuel(s) for Firing Liners

4.6.1.2 Policy Support

- Increase Promotion and Consumer Awareness
- Develop Enabling Environment and Positive Official Attitudes
- Information Exchange and Networking Among NGO's, Government Departments, and other relevant stakeholders
- Include Improved Stove Production and Marketing in School Curriculum

4.6.1.3 Rural Household Energy Initiatives:

- Expand Programme to Small Urban and Rural Areas Outside of Addis
- Enhance Research and Development into other Alternative Energy Sources for Cooking in Households
- Continue to conduct research into ways of improving Charcoal Conversion Efficiencies at the household level
- Encouraging Inter-fuel Substitution

4.6.2 Recommendations for Maintaining the Commercial Viability of Improved Stoves in Kenya

4.6.2.1 Establishment and enforcement of quality standards

The Kenya team has recommended that the Kenya Bureau of Standards (KBS) can spearhead the proposed action in conjunction with research institutions and, not least, by improved stoves producers themselves. The project co-ordinators feel that this action is better dealt with by more producer training, information and consumer awareness. It will be difficult to enforce national standards in this area and it is unlikely that there will be much interest from the KBS.

4.6.2.2 Delivery of financial and business support services

It is recommended that a training package should impart relevant business skills such as accounting, book keeping, sales and marketing, costing, budgeting, banking and management, etc. Training of producers should be complimented with an adequate supply of affordable credit to enable them to upgrade and expand their production processes, hence producing better quality and competitive products.

4.6.2.3 Research, technical knowledge and stove testing

It is unlikely that further significant design improvements are required in the Kenyan context but there is likely to be a shortage of skilled professionals with knowledge about the correct design of stoves, testing and evaluation if this subject is no longer dealt with at university or technical college level.

4.6.2.4 Education of consumers

When all is said and done, consumers have to be educated on what an improved stove is and most importantly what level of performance to expect in terms of fuel savings, ease of lighting, cooking time, durability, etc.

4.6.3 Recommendations for building the commercial viability of improved stoves in Uganda

Uganda has a different position to Kenya and Ethiopia where they are trying to maintain and build on an already successful improved stove production. In Uganda the industry is much smaller and the market for improved stoves much less developed than Kenya's or Ethiopia's. The study has identified two key areas where change is needed to support the industry.

i) Improve incomes for improved stove entrepreneurs

In Uganda improved stove manufacture is not an exciting business offering significant poverty reduction to entrepreneurs. This means that resources are not put into the industry to improve production, increase output and to bring down prices. It remains a low investment, low output activity with poor quality control and a lack of training. Producers often come in and out of the market and engage in other manufacturing and marketing activities too, in order to make ends meet and spread risk.

ii) Increase status and knowledge of fuel efficient stoves among all consumers

Fuel efficient stoves do not have a high status, they are more appreciated among the low income groups who can readily perceive their benefits. However, this does not encourage their use more widely or establish a large secure market. It is very important for middle and upper class Ugandans who are presently using traditional metal stoves to switch to using improved stoves if Uganda is to utilise its indigenous biomass resources more efficiently, and continue to provide livelihoods for those engaged in biomass production and transformation, and those who are engaged in producing the devices that use those resources to generate energy. This will increase

the market bringing down prices and encouraging all, both rich and poor to use the stoves.

4.6.3.1 Actions to improve entrepreneur incomes and increase consumer awareness

Actions to impact on i) and ii) above need to be implemented together as there is a feedback reaction between improving incomes and improving consumer awareness. As long as awareness is low, demand is low and producers cannot generate good incomes, prices remain high, quality remains low and consumer awareness remains negative.

4.6.3.2 Actions targeted at entrepreneurs

A commercialisation programme is needed to deliver the following:

- Technical support and training
- Business training and support
- Quality control
- Credit provision

A full business orientated package is needed to build up capacity in the improved stoves sector and to encourage healthy competition amongst producers. Technical skills should be improved to increase production while increasing quality. This will lead to lower unit costs and better products. This can, at the same time, be supported by business training for stove producers so that they can better manage improvements in the production prices and also be able to manage cash flow requirements while changes take place. To further support the business improvements, credit should be made available on favourable terms so that the producers can quickly take advantage of their new skills by increasing production into the market.

4.6.3.3 Actions targeted at consumers

A well designed stove programme will also deliver:

- Government supported national promotion and advertising
- Market place/local promotion

National level government promotion highlighting the benefit of efficient stoves and the recommended designs is needed to raise the profile of the stoves. The main target audience in Uganda seems to be middle and upper income brackets who at present do not appreciate the benefits of the stove. By targeting these groups with TV, radio and press advertising, while ensuring there is a good supply of quality stoves to meet an increased demand, the status of the product will be raised across all income groups.

At the same time local level promotion at key market centres around Kampala and other smaller towns can be organised. This will further promote the stove and lead to

word of mouth recommendation which is ultimately the best form of promotion a product can get.

APPENDICES

APPENDIX 1 COUNTRY FINDINGS

This appendix presents results from the three study countries for four distinct aspects:

- Consumer perception of fuel efficient stoves
- Financial impact of fuel efficient stoves on households
- Poverty impact of fuel efficient stoves on stove entrepreneurs
- Efficiency tests on fuel efficient stoves

The detailed results are not presented here and can be found in the country reports, case studies and stove test reports (see supporting Final Report Annex). The aim here was to present enough of the analysed findings to back up the conclusions and recommendations in sections 3 and 4 of this report.

A 1.1 Consumer Perception of Fuel Efficient Stoves

A1.1.1 Ethiopia Consumer Perception Findings

In Addis Ababa, housewives purchased improved stoves for various reasons. In particular, households expressed very high satisfaction with the improved stoves due to advantages they gained in cooking speed, safety, convenience, durability, quality of food produced, aesthetic appeal, and reduction in smoke. Households also acknowledged the fuel savings achievable with the improved stoves as another significant reason why they appreciated the Lakech and Mirte. However, as Table A1 shows, fuel savings did not rank in the top seven benefits cited by consumers. This supports previous work carried out by ESD and its teams in Ethiopia and Kenya showing that fuel savings are not the primary driver for consumers who purchase improved stoves.

Table A1 and A2 illustrate how many families out of 160 evaluated the qualitative and financial benefits of improved stoves. Approximately 80% of the sample population ranked increased safety and convenience as the most important benefits of using an improved stove. Around 70% of the households considered the increase in speed of cooking and aesthetic appeal of the device to be key benefits and reasons for using the improved stoves. 55% of the families felt that the improved stove reduced the level of indoor air pollution. More than half of the households also expressed satisfaction in the improved stoves ability to increase the taste of food and in ease of cleaning and maintenance. 88% of the families indicated that the improved stoves in general reduced wood fuel consumption.

Table A1 Consumer's Level of Satisfaction with Various Benefits of the Lakech Improved Stove in Ethiopia

Benefit	Number of Families Who Felt the Lakech Provided a Particular Benefit	% of Families Who Responded
Increases safety when handling the stove	133	83.1%
Increases convenience for cooking	130	81.3%
Has more aesthetic appeal and appearance	114	71.3%
Increases speed of cooking	110	68.8%
Is more durable	105	65.6%
Improves the taste of food	96	60.0%
Is easier to clean and maintain	89	55.6%
Reduces indoor air pollution and smoke	88	55.0%
Total No. in Sample	**160**	**100.0%**

Table A2 Consumers' Perception of Improved Stoves on Fuel Consumption in Ethiopia

Fuel Consumption	Improved Stove Types			Total	*Per cent*
	Lakech	Domestic Mirte	Commercial Mirte		
Lower	66	55	22	143	*88.8*
Same	6	2	2	10	*6.2*
Higher	0	1	1	2	*1.2*

A1.1.2 Kenya Consumer Perception Findings

Consumer interest in the KCJ was garnered around both financial and non-financial benefits. The KCJ provided a number benefits for housewives and their families. First and foremost the KCJ was perceived to embody fuel efficiency as more than 90% of all of the households in the study felt it directly reduced charcoal consumption and provided more meals per unit of charcoal. There were other key aspects of the KCJ's function which were of notable importance to consumers (See Table A3). 72% of the poorer families interviewed observed that the time required for cooking traditional meals decreased significantly – indicating that the KCJ has faster cooking speed. 74% and 80% of poorer families expressed satisfaction in the KCJ's capacity to reduce indoor air pollution mainly from smoke and to minimise accidents, respectively. The KCJ was also easier to clean and maintain for 81% of all of the households. It also generated better food quality according to more than 79% of all of the households interviewed. On the other hand, 60% of the consumers felt that the stove required more time to light than traditional stoves and that the KCJ was not very durable.

72% of the consumers did not find the KCJ's aesthetic appeal to be important as a reason for purchase and use in the household.

Table A3 Consumer's Level of Satisfaction with Various Benefits of the KCJ Improved Stove in Kenya

Benefit	Number of Families Who Felt the KCJ Provided a Particular Benefit	% of Families who Responded
Increases safety when handling the stove	82	82.0%
Improves the taste of food	81	81.0%
Is easier to clean and maintain	80	80.0%
Increases convenience for cooking	77	77.0%
Reduces indoor air pollution and smoke	70	70.0%
Increases speed of cooking	62	62.0%
Is more durable	40	40.0%
Has more aesthetic appeal and appearance	28	28.0%
Number in sample	**100**	**100.0%**

A1.1.3 Uganda Consumer Perception Findings

Among the poorest households the main opinion on the Improved Cook Stove (ICS) was that it broke easily, cost relatively little and was fuel saving whereas in the category 2 households (earning from .01-.05 million Ush per month) the largest response (31%) had never thought about acquiring an ICS, see Table A4 below. However, others in this group said it was expensive, broke easily and was fuel saving while others said it was durable. Among the lower middle income classes the largest response (31%) had not thought of acquiring an ICS, while 19% said it was fuel saving. Those who said it was durable equalled those who said it was expensive. More than half of the respondents (56%) in upper income class had never thought about purchasing an ICS at all. In this group 13% had never heard of it while (25%) of these respondents said it was fuel saving. Generally speaking a higher proportion (60%) of respondent with positive attitude towards the ICS were found among the category 1 households while the least (25%) was found among the upper income families.

Table A4 Consumer opinion on the Improved Cook Stove in Uganda presented by income group

Opinion on the ICS %	Household Monthly Income Categories (Ugandan Shillings in Millions)			
	(1) <0.1	(2) 0.1-05	(3) 0.5-1.0	(4) 1.0+
Expensive	0	15	15	0
Never heard of	0	0	4	13
Not thought about	0	38	31	56
Breaks easily	40	15	8	6
Affordable	40	5	4	0
Cooks fast	0	3	0	0
Fuel saving	20	13	19	25
Durable	0	13	15	0
Hard to light	0	0	4	0
Number in sample	**5**	**40**	**26**	**16**

Regarding the cost price of the ICS, Category 1 and 4 households reported that the price was acceptable. However category 1 and 2 households expressed sentiments that the time required to light an ICS were excessively high whereas only 29% in category 3 had similar sentiments. The majority (80%) among households in income categories 1, 3 and 4 didn't face a problem of smoke when using the ICS, however 50% of persons in category 2 said the ICS produced smoke. All respondent households across all categories expressed positive sentiments on the fuel saving capacity of the ICS. While the incidence of accidents and burns were not reported among the ICS users. Most of the respondents (100%) reported the ICS to be clean except one respondent in category 4 (however this sentiment could be attributed to storage difficulty accruing from the dust and dirt characteristics of charcoal and the need for disposal of a large quantity of ash).

On the maintenance of the ICS the category 1 households didn't express any difficulty. While 50% of households in category 2 expressed difficulty in maintaining the stove. 71% of Households in category 3 expressed difficulty with ICS maintenance. On the durability of the ICS, over 50% the households across all categories and (100%) in category 4 expressed dissatisfaction with the durability of the stove. On the ICS appearance all the respondents expressed satisfaction with the stoves aesthetics. This implies that a major contributory factor in the stove adoption would be to improve its aesthetic values. A number of ways of improving the stove attributes were given by the respondents and these included the use of better quality clay, using better gauges of claddings and the use of "metallic linings".

A1.2 Financial Impact of fuel efficient stoves on households

A1.2.1 Financial impact on Ethiopian Households

It is key to look at the impact by income group as the amount of expenditure on fuel is dependent on income. In Ethiopia, three income groups were defined; less than Etb (Ethiopian Birr) 600 monthly earning, Etb 600 to Etb 1599 and over Etb 1600. Table A5 gives the savings a perceived by users of the devices not measured savings by controlled cooking tests and fuel quantity measurement.

Table A5 Percentage of Savings Due to Each Stove By Income Class

I) Low Income Group: (Less than Etb 600 with an Average of Etb 298 per Month)		
Stove	**Monthly Saving (Etb)**	**% of Income Saved**
Lakech	16.8	5.6
Dom. mirte	50	16.8
Comm.mirte	73.6	24.7
II) Middle Income Group: (Etb 600 to 1599 with Monthly Average of 926)		
	Monthly Saving (Etb)	**% of Income Saved**
Lakech	22	2.4
Dom. mirte	43	4.6
Comm.mirte	60	6.5
III) High Income Group: (Etb 1600 + with an Average of Etb 2992 per Month)		
	Monthly Saving (Etb)	**% of Income Saved**
Lakech	26.4	0.9
Dom. mirte	100	3.3
Comm.mirte	100	3.3

The above tables indicate that the savings from the Lakech charcoal stove are not large as a percentage of income although 5.6% for the low income families will be of some worth to them. This is a monthly saving of about Etb17 or about US$2. On the other hand, the savings from the Mirte are much more significant; for the low income group, this accounts for an average saving equal to 17% of income, or some Etb 50 ($6).

A1.2.2 Financial impact on Kenyan Households

Kenyan households save from 32 to 53 Kenyan Shillings (Ksh) per week (between US$0.75 and US$1.00 per week) using the KCJ compared to traditional metal stoves. Table A6 depicts how much money families are saving per week and per annum according to residential area.

Table A6 Financial Savings Perceived by Families Using the KCJ[3]

Residential Area	Sample Size	Savings Per Week (Ksh)	Savings Per Year (Ksh)	Savings as a Percent of Annual Income
Highrise	75	53	2756	1.5%
Kaloleni	80	33	1716	2.3%
Kibera	74	49	2580	5.2%
Muthare	52	32	1700	4.0%

Sample size n=281

As a percentage of total annual income, it is clear that the poorer families can gain a 4-5% reduction in overall expenditure by using improved stoves – this percentage is a significant economic benefit given the vulnerable status of such households. Detailed interviews showed that the bulk of savings accrued by the groups from using the KCJ was spent on food and groceries, more fuel, and clothing.

A1.2.3 Financial impact on Ugandan Households

The data for Uganda are not equivalent to Kenya and Ethiopia in being expressed in terms of **the perception of users** to the savings they accrue from using the improved charcoal stove. What is available is the amount spent on charcoal by users of unimproved stoves by income group. In addition charcoal savings are known, based upon information to be obtained from tests on the best improved charcoal stove tested by the project. From this we can derive the percentage of likely savings for each income group. The results are shown in Table A7.

Table A7 Calculated savings with the most efficient ICS tested, Uganda

Income category In million Ugandan Shillings per month[4]	**(1) <0.1 mi**	**(2) 0.1-05 mi**	**(3) 0.5-1.0 mi**	**(4) 1.0+ mi**
Charcoal quantities purchased (sacks/Mth)*	0.61	1	1.4	1.6
Household expenditure on charcoal Ush/month	7,833	10,813	17,180	13,343
28.3% saving with improved stove per month	2221	3066	4872	3784
Charcoal use as percentage of monthly energy expenditure	**8%**	**4%**	**2%**	**1%**
Saving as percentage of monthly energy expenditure	**15.8%**	**11.7%**	**8.8%**	**6.8%**
Saving as percentage of total monthly income	**2.2%**	**1.0%**	**0.6%**	**0.4%**

*Assumes present charcoal use is for an unimproved stove
Assumes all charcoal use for cooking and water boiling (no ironing)

[3] Approximate exchange rate, September 2000, of Kenya Shillings (Ksh) 60 to US$1.00.
[4] Exchange rate, September 2000, approximately Uganda Shillings (Ush) 1600 = US$1.00.

A1.3 Poverty impact of fuel efficient stoves on stove entrepreneurs

The poverty impact of involvement in the manufacturing and marketing of fuel efficient stoves was studied in all three countries. A summary of the results is presented below. More details can be found in the country reports. In Kenya a control sample of producers of unimproved traditional stoves was also studied.

It should be noted that stove production in urban areas in all three countries is almost exclusively an informal sector activity. Furthermore, traditional charcoal stove artisans are generally at the bottom of the economic ladder in these urban centres, with metal working being a particularly low status occupation in Ethiopia. Stove artisans are generally young males who generally live with their parents, or extended families, or in shared accommodation. It is a noisy, dangerous occupation, with easy entry, and relatively little mobility other than for a few who move upwards into more complicated metal-smithing.

Ceramic production in Ethiopia has a very long history. Ceramics are almost exclusively produced by women, with mothers handing down the craft to their daughters. In the case of Addis Ababa, the ceramic liner producers for the improved charcoal stove come from a poor rural area near Addis Ababa, where ceramic production supplements poor farm families' incomes.

In both Kenya and Ethiopia, informal sector artisans adopted the improved stoves at a very early stage, either by project strategy (Ethiopia), or as an opportunistic strategy by itinerant metal workers to earn more income, or to diversify production.

A1.3.1 Poverty impact on Ethiopian improved stove producers

Full results can be found in the Ethiopia country report.

A1.3.1.1 Income

Analysis of employment and income conditions of the producers indicate that out of 28 people who were unemployed before the stoves business, 24 (86%) are now employed and they are earning monthly incomes of up to Etb 700[5]. The number of producers earning monthly income of up to Etb 100 showed about 7% growth after the business. While nearly a quarter of the producers were earning monthly income between Etb 100 and 400 before the business, the proportions showed remarkable increase (44%) after they were in the business for more than one year. Those who were earning monthly income of between Etb 400 and 100 also grew from 12% to Etb 22% after entering the stoves business. Similarly, the proportion of producers earning monthly income of more than Etb 1000 grew from 2% to 8% after the business.

On the whole, producers' monthly income grew by an average of 14% after entering the stoves business. According to results of the survey, while average monthly income

[5] Exchange rate, September 2000, approximately Ethiopian Birr 8 per US$.100.

of producers was Etb 491 before the business, it was Etb 560 after the business. However, averages are not strong indicators of the magnitude of impacts for they are easily affected by extreme values either ways. In this case, for instance, the values are enormously affected by a few producers earning monthly income of more than Etb 1000. Therefore, if we exclude those outliers, then average monthly income of the producers drops remarkably to Etb 127 before stoves and Etb 261 after stove business (i.e. more than double the income.

A1.3.1.2 Food Intake

According to results of the survey, food intake of producers has improved tremendously after the business. While 48% reported that their food intake was 'better', 17% reported that it is 'much better' now compared to the time they started the business. One-third of the producers reported that their food intake was the 'same' as before.

A1.3.1.3 Medical and Health Care

The number of producers who can now afford to pay their own medical bills "sometimes", "very often" and "always" after not being able to pay for them has grown by 153%, 107%, and 185%, respectively. Moreover, the number of producers who can now pay for their families medical expenses "sometimes", "very often", and "always" where prior to starting in the improved stove business they could not, grew by 283%, 100% and 157%, respectively.

A Case study from Ethiopia: "The liners business made my life easier in the past" – An old lady

"… finding a market was not an issue in those good old days. Huge orders come every week from various producers. During those days, the question was that of ability to produce as many liners as one can. The market was readily available to absorb all what you produced. Before the introduction of liners my monthly income had never reached the mark of Etb 200. I don't keep records of my income from pottery works. However, total revenue from bi-weekly sales of ceramic products was Etb 60 per week. I spend Etb 20 per week on cow dung for firing and on transportation of products to Addis market. Therefore, my weekly income (without accounting for labour) was Etb 40. After I started liner production our income grew by more than ten fold. Liners became the most important source of livelihood for my family. From income from liners I supported a seven-persons family including myself. With the earnings from liners three new houses were built and two other renovated. Previously, our income was barely sufficient to support the family. Our lives have improved tremendously thanks to the liners. We had more than sufficient to eat. I managed to send two kids to school. When I fall sick three years ago, I used my savings for my medical care, which I could not have made it otherwise. Above all, you know how much expensive it is to pay for a wedding party. I was so proud and happy when I covered everything for my daughter's wedding party from my savings. This would have been impossible without liners. Until the market died recently, liners have changed my life considerably". (Case Study 2.2). *Further Ethiopian case study summaries can be found in the Ethiopian country reports and the full case studies in the Ethiopian Case study report, see Final report Annex.*

A1.3.1.4 Children's School Fees

In terms of the ability to cover for school fees, producers' financial positions have improved after the business. While the number of those who cannot afford to pay for school fees dropped by between 40% and 100%, numbers of those who can afford grew by 60% to 160%.

A1.3.1.5 Extended Family Obligations

In addition to meeting their own basic necessities, more and more producers were also able to provide support to extended families. For instance, number of producers that can afford to support extended families "sometimes", or "very often', or "always" grew between 200% and 400% after the new business.

A1.3.1.6 Shelter and Accommodation

Housing conditions have improved among 52% of the producers after the business either by way of owning or affording to rent their own housing units. Analysis of changes in housing conditions of producers before and after the business reveals that 27%, 8% and 40% of the Lakech, Mirte and category of 'Mixed' respectively, have moved out of their parents homes and managed to pay for or own their own residences after the business. For all categories of producers, the proportion of those who live with their parents went down by nearly a quarter signifying that they are no longer dependent on their parents for housing after the business. Ownership of housing by producers has also shown a 25% increase after the business signifying considerable improvement in producers' ability to afford their own residences totally owned by themselves. The number of producers that can afford to rent their residence has also grown by 14% after the business

A1.3.1.7 Ownership of Assets

Ownership of durable household and business items such as electronics, furniture and tools has also showed significant improvement after the business. On the average, ownership of durable household and workshop tools and equipment has grown by 21% after the stove business. Compared to the period before the business, ownership of workshop tools and equipment has increased remarkably by over 120% signifying a strong position of producers to remain in business. Ownership of electrical and electronic appliances and household furniture has grown by 28% and 7% respectively in the period after improved stoves business.

A1.3.1.8 Access to Credit

Analysis of the survey results indicated that access to financial credit for producers has showed remarkable improvement after they started the new business. After the new business, 22% of the Lakech 42% of Mirte and 44% of the category of 'mixed' had access to financial credit. Loan sizes, which were limited to less than Etb 1,000 before the business, exceeded Etb 5,000 afterwards. According to some producers, the improved stoves business did not only improve their credit worthiness, but it has also enabled them lend money to others either by way of direct cash credit or credit sales of their products to merchants. For instance, one of the big producers of the Lakech, in addition to lending money to others, was able to sell improved stoves worth Etb 10,000 to 15,000 on credit.

A1.3.1.9 Membership and Position in Community Organisations

The rate of participation of the producers in community organisations has shown a remarkable increase after the new stove business. First of all, unlike the period before the business where 30% of the producers did not get the chance to participate in any kind of community organisations, nearly one-hundred per cent of them were taking part in one or another type of community organisation. Secondly, membership in an 'Edir", an important community organisation particularly at times of misfortunes, which was only about 37% before, grew to 55%. Thirdly, and most importantly, membership to an 'Equb', (voluntary financial association where savings are deposited and issued to a member in a 'Merry go Round" way) which was less than 22% before, grew to 31%.

A1.3.2 Poverty impact on Kenyan Improved Stove Producers

A1.3.2.1 Income

Income serves as one of the principal indicators of wealth building capacity, particularly in an urban environment, where virtually all economic activity is monetised (i.e. in the cash economy). Financial success can therefore translate into capacity to afford an improved standard of living. The Kenya stove producers' study evaluated the average monthly income of the four main sub groups of KCJ producers. This is illustrated in Table A8. These values compare with traditional stove producers who earn approximately US$100 per month, maximum.

Table A8 Average KCJ Production Business Owners Incomes and Average Employment Opportunities According to Four Sub Groups of Improved Stove Production (in US dollars, US$)

	Liner Producer	KCJ Producers (Mixed Specialities)	Cladder	Marketer	Assembler
Average Monthly Income	22,288 Ksh 318 $	20,985 Ksh 299$	16,029 Ksh 228 $	13,513 Ksh 193 $	7,714 Ksh 110 $

Liner producer business owners earn the greatest monthly salaries (318 US$), followed by KCJ production owners involved in mixed specialities (such as liner production, cladding, and assembly or cladding and assembly, etc). Dedicated KCJ cladders, marketers, and assemblers earn 27%, 38%, and 65% less than dedicated liner producers, respectively. The producer group with the least financial incentive is dedicated assembly workers followed by dedicated marketers.

A1.3.2.2 Food Intake

In particular, producers witnessed a 76% increase in their ability to afford 'better' nutrition and food intake from previous levels of 'inadequate' or 'adequate'. Of all, sub

groups of producers, marketers had the highest increase in nutritional improvements (92%) and cladders the lowest (63%). Twenty four percent of the producers retained an adequate level of food intake and nutrition despite being involved in the improved stove business.

A1.3.2.3 Medical Care

Improved access to health care services for producers was observed by all sub groups. 38.8% of producers gained the ability to afford (where before they were unable to afford) all medical treatment, bills, medicines, doctors consultations, and other services on necessary occasions. 20% of the producers found it easier to afford all (where before they were able to pay for half or less) of their medical expenses after entering the improved stove business.

A1.3.2.4 Children's School Fees

In terms of being able to provide education to their school aged children, 43% of the producers achieved a high enough standard of living after the improved stove business to pay for all necessary private or public school fees and learning materials and uniforms. Another 27.6% were able to finance one or more of their school aged children's education part of the year where before they could not afford to send any children for any terms. 17.6 % of the producers accumulated the resources after entering the KCJ production business to educate their children on a full time basis where before the children were in school part of the year or were without proper learning materials, meals, and uniforms.

A1.3.2.5 Shelter and Accommodation

45.8 % of the producers were able to gain the financial security and independence to move from family housing to rental accommodations and private residences. More than a third of the producers were able to rent their own accommodations while 13.6% bought small houses either for accommodations in Nairobi or on their land up country. A tiny fraction of the producers (3%) remained with their families and a slightly larger fraction (8%) remained in their private residences. The largest bulk of the producers (33.4%) could afford rental housing during the period of their involvement in improved stove production.

A1.3.2.6 Ownership of Assets

80-85% of the producers were able to acquire radios/stereos and household furnishings such as a bed after entering into the improved stove business. Very few producers were able to save enough for a colour television, but 20% were able to buy black and white televisions after entering the business.

A1.3.2.7 Property Ownership

The acquisition of property, particularly land holdings, was only slightly correlated with entry into the improved stove business for producers. 17.8% of the producers accumulated enough financial savings to invest in property, however, the great

majority (82.2%) of producers did not have either reason, incentive, or resources to purchase property.

A1.3.2.8 Livestock Ownership

A similar pattern emerged in producer's acquisition of livestock. 24.2% and 17.4% purchased goats and cows, respectively, with the savings earned from working in the improved stove business. Given that goats and cows on average cost 30 USD and 215 USD, respectively, any producer investing in such animals has been able to accumulate enough disposable income to afford such purchases. Moreover, livestock can be sold at a 15-20% mark up once they reach maturity and are healthy. This provides a further source of income for producers.

A1.3.2.9 Access to Clean Water

Access to clean water for all producers increased on average by 25%. The improvement is reflected in increased access to tap or bore hole water as opposed to local surface water (rives, ponds, and wetlands, and large standing puddles).

A1.3.2.10 Social Obligations

The role and interaction of stove producers in community life, whether through church organisations, youth groups, self-help groups, and Jua Kali associations, and credit schemes did not noticeably increase after entry into the improved stove business.

A1.3.2.11 Access to Credit

Access to start up enterprise capital through micro-credit loans was not a common vehicle for producers to enter the improved stove business. As a whole, only 7% of the producers obtained credit for starting up or expanding business operations in Nairobi.

A1.3.3 Poverty Alleviation Benefits Among Traditional Stove Producers in Kenya

As a control sample, twenty seven traditional stove producers were interviewed in July 2000. Each of the respondents was dedicated to traditional metal stove production and was not involved in producing KCJ's or linings for KCJs. Nor were they involved in any other major activity. Thus the results from the surveys reflect the socio-economic advantages or disadvantages the producers experienced as a result of being in the business of traditional stove manufacturing.

In Nairobi, **traditional** stove producers earn approximately 7583 Ksh (approximately US$120) per month versus **improved** stove producers who earn approximately US$318 as liner producers.

None of the traditional stove producers have been able to save enough money to move out of their families' residence, rent a room or house, or own a home. Rather, all traditional stove producers interviewed live with their parents and extended families.

Five of the producers were able to purchase land for their own personal use after being in the business for about 5 years. More than half of the producers did not have children or families. However, of those who did, 9 were able to afford school fees for their children and 9 were also able to afford medical care for themselves and family where they were previously unable to before becoming stove producers.

There were no other major benefits or advantages that these traditional stove producers accrued. For example, only 3 to 5 of those interviewed were able to meet other family obligations where previously they were unable to. And only 6 observed any noticeable improvement in food intake and ability to buy new clothing for themselves and family after becoming producers.

These surveys of improved stove producers and the traditional stove producers showed that, unambiguously, traditional stove producers do not achieve the same financial benefits and trickle down effects from the stove business as those engaged in improved stove production.

A1.3.4 Improved Stove Producers in Kampala

A1.3.4.1 Income

Average monthly income for traditional stove producers was computed from the quantities of stoves sold per month among all of the producers interviewed according to speciality. There was significant variation in the reported incomes obtained across all types of producer. This was attributed to differences in the scale of production.

For "improved stove" producers, on average the monthly earnings from cladding production was Ush138,490 (approximately US$80) per month, for stove assembly Ush 460,325 (approximately US$230) per month and Ush 500,895(approximately US$300) per month from those who produce the all clay stoves. It is important to note that all clay producers' monthly income and that of the liners is higher than that of cladders and assemblers.

A1.3.4.2 Food Intake

Food availability for producers showed mixed changes with some producers situation improving and some declining. 43% experienced occasional food shortages after the business where before they had sufficient supplies. A quarter of the respondents that formerly never had enough food now had sufficient food all the time. Another 25% had improved from a situation of facing regular food shortages to a position of reduced food scarcity. Then a half of the people who reportedly never had sufficient food before were still in that situation today even after joining the stoves industry.

A1.3.4.3 Medical Care

Improved stove producers witnessed mixed changes in ability to afford medical care. 73% of the respondents said that their ability to pay for medical services had improved given that they previously had difficulty paying for these medical services yet now these services were readily affordable. Of the respondents that were sampled 67% said that they could access medical care just as well today as they could some time back before they joined the stoves business. However some 33% claimed that their ability to access medical services today had fallen to less than what they could access before they started the stoves business.

A Case study from Uganda: A successful improved stove assembler in a struggle for urban survival in Kampala

Elizabeth is 48, she is a single mother of 9 children and lives in one of the major slum areas of Kampala city called Kisenyi. She moved to Kampala from Mubende to live with her grown children. Elizabeth had never thought of getting a better job that would fetch more money for her than the groundnuts she used to sell along the streets of Kampala. She kept working but praying to God to find her an alternative job. "I knew God never forgets those who ask him for help". One day, when Elizabeth was at home preparing her groundnuts, her nephew visited with good news. Her nephew proposed an alternative job regarding assembling improved charcoal stoves. Elizabeth says that her nephew was well trained in these skills from training at Mukono vocational school and promised to train her if she had interest in the business. Elizabeth and two of her sons showed interest and immediately began training. It took them four days to learn to assemble the stoves.

When Elizabeth acquired the skills, she abandoned her first job immediately and began assembling stoves with her two sons. Later her sons abandoned the job but Elizabeth stayed with it. At the start of the business, Elizabeth could assemble and sell 10 stoves a day. The number of assembled stoves that was sold each day increased when the demand increased. She then employed more workers.

" I became popular in Kisenyi and most people who did not know me learnt about me because of this business. In the first place I was the first lady to assemble these stoves here in Kisenyi and I trained many people in these skills." Although the business of improved, charcoal stove has generally gone down in Kampala, Elizabeth believes she is still popular in the area. Currently, Elizabeth assembles and sells between 3 to 5 stoves a day. The rate of competition is high and prices have gone down. The profit on an improved charcoal stove has dropped from Ush 800(US$0.50) per stove to Ush 300(US$ 0.20)

Before she took over the business of assembling stoves, Elizabeth was not able to feed and provide for her four dependants that lived with her in Kampala. Currently she can provide for them well plus five workers and two other female relatives that later came to live with her in Kisenyi. Other things she has acquired from her business include 3 acres of land in Kiboga village in Mubende district, an electric groundnut grinder/motor, and a number of household properties like mattresses, beds, radio, chairs etc. She can now afford to pay school fees for her grandchildren without any difficulty, pay her house rent, buy clothes for herself and her family members and at the same time extend financial support to her relatives in the village.

A1.3.4.4 Children's School fees

67% who were facing difficulty in paying school fees before entering the business still had the same problem afterwards. 33% of the producers who had some difficulty in paying school fees before now felt they could meet this need relatively easily now. Fortunately, 52% of the producers felt they had come from a state of being unable to pay their dues to now always being able to pay. This marks an improvement in the earning status. 67% who earlier couldn't pay the fees now had some better ability to pay though they were still struggling.

A1.3.4.5 Shelter and Accommodations

77% of the producers sampled that used to live in one-roomed houses are still living in one-roomed housings. And unfortunately, 71% of the producers who used to live in three roomed houses now have been reduced to living in one-room houses. Thus a significant improvement in quality of housing has not been achieved by those in the stoves business.

50% of the respondents who used to own their own houses before joining the stoves business still own their own houses, this implies that another 50% lost their houses and reverted to staying with their families. Only 14% of the respondents said that they were able to acquire a house after entering into the business, whereas previously they could not afford it.

A1.3.4.6 Ownership of Assets

Only 28% of those sampled who didn't have consumer goods before had managed to acquire some equipment now. Furthermore, 72% of the respondents claimed that they never had electrical equipment before and they still do not own the same. In fact, 60% of producers who owned electrical items before starting the stoves business don't own them afterwards. Improved stove production in Uganda does not appear to be a route to obtaining consumer goods.

A1.3.4.7 Extended Family Obligations

While before a reasonable number had difficulty giving support they all said they could give support afterwards. About 60% of producers who could never afford to give extended family support before starting the stoves business can always afford to afterwards. All the producers who used to provide extended family support before joining the business still had the ability to do so now. None had given up the practice or reduced his extended family obligations. 64% of those who used to meet their extended family obligations with some difficulty had now, since joining stove production, improved their ability to meet these obligations. While 36% of the respondents who said, that they struggled with paying these dues still struggled with the same. 67% of the respondents who said that they never used to provide extended family support before, could now meet these obligations. Then another 33% who never used to meet these obligations can now meet these obligations occasionally.

A1.4 Gender focus of stove producers

Kenya

A total of 145 improved stove business owners/managers (7 of which were women) were interviewed from the main production centres. These 145 owners employed 321 producers, of which 97.1% were men. A breakdown on the abundance of improved stove business owners and employees (male, female, and family) according to various improved stove production specialisations is indicated in Table A9. Due to the decentralised nature of KCJ production in Nairobi, not every producer was identified. However, the producers captured in the Universe and Sub-Universe survey represents more than 90% of the producers in Nairobi.

Table A9: Specialisation and Abundance of Stove Producers (Owners and Employees) Desegregated by Gender According to the Four Main Sub Groups of Improved Stove Production. (N=145)

Specialisation	**Number of Producers**				**%Estimated Coverage of Entire Producer Population**
	Owners	Male Employees	Female Employees	Family Member Employees	
Liner Production	40	79	0	5	90%
Cladding Production	24	64	2	2	85%
Assemblers	14	44	0	1	90%
Marketers	21	6	3	2	70%
Mixed Specialties C-A or L-A or L-C-A or L-C-M-A	46	103	4	6	85%
Total	145	296	9	16	

Based on Table A9, it is clear that men comprise the bulk of the KCJ production labour force while women play a remarkably minor direct role in the production of the KCJ in Kenya and do not gain significant income generating benefits from the commercialisation of the KCJ. Family employees are slightly more involved in KCJ production, but still play a small role in overall production. *It is important to note, that a little over 35% of the improved stove production business owners did not have employees working for them.*

Ethiopia

Over 130 producers engaged in production and marketing of improved stoves were surveyed to determine impacts of the business on their lives. From the outset, it is important to bear in mind that while 100% of liner producers are rural potters and farm households from Legedadi, about 20kms east of the capital, the rest are informal sector artisans based in various parts of the city. Traditionally, liner producers were, and still are, engaged in the production of various pottery products supplied to the city while the majority of those producers in Addis were engaged in the manufacture of some household items including traditional charcoal stoves. It is also important to note at this stage that pottery is the domain of women in Ethiopia traditionally as well as today. The role of men in the business is limited to some aspects such as digging the soil, transportation and marketing of the products.

Case study Ethiopia: 'Gender is not a barrier. External support isn't either: Energetic female producer in Addis

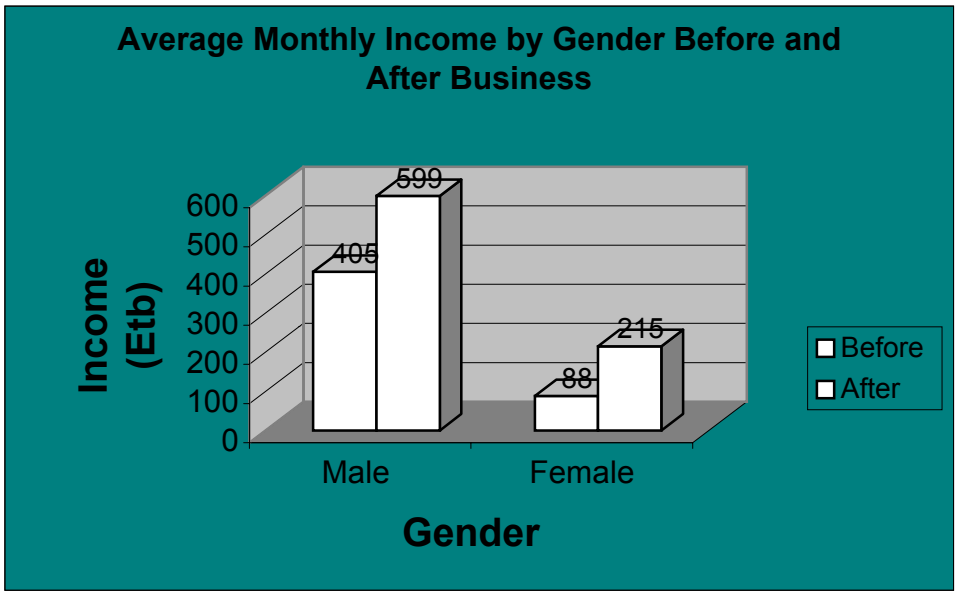
"Once I and my brother were convinced of the commercial prospects and benefits of the business, we decided to raise money for our project. We pooled our own resources and started production and marketing of improved stoves with a capital of Etb 10,000. Everyday when I get back from my routine sport exercise, I used to work equally with my brother. Neither gender nor age is a factor in success. It is your determination for hard work that matters. When we grew a bit bigger and afford to pay for labour, I started to specialise on marketing. This was very important because my brother is very poor in marketing and customer handling. I am very good at marketing and customers liked me very much. Now I am working as a full time marketer. After I became stove producer I realised that many people love and appreciate me. When new customers come to my workshop they always ask me that they want to talk to the owner assuming that I don't qualify to be one. May be because of my age and gender. If they insist to see the owner, sometimes I get back to home, change my clothes to look more presentable and get introduced to my customers. When they realise that I am the same person, we all explode in laughter. Majority of my customers do not leave the workshop without asking me questions regarding their doubts about me as owner of the business. When they are convinced they encourage me and appreciate my efforts". (Case Study 2.6)

Table A10 shows access to education for the producers split by gender. 25% of the producers were women, the rest were men. Considerable differences in educational attainment were observed between men and women producers. When examined from within the respective groups, 39% of women are illiterate while the proportion drops to only 13% for their men counterparts.

Table A10 Educational Levels of Improved Stoves Producers by Gender

Level of Education	Male	Female	Total	%
Illiterate	13	13	26	20
Non-formal Education	5	1	6	5
Elementary	16	4	20	15
High School	50	11	61	46
12+	14	4	18	14
Missing	1	0	1	1
Total	99	33	132	100
Per Cent	75	25	100	

Figure A1 Income by gender in Ethiopia



When viewed from the gender perspective, the differences in average monthly incomes of men and women producers is glaring both before and after the business. Despite the difference, average monthly incomes of both men and women producers of improved stoves have shown considerable improvement after the business. In fact, the improvement in women's average monthly income was higher (2.4 times for women and 1.5 times for men) than that of men relative to their earnings before the business. Figure A1 shows these results.

Uganda

Generally there were more male producers than female producers in each category of production. The proportion of the male producers among cladders, liners, assemblers and all clay producers was 98%, 65%, 65% and 60% respectively.

In general there was a male bias in stove production. This is because the proportion of female producers was reported to be 2% in claddings, 35% in assembling, 35% in lining and 40% in all clay stove production. The reasons why fewer women are involved in the production of stoves was revealed during focus group discussions and was attributed to greater physical exertion demanded by the activity. The process of marketing the stoves is by hawking in the streets, a practice that many women would not be willing to engage in the activity. However, fairly balanced representation by gender was found in the production of linings and all clay stoves.

A1.5 Impacts on Traditional Stove Producers and Biomass Fuels Suppliers

A1.5.1 Impacts on traditional stove producers

A1.5.1.1 Ethiopian traditional charcoal stove

Impacts of the Lakech improved charcoal stove on producers of traditional metal charcoal stoves, "Fernelo", are rather positive. Discussion held with some producers revealed that initially, there was a fear of losing their business. However, the reality was different. Introduction of the Lakech stove into the Merkato was a 'blessing in disguise' for almost all of the traditional "Fernelo" producers. It was an additional business opportunity for them to take advantage of. There were a number of factors that attracted "Fernelo" producers into the Lakech stove business. Some of these were:

- *ease of entry in to the business;*
- *some initial official support and promotion to the Lakech;*
- *growing market demand for the product;*
- *huge profit margins especially during the first few years of the Lakech;*
- *production of the Lakech does not require capital and additional and/or advanced tools and equipment.*

While the majority of traditional "Fernelo" producers have joined the growing Lakech stove industry a few sceptical ones have continued production of both types of stoves side by side. When the Lakech market reached its climax in 1995/96, the market share of the Lakech had reached about 90%. However, as a result of fierce competition that eroded margins and poor quality of stoves that resulted in loss of consumer confidence in the market, the market share of the Lakech is believed to have gone down considerably at present. Moreover, Merkato wholesalers also expressed that since the Lakech is not as strong as the traditional "Fernelo"', it requires careful handling during transportation to other demand centres out o f Addis. As a result, marketability of the Lakech outside Addis market has been reduced significantly over the past few years.

A1.5.1.2 Ethiopian Electric Injera Mtad Producers

A study conducted in mid 1991 revealed that there were well over 300 electric Injera Mtad production and repair workshops in the capital, Addis alone. With the opening up of the economy that created new business opportunities and growing demand for electric Injera Mtads owing to subsidised electricity tariff in those days, the figure was expected to double between 1992 and 1997. However, recent electricity tariff revision, as a result of which the tariff was increased progressively and reached the mark of 150%, was bad news among the majority of producers. Since the tariff revision that made electricity unaffordable fuel for most households and commercial Injera bakers, there has been, and still is, a tremendous shift from electricity to woody biomass for Injera baking. This shift has created a golden opportunity for those who are involved in the Mirte biomass Injera stove business.

Attractive margins and growing market demand for ordinary Mirte and commercial Mirte (cladded) stoves have lured former electric Injera Mtad producers in Addis. Consequently, several workshops that were hit by negative effects of the recent electricity tariff rise have shifted (either partially or fully) to production of the Mirte stove as their customers (consumers) did. In summary, with respect to the impact(s) of improved stove commercialisation on traditional stove producers, three important conclusions could be drawn. Firstly, the impact of introduction and commercial dissemination of the Mirte stove on electric Injera Mtad producers was either non-existent or insignificant. Secondly, it is the recent electricity tariff rise, and not the Mirte stove, that gave a deadly blow to several traditional electric Injera Mtad producers in Addis. Thirdly, while the majority of traditional "Fernelo" producers have shifted completely to Lakech production, some have made a partial shift maintaining the "Fernelo" business so as to serve a niche market. Last, but not least, the Mirte stove opened up an opportunity for traditional electric Mtad producers who were badly affected by the electricity tariff rise an, hence, would have gone bankrupt otherwise.

A1.5.1.3 Kenyan Traditional Stove Producers

Twenty seven traditional stove producers were interviewed in July 2000. Each of the respondents was dedicated to traditional metal stove production and was not involved in producing KCJ's or linings for KCJs. Nor were they involved in any other major activity. Thus the results from the surveys reflect the socio-economic advantages or disadvantages the producers have experienced as a result of being in the business of traditional stove manufacturing.

In Nairobi, traditional stove producers earn approximately 7583 Kes (100 USD) per month versus improved stove producers who earn up to 318 USD as liner producers.

None of the traditional stove producers have been able to save enough money to move out of their families residence or a rental situation into a home they own themselves.

Five of the producers were able to purchase land for their own personal use after being in the business for about 5 years. More than half of the producers did not have children or families. However, of those who did, 9 were able to afford school fees for their children and 9 were also able to afford medical care for themselves and family where they were previously unable to.

There were no other major benefits or advantages that these traditional stove producers accrued. For example, only 3 to 5 of those interviewed were able to afford other family obligations where previously they were unable to. And only 6 observed any noticeable improvement in food intake and the ability to buy new clothing for themselves and family.

Overall, traditional stove producers do not receive the same financial benefits and trickle down affects of this income compared to improved stove producers.

A1.5.2 Impacts on Biomass Fuels Suppliers

Impact on this sector was only examined in Ethiopia. The following discussion indicates that biomass fuel sales and prices are affected by a number of complex country specific factors and fuel efficient stoves are likely to have only a marginal (and unmeasurable) effect on the suppliers compared with the other factors.

The underpinning assumption behind reviewing the current situation of biomass fuels suppliers in Ethiopia, in relation to impacts of successful dissemination of fuel-efficient stoves, is that since consumption of biomass fuels is brought down due to improved stoves, it is likely that suppliers of those fuels will suffer from reduced demand and hence sales volume and profit margins. However, factors that influence the demand for and price of biomass fuels are complex and numerous of which energy-efficient stoves are but one. Some of these important factors influencing the biomass fuels market in Addis are:

- *macro-economic policies through subsidy, duty and tax affecting inter-fuel substitution;*
- *price and availability of other alternative fuels;*
- *liberalisation of the biomass fuels trade*
- *prevalence of food (in)security situation in biomass production areas;*
- *changes in household income;*
- *various coping strategies and adaptation to scarcity;*
- *demographic changes.*

Obviously, all or some of these factors might have had an impact on supply and suppliers of biomass fuels over the years. Therefore, in the absence of time-series data collected through the monitoring of impacts of respective factors over a given period of time, it is very difficult to single out those factors that had had an impact and to account accurately for the relative share of the impact attributable to each factor believed to have an influence on the market. Moreover, there is no recent biomass supply data to compare with those of the early 1990s and to see any possible changes in the market over the years.

A study conducted in 1988 indicated that biomass fuels supply is an industry employing over 6,000 people on a more or less regular basis, in Addis Ababa alone. This figure is excluding perhaps some sizes of retailers who market fuels directly to consumers. As part of the overall economy the biomass fuels market in Addis has passed through enormous changes that influenced it in one way or another. Relevant findings of available information and some of the most important changes that are believed to have had an impact on the biomass fuels market are discussed below.

a) Comparison of biomass fuels supply studies conducted in 1988 and 1992 reveals the following:

   - overall supply of biomass fuels had gone down considerably, in terms of weight in 1992.
   - while the numbers of suppliers had also gone down in 1992, biomass fuel carrier combination and importance had also changed where the importance of motorised transport as a carrier has grown considerably. This could be due to increased distance of supply sources.

b) Liberalisation of the biomass fuels trade since mid 1991 allowed free movement of biomass fuels as a result of which more suppliers might have joined the market.

c) Prices of two very important household fuels, kerosene and electricity, remained heavily subsidised until very recently. As one could see from consumption levels of the two fuels over the years, (several hundreds of metric tonnes of wood equivalent was saved annually due to kerosene and electricity in the 1990s) the impact of kerosene and electricity in terms of reducing the household demand for woody biomass has been enormous. Thus, logically, whatever adverse effect might be there on Addis biomass fuels suppliers, it is attributable, by and large, to such macro-economic policies that affected the biomass market enormously.

d) Gradual, but progressively advancing removal of subsidies on electricity (since 1998) and kerosene (January 2000) has caused consumers to revert back to woody biomass which they had given up previously as a result of the increasing difficulty of supply and prices. The recent remarkable shift of consumers in favour of woody biomass has created additional and growing demand for improved stoves in Addis Ababa and elsewhere in major urban centres. Therefore, it is likely that the same shift, particularly with the recent removal of subsidy on kerosene, will create new market opportunities for biomass fuels suppliers.

e) Currently, biomass fuels prices, particularly those of firewood and BLT, have shown a dramatic drop, nearly 100%, in several urban areas of the country including Addis. For instance, 100 biomass fuels price measurements (45 observations for wood, 35 for charcoal and 20 for BLT) taken in November 1999 indicated that prices of firewood, BLT and charcoal in four major markets

in Addis were Etb. 0.33, 0.32 and 2.62 per kilogram respectively. In March 2000, retail prices of wood and charcoal went down to Etb 0.3 and 2.00 respectively. The retail price of firewood is one of the lowest prices observed in the biomass fuels market in Addis during the past decade or so. A number of factors are believed to have contributed to such a 'free-fall' in prices of biomass fuels in Addis and the country as a whole since early 1999. The two most important factors are:

- government policy that favoured unrestricted movement and marketing of biomass fuels;
- relatively cheap and easily available fuels such as sawdust for commercial Injera baking. In the course of this study, discussions held with a few commercial Injera baker revealed that thanks to the improved stoves optimised for almost all biomass fuels, the majority of commercial Injera bakers in Addis use sawdust and its price is cheaper relative to those of wood and BLT.
- prevalence of food insecurity situation in several parts of the country. More farmers and urban poor, who are in desperate search for survival, are engaged in the supply of biomass fuels to support their families and they would go hungry otherwise. Therefore, a situation whereby more suppliers compete to meet relatively constant demand is created. As a result, much more biomass fuels are available in the market leading to a sharp decline in prices. On the other hand, however, given the continuous removal of subsidy on alternative household fuels such as kerosene and electricity, the growing market demand for improved biomass stoves, and above all, seriously degraded natural resource base in the face of recent policies that aggravate the problem further, it is not likely for current biomass fuels price trends to continue.

A word of caution is important at this junction. Several market surveys conducted recently in a number of urban centres in the country confirmed that biomass fuels are more available and their prices are much lower than ever before in the decade. At a glance, this observation is deceiving for it throws wrong signals that the biomass resource base has improved nationally. But, the reality on the ground is different. In the face of growing population pressure, the absence of a supportive policy environment, meaningful afforestation efforts, unaffordable and/or unavailable alternative sources of energy, and above all, prevalence of food insecurity, the natural resource base of the country is getting worse than ever before.

A1.6 Efficiency tests on fuel efficient stoves

A1.6.1 Ethiopian Improved Stove Performance

Five large size Lakech stoves were tested in 2000, and their results compared with the standard quality Lakech that was tested in 1995. They were also tested against the

square traditional metal stove. One of the Lakech stoves was obtained from a household that had been using it for over three years and was still in good condition. Results are shown in Figure A2 below.

Figure A2 Test results from the large size Lakech improved charcoal stove

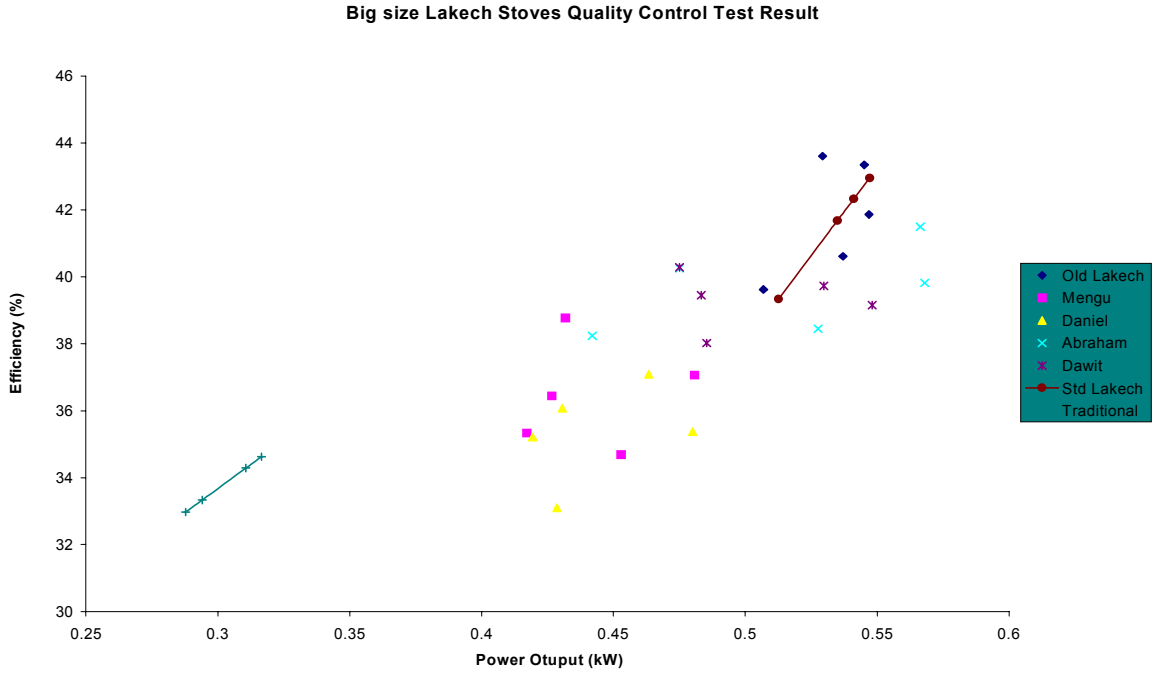


Figure A2 shows that the old model of Lakech scored best with an efficiency similar to that of the standard Lakech, between 39% and 44% efficiency. Most of the present models score less well with efficiencies of 33%-38% and 38%-41% depending on the model, somewhere between that of the original Lakech and the traditional metal stove, TMS. The TMS tested had an efficiency between 33%-34%.

Five small size Lakech stoves were randomly selected and purchased from different market places. Each of the five stoves were made by different producers. Results for the small design of Lakech stove are similar to the large stove but in some cases the presently produced Lakech stoves are even less efficient, 28%-31% than the traditional metal stove.

Full results for all the Ethiopian tests can be found in the Ethiopian partner report "Quality Control Test Results of the Lakech and Mirte Stoves" included as an Annex to this report.

A1.6.2 Kenyan Improved Stove Performance

Water-boiling tests (WBT) were used to assess the level of fuel savings delivered by the KCJs currently produced and marketed in Nairobi whereas the TMS was used as the control in the experiment.

The WBT gives a quick comparison of the performance of different stoves. Water is used to simulate food material while the steam generated simulates heat absorbed. The test includes "high power" and "low power" phases. The high power phase involves heating the water from the ambient temperature to boiling, as rapidly as possible, through keeping the ash box completely open. Simmering is done over a 30-minute period by keeping the ash box closed.

Based upon water boiling tests conducted on the KCJ and locally available traditional metal stoves, the specific fuel consumption (SFC), of an average KCJ in the market today saves more than 24% on charcoal whereas in 1987, it was shown to save about 30-50%. (See Annex for full details of stove tests in Kenya).

A1.6.3 Ugandan Improved Stove Performance

Nine stoves were tested in the laboratory in the Department of Mechanical Engineering using a water-boiling test to determine the performance of stoves in terms of thermal efficiency. There are some similarities between most of the stoves. There were 4 stoves of distinctly different design, the metal sigiri stoves (i.e. traditional stoves), the Usika stove, the Black Power stove and the JEEP stove. The rest of the stoves have similarities in design but vary in the size of the stove, the number of the holes in the liner, and the size of the door. This shows the extent of duplicate activities going on in the stove fabrication in the informal sector.

The results of the water boiling tests carried out on the improved stoves show variations among the different brands, (see Annex for full details of stove tests in Uganda).

The efficiencies are higher than recorded in most literature. The implication is that the method used to ignite the charcoal (using 50g of glowing charcoal) affected the efficiencies shown in the tests. The pot used in this test was the same size as used in the Kenyan tests. However, they used less water. In this test 4200g of water was used that fills 2/3 of the pot as required by the VITA test procedure. Another factor is the calorific value of the charcoal was not determined. In most literature, the value varies between 25,000 to 32,000 KJ/kg. In this experiment the value used was 29,000 KJ/kg. The results from the stove tests in Uganda were inconclusive and further work will be needed during further stove initiatives to establish the true present situation.