Harnessing solar stove technologies in South Africa to promote improved household energy provision

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Promouvoir les technologies solaires pour la cuisson en Afrique du Sud et l'amélioration de l'approvisionnement en énergies domestiques.
Cet article traite d'une diffusion réussie de cuisinières solaires à travers un projet comprenant deux phases. Au cours de la premiere, 70 familles ont bénéficié de cuisinières solaires. Un questionnnaire a été remis à chaque famille afin d'évaluer l'utilité des cuisinières. Une fois fois qu'il a été prouvé qu'elles étaient bien acceptées, la seconde phase a été consacrée à la commercialisation, par des détaillants, de ces cuisinières. L'accès a davantage concerné des familles relativement aisées du fait que les familles pauvres avaient tendance à collecter le bois. Les économies réalisées ont été utilisées differemment selon les communautés

Introduction

Successful dissemination is a complex undertaking that involves many actors and activities. The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) supported by the German Government, decided to investigate the dissemination of solar stoves, from production to household use. The Governments of Germany and South Africa provided joint support to a solar stove pilot programme that included a comparative field test under real-life conditions to determine the social acceptance of solar stoves, as well as testing the commercial dissemination of solar stoves.

Background and methodology

Data was collected on the socio-economic background, cooking habits and energy use and expenditure of 200 randomly selected households out of a potential 6800 households in five pre-selected communities in the North West and Northern Cape Province of the Republic of South Africa.

Phase 1 methodology

Phase 1 comprised a field test in three areas for selected households, including the measurement of fuel use. Based on the results of the baseline study, the three test areas selected were: Onseepkans, Pniel and Huhudi. They represented deep rural, rural and peri-urban areas with related fuel use patterns. A total of 100 families made up the test sample, 70 user families (with solar stoves) and 30 'control' families (i.e. those without solar stoves). A set of questionnaires was designed to be completed on a daily, weekly, monthly and bi-monthly basis by:

- the households using solar stoves, such as the stove shown in Figure 1
- control households without solar stoves
- Area Monitors (people living in the study area who have been trained by the programme to do project monitoring)
- participating institutions
- project supervisors.

The level of use of the stoves by the households was measured, in part, by end-user acceptance.

Once it was found that end-user acceptance was sufficient to warrant large-scale dissemination, the second phase of the project got underway.

Phase 2 methodology

During this phase solar stoves were sold through selected retailers on the open market, and end-user contact details were obtained through returned warranty postcards. Fuel consumption was not measured, but those using solar stoves were asked to report on their fuel use.

Figure 1 T16 – a fast cooking stove that also bakes bread

Due to the respondents being widely dispersed geographically, a group of 54 people who bought stoves and sent in the warranty postcards were interviewed by telephone. A smaller end-user group of 9 people in the Huhudi township were interviewed by Joseph Koosimile, the Area Monitor who had provided after-sales service during Phase 1. The results from these two groups highlight the differences between the behaviour of various solar stove users.

Phase I results

Fuel saving

Despite this strategy, the poorest families in the study were spending up to 26% of their monthly income on fuel. The variation in spending on fuel is largely due to the amount of *collected* wood that families use, as families with a very low income often collect wood to reduce fuel costs. By using solar stoves the consumption of other fuels were reduced as shown in Tables 1 & 2.

The average saving per household was 38%, which translates to approximately US$60 per annum. These figures were calculated using actual measurements before solar stoves were introduced in winter 1996 and 1997, and for both users and the control

Table 1 Fuel savings per household per annum

Kerosene	33%	30 litres / annum
LPG	57%	30 kg / annum
Wood	36%	0.9 tonnes / annum

Table 2 Average monthly savings in the different test areas

	Rand (ZAR)	US dollars ($US) (1997 rates)
Deep rural	12	3
Rural	17	4
Peri-urban	26	5

group in summer 1997. Users indicated that these savings were significant and promoted the continued use of solar stoves.

Time saving

It is mainly women who do the cooking in the household; therefore it is their time that is being saved using a solar stove. There are two potential time-saving elements associated with the introduction of solar cooking:

- time saving which results from the reduction in wood gathering
- potential time saving in the actual cooking process itself.

Although most solar stoves cook more slowly than fuel stoves, they require very little attention once the food is in the stove. Freed from the time-consuming tasks of cooking and wood collection, women may concentrate more on childcare and domestic activities, training and educational programmes, social networking (an important rural livelihood strategy), as well as leisure. Where children are the main wood gatherers, the time saved can be spent on school work or play.

Time-saved from *reduced wood collection* because of solar stoves was calculated as 36%. Since households spend, on average, three hours collecting wood per trip, in theory, families can save up to 33 hours per month if they collected fuel daily prior to using a solar cooker.

Time-saved through *cooking* using a solar stove was calculated as follows: a family saves 15 minutes in supervision time per solar cooked meal, this amounts on average to 5 hours per month. This estimate is only valid if the user does not have to come home specifically to start cooking.

Impacts on poverty reduction

Where fuelwood shortages encourage the use of fossil fuels for cooking, this aggravates poverty and impacts negatively on local economies. Solar cooking is an emission-free, environmentally-friendly technology which could reduce firewood shortages – provided that the technology is acceptable to end-users, and that the stoves are both appropriate and affordable.

The economic benefits associated with time savings can be significant if the time is spent on productive, income generating activities. Since it is primarily women who are involved in cooking and wood collection, the potential for economic benefits depends on the opportunities available for increasing earnings and output.

The impact of solar stoves on the household economy is dependent on the organization of the household economy and the extent to which the household is linked to the wider economic network. In Onseepkans and Pniel, solar stoves became a valuable resource for social networks, as information on solar stoves and the preparation of food were exchanged. Savings achieved through the use of the solar stoves were invested in more food, which was shared among organized cooking groups. These cooking groups increased food security as well as variety in the daily diet (Figure 2), and indicated that the households greatly benefited from the solar stoves.

- In Onseepkans, Pniel and Huhudi, some of the money saved was given to the schools.

Figure 2 Cooking chicken stew in a village in North West Province

- In Onseepkans and Pniel, there was an increase in contributions to the church.
- Other resources that benefited by savings, and which helped with poverty alleviation are women's groups, savings clubs, and clinics.
- In Onseepkans, the time saved became increased labour time for subsistence agriculture.
- In Pniel, the increased time and increased savings was spent on transport to enable greater access to centres seeking job opportunities.
- In Huhudi, hawkers (entrepreneurs who prepare and sell food) saved money to buy fuel and food to sell.

Phase II results

Fuel savings

Telephone interviews

Very few respondents distinguished between energy saving and monetary saving, but it was clear from further discussions that energy saving was synonymous with monetary saving, thus these responses were counted together. From those interviewed, 52% of the respondents indicated that they were saving money by using a solar stove. The average monthly savings reported by the respondents who are mostly from urban areas is approximately ZAR110. Others (13%) could not say how much money they were saving. Of those who said that they were not saving anything, they admitted that they could save if they had used the solar stoves.

Respondents reported that the fuels most saved by using their solar stoves were electricity, gas and paraffin (kerosene), in that order.

Huhudi respondents

Most of the respondents said they saved money by using a solar stove. The only respondent who did not save money only used firewood which she collected and therefore spent no money on fuel. The majority save anything from ZAR20 – ZAR100 with an average monthly saving of ZAR45, which is only 41% of the savings identified by those interviewed by telephone.

The Huhudi respondents save mostly paraffin, gas and electricity/ wood.

Time savings

Telephone interviews

Saving time by using a solar cooker was reported by 44% of the respondents. On average these respondents save 26 hours per month by using a solar stove. Some respondents reported time savings but could not quantify it, while one respondent said you can only save time if you can leave the stove alone outside. One respondent said the stove is too slow to save any time, while another believed that you had to watch the stove all the time or it will burn.

Huhudi respondents

The Huhudi respondents all agree that they saved time by using a solar stove. They report saving from 18 hours per month to 84 hours per month, averaging 40 hours per month. The time saving is influenced by a variety of factors such as the type of fuel being used, the length of time for which they would normally cook on their stove/open fire (which also depends on the type of food cooked) and how many meals they cook per month. The Huhudi respondents save at least 35% more time than those interviewed by telephone.

Impacts on poverty reduction

The people interviewed by telephone were from the middle to higher income groups, and the Huhudi respondents from lower to middle income groups. The economic benefits associated with time savings can be significant if the time is spent on productive, income generating activities. Since primarily women are involved in cooking and wood collection, the extent to which they participate in agriculture and other economic ventures will determine the magnitude of the associated benefits – not yet measured in Phase II.

How solar stoves improve household energy provision

Poverty implies, amongst other things, limited access to energy sources. Energy is a required basic need for cooking, heating of water, lighting etc. Energy issues need to be viewed against the broader background of poverty which dictates energy choices of households. Poor households in the study areas (with an average income of less than ZAR500 per month) were found to spend up to 26% of their total household income to satisfy their energy needs, while richer households (with an income of a ZAR1000 or more) only spend up to 7%. Low and unreliable incomes perpetuate households' dependence on energy sources that are either free, or which can be purchased in small quantities on a daily basis. Livelihood and survival strategies form the bulk of the social economy and contribute to the complexity of accepting a new technology.

Solar stoves can improve household energy provision in the following ways.

- In poorer households where a larger percentage of monthly income is spent on fuels, more money is made available for buying other fuels, thereby enlarging the fuel mix available for the household.
- Besides enlarging the fuel mix, solar stoves also increase energy security. Once the household owns a solar stove, they will always be able to cook (as long as the sun is shining).
- The money saved, which would have been spent on energy, is now available for other things.
- By cooking with a solar stove, fossil fuels or electricity are accessible for other activities. For example, instead of using kerosene for cooking, it could be used for lighting.
- Foods that require a long cooking time use a lot of fuel, so they are ideally suited for solar cooking (e.g. maize, soup, beans, baking bread, etc.).

Conclusions

Solar stoves have had particular impacts on women and their access and control of resources.

- Monetary savings (due to less gas, paraffin and wood purchases) have enabled women to allocate finances to other things – the family (clothing, food), service providers (education, health) and the church (building fund, church groups).
- Saving time provides the opportunity for women to spend more time strengthening their social networks, undertaking household duties and, in some cases, activities such as knitting.
- The money and time saved can be used for more economic productive activities, thus reducing poverty.

Solar stoves have the potential to increase energy supply and security in rural households, but they must be affordable, accessible and of good quality. It is unfair to burden those on very low incomes with inferior quality products that do not work. Solar stoves require promotion to be believed, and some adaptation in cooking habits and planning may be required.

Field testing has been very promising, and the second phase has clearly showed the importance of the price and efficiency of solar stoves, and the importance of promoting the concept.

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