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CONFERENCE PAPER

The energy profile of a low-income urban community

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Abstract
As part of a household energisation experiment, a baseline survey was undertaken from a sample of 152 households in the informal settlement of Samora Machel. The survey covered energy needs for cooking, space heating, water heating, lighting and any other demands, the costs of energy and total household monthly expenses. The average home had 3-4 inhabitants in less than 2 rooms. Paraffin was the primary source of energy for cooking and space heating, and played a significant role in water heating and lighting. Electricity was quite widely available, but was used primarily for low-power services such as radios and cellphones. Only 10% of all homes had a refrigerator. 20% of all homes purchased LP gas regularly but only used it on social occasions. Fuelwood was collected rather than purchased, and mainly burned in an open brazier, both for cooking and space heating. Space heating was primarily by cookstove; only one home had a specially designed heater using paraffin fuel. The median household expenditure was R1 800/month and 20% of this was spent on energy services. About half the homes are at risk of energy poverty, where lack of energy could give rise to a range of health problems, particularly during the colder months.

1. Introduction

The use of paraffin in low-income homes is associated with a number of problems such as the death of children who drink it accidentally, the spread of fire when as many as 2 000 homes can be destroyed in a single blaze, extensive burn injuries and ongoing indoor air pollution with attendant upper-respiratory-tract infections. For these reasons, the Western Cape Provincial Government suggested testing an alternative fuel, and it was necessary to find a community where the effects of an intervention could be measured.

Accordingly, a search for a suitable community was initiated. We were assisted by a charitable organisation, the Mustadafin Foundation, a Non-Profit Organisation that works across the Western Cape to uplift destitute communities through education, feeding schemes, health care programs, youth interventions and skills development.

They recommended the Samora Machel community, a typical informal settlement in the Philippi district of Cape Town. Figure 1 gives an aerial view of a typical section of the township, with the small crèche almost in the centre of the picture. The crossroads at the lower centre are at 34o01"02' S 18o35"07'E. After preliminary investigations, it was agreed that this seemed a suitable site, which would be confirmed by the survey.

Figure 1: An aerial view of a typical section of the Samora Machel community, Phiippi

2. Methodology

A questionnaire which had been developed previously for studying the energy profile of a rural com-

munity (Lloyd et al., 2004) was slightly modified and translated into Xhosa. A meeting was held with the community, in which the purpose of the survey was explained. The names, addresses and cell-phone numbers of people who indicated they were willing to take part in the survey were captured.

Three interviewers from Mustadafin were trained in the administration of the questionnaire, initially by administering the questionnaire to each other, and then on volunteers who would not be taking part. A Mustadafin supervisor also took part in the training; he was to debrief the interviewers at the end of each day and to check the questionnaires for consistency.

Then the interviewers went house-to-house. The residents were first asked to complete a consent form, which outlined the purpose of the questionnaire and gave an undertaking that the information they provided would be treated as confidential and only published in an aggregated form. Once that had been signed, the interviewers administered the questionnaire. It took three interviewers four days to administer 155 questionnaires, of which 152 proved free of errors and thus suitable for analysis.

The data were entered on an Excel spreadsheet, which facilitated analysis. Some idea of the comprehensiveness of the survey may be gained from the fact that the spreadsheet was 148 columns wide and 152 rows deep (not counting title columns or rows.)

3. Results

Social

The average home had three to four residents. The distribution of occupancy in all homes is given in Figure 2.

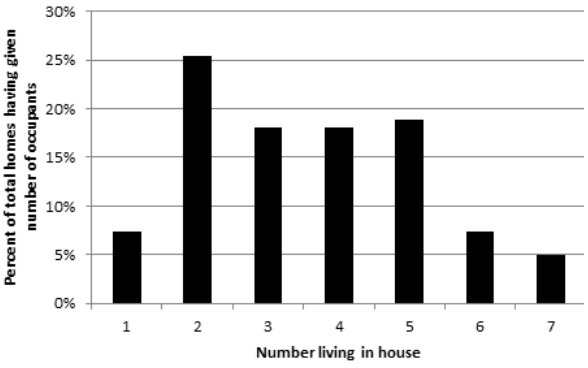

Figure 2: Occupancy level of homes

Very few were single occupancy and there were none with more than seven. The median home had less than two rooms, as shown in Figure 3.

Asked who made the purchasing decisions, 38% reported that it was the husband, son or male partner; 59% said that it was the wife or female partner; 3% reported that it was joint decision-making.

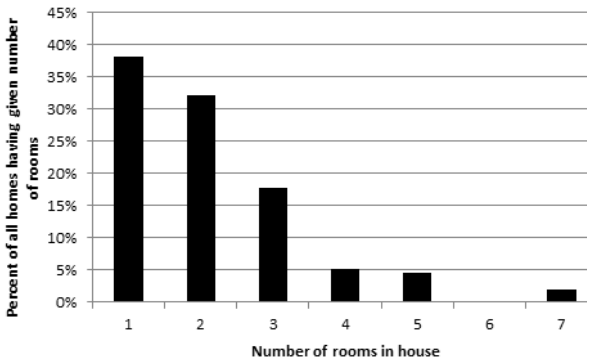

Figure 3: Number of rooms in house

Cooking

Paraffin was easily the most popular fuel for cooking, as shown in Figure 4.

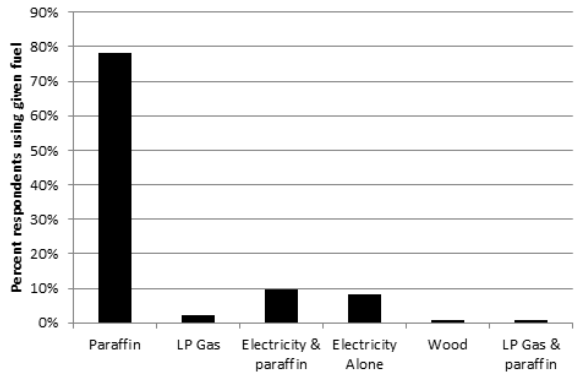

Figure 4: Household choice of fuel for cooking

Less than one house in five had access to electricity, and half of those used paraffin once their allowance of free basic electricity (50kWh per month) was expended.

Over 90% of the respondents cooked on a paraffin stove, and 8% cooked electrically. There were a few LP Gas cookers and one person cooked on an *mbaula* (brazier).

Asked why they chose paraffin for cooking, nearly half the residents said it was on the grounds of cost and 40% said it was because it was readily available. When the paraffin users were asked whether they liked cooking on paraffin, only 22% replied that they did, and of those, 10% said they only did so because it was cheap; 12% said they did so even though it made them sick; and 4% said they did so even though they knew it was unsafe. Those (88%) who disliked cooking on paraffin said it was dirty, expensive, made them cough and was unsafe. The problems experienced when using paraffin for cooking are given in Figure 5:

When asked for alternative fuel choices, many responded that paraffin was their only choice! This is shown in Figure 6. However, over 20% of the respondents would choose electricity, and of those, most reported that they would use electricity when

they had guests. A further 20% said they turned to firewood as an alternative, and nearly all did so because they had run out of cash. More than 10% said they would turn to LP Gas, and about half of those said they would do so when they had guests.

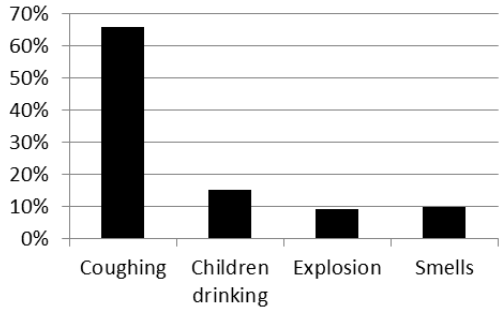

Figure 5: Problems experienced when using paraffin for cooking

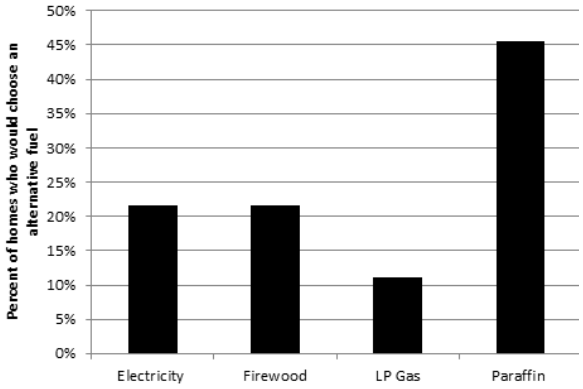

Figure 6: Choices of alternative fuels

Space heating

Paraffin also dominated the choice of fuels for space heating. Here wood played a larger role than it did in cooking, as shown in Figure 7:

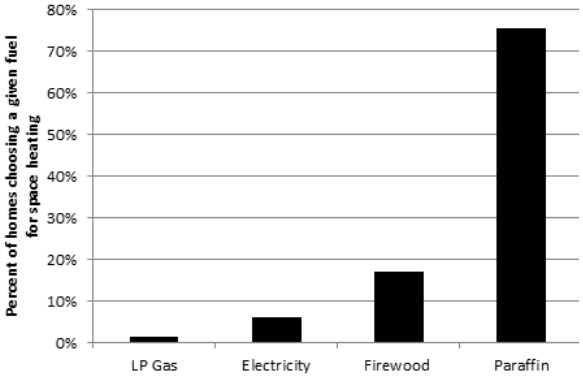

Figure 7: Fuel choices for space heating

The type of appliance used for space heating was, of course, highly correlated with the choice of fuel:

Some features of interest were:

- Over 10% of the homes had no means of heating;
- While paraffin dominated, only one person had a purpose-designed paraffin stove; the remainder used their cookstove to provide space heat;
- Those who burned wood mainly used an open brazier ("*mbaula*"); there were only two purpose-designed solid-fuel stoves.

The problems that people experienced with their appliances were very similar to those shown in Figure 5, except that significantly more (over 20% of the respondents) reported that explosion was a hazard when paraffin stoves were used as space heaters. This is supported by the earlier finding (Lloyd, 2002) that the longer paraffin stoves burned, the greater was the risk of explosion. Of course, the stoves would be used for longer in space heating than in cooking.

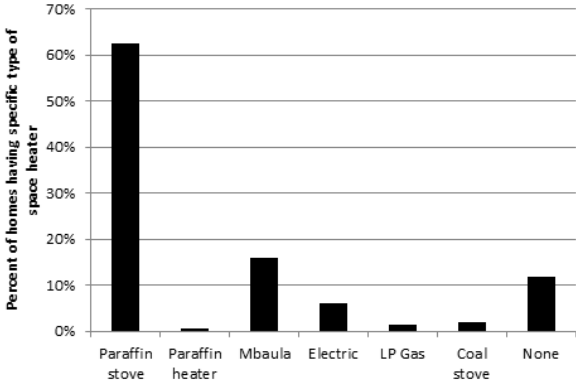

Figure 8: Types of appliances used for space heating

Water heating

Water heating was also dominated by paraffin, as Figure 9 shows.

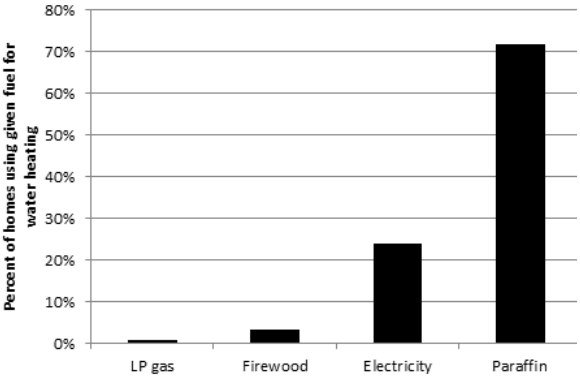

Figure 9: Fuel choices for water heating

It was of interest that nearly one-quarter of all homes used electricity to heat water. There were no electric geysers or solar water heaters in any of the homes. The appliances in use are given in Figure 10.

A feature of this is the relatively large number who heated water electrically. Only 8% cooked on

an electric stove, but nearly 25% heated water electrically. Clearly, the community has worked out that they can afford the convenience of a short, sharp burst of electricity to heat water, but the need to linger over cooking makes the use of electricity unaffordable.

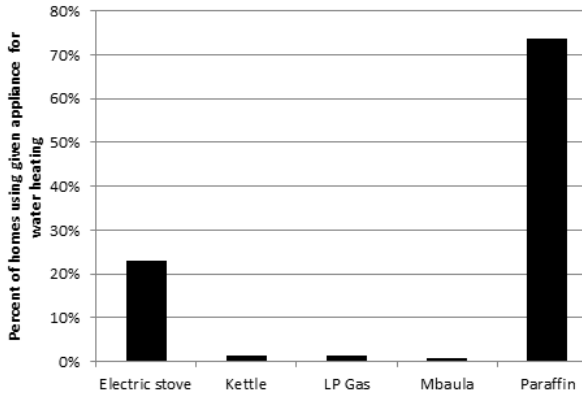

Figure 10: Appliances used for water heating

Lighting

At least there is one household energy need that is not dominated by paraffin – less than half the homes are lit by paraffin lamps, as Figure 11 shows.

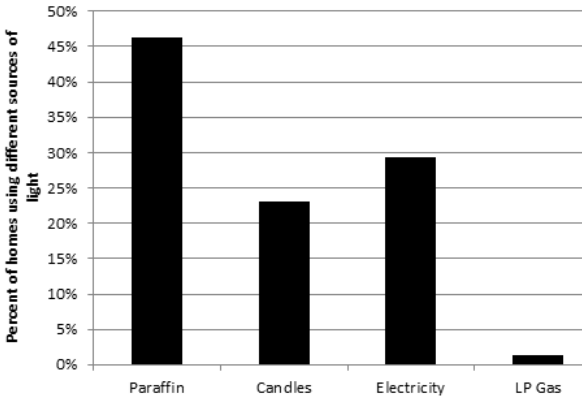

Figure 11: Sources of light in Samora Machel homes

Nearly a quarter still rely on candles, and close to a third use electricity. As this is significantly more than are supplied with electricity, it is evident that some homes are lit via lifelines from electrified neighbours. The median consumption of candles was about 18 per month in the homes that used candles.

Appliances

The appliances in use in SamoraMachel are shown in Figure 12. The large number of kettles seems surprising, until it is realized that most of these must be unpowered kettles, i.e. spouted containers for heating water which must be placed on a stove or fire. The low incidence of refrigerators and similar electrically powered appliances, which are almost universal in higher income homes, is noteworthy. Radio is generally battery-driven; most homes that were electrified had a television; non-electrified homes with television used batteries and complained about the cost.

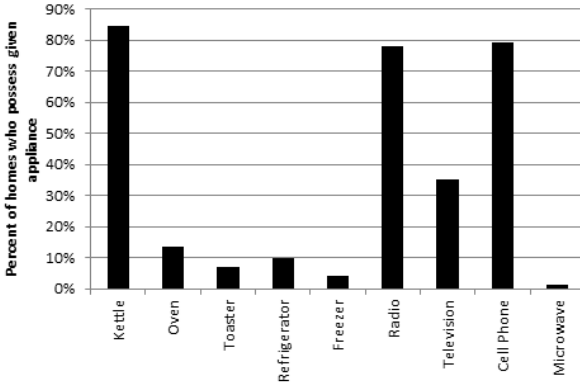

Figure 12: Appliances in use in Samora Machel

Costs

Attempting to obtain a community's idea of cost-of-living expenses is fraught with difficulty. However, in the present case, some estimates were surprisingly good. For instance, one question asked how much fuel the user used each month, and another asked what the cost of the fuel was. In the case of paraffin, the results are shown in Figures 13 to 15.

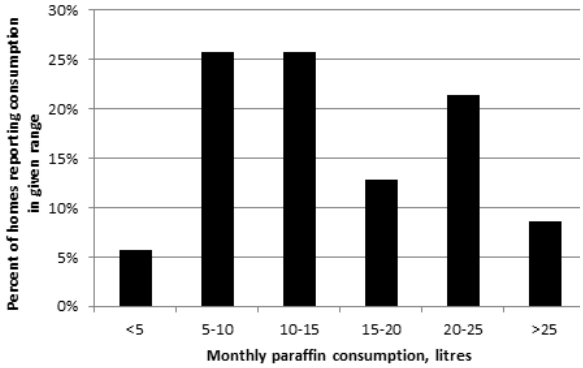

Figure 13: Reported monthly paraffin consumption, l

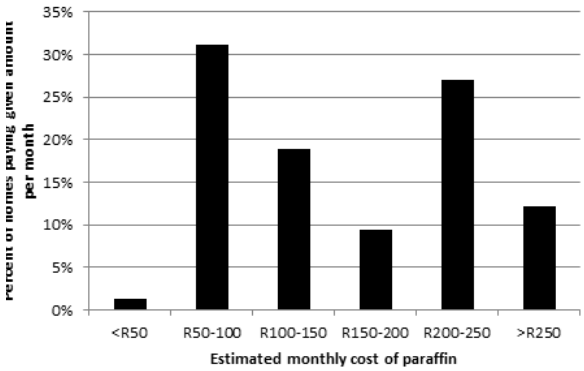

Figure 14: Reported monthly cost of paraffin, R

The fact that the average price of gas determined in this way is close to the known price at the

time of approximately R11.50, and that the estimated price is approximately normally distributed, gives some degree of confidence in the demand profile shown in Figure 13 and the use profile shown in Figure 14.

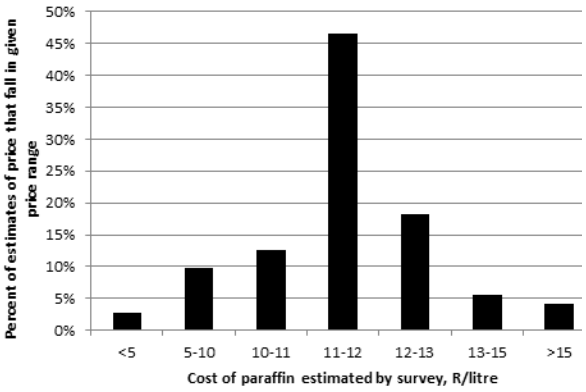

Figure 15: Estimate of paraffin cost, R/litre

About 40% of the homes had some access to electricity and were able to report their average costs, which are shown in Figure 16. The median cost is about R110 per month, which would indicate a median consumption of about 150kWh/month, inclusive of the 50kWh of free basic electricity which the poor are allowed.

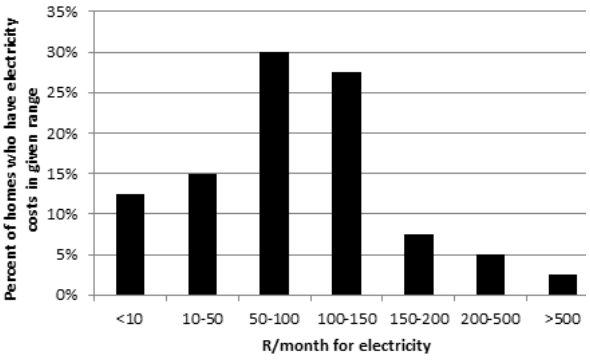

Figure 16: Monthly cost of electricity in electrified homes in Samora Machel

This would be too little to run a fully electrified home, and indeed is what would be expected, given the general lack of appliances noted earlier.

A very similar study was possible for the data on candle use. The median candle consumption amongst candle users was 18 per month and the median cost per month was R22, giving an estimated cost for a packet of 6 candles of about R7.35 – compared to a recent actual cost of R7.49. Again, therefore, the estimates derived from the questionnaire were close to the known truth.

The respondents were asked to estimate their monthly expenses for a range of goods and services, namely food, clothing, transport, school fees, entertainment, servicing of loans, energy (coal, electricity, LP gas, batteries, fuelwood) and any miscellaneous expenses (which were mainly cosmetics). The total expenditure per month is given in Figure 17.

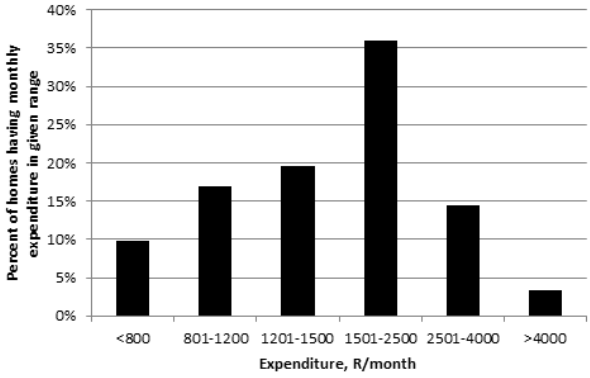

Figure 17: Monthly expenditure on goods and services, Samora Machel, October 2013

The median household expenditure of about R1 800 per month is close to the known household income of R1 800/month.

Figure 18 shows the monthly expenditure on energy, and Figure 19 shows the distribution of the ratio of energy to total expenditure.

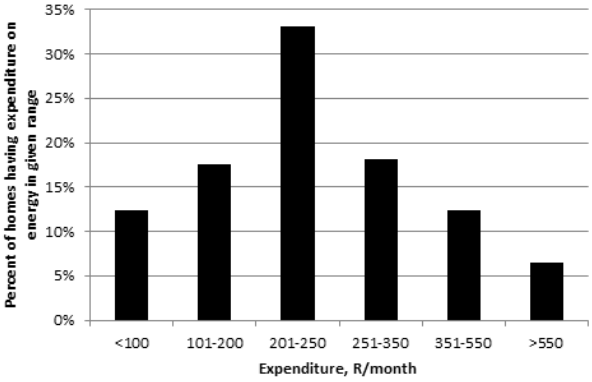

Figure 18: Monthly expenditure on energy

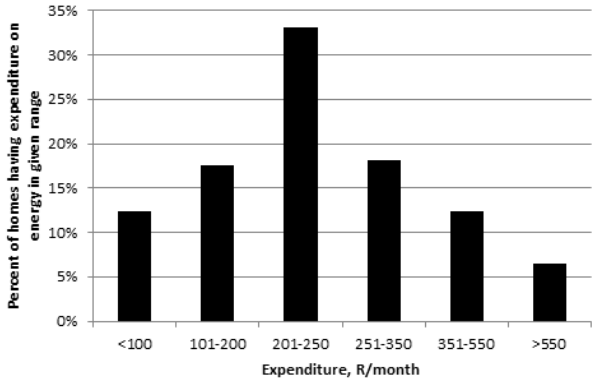

Figure 19: Ratio of energy to total expenditure per home.

4. Discussion and conclusions

This study of energy use in an informal settlement, Samora Machel, on the outskirts of Cape Town has given useful insight into how the poor actually live.

The environment is crowded, with more people per house than there are rooms. The people rely on paraffin to a large extent for most of their household energy. They cook, keep warm, heat water and light their homes with paraffin. There is some access to electricity – 38% of the households have a monthly electricity bill – but the use of electricity is mainly confined to low-power demands such as radio and communications. There are few refrigerators and fewer still freezers.

Fuelwood plays a role in space heating, and candles play a role in lighting, but even in these areas, paraffin dominates. It dominates even though most homes reported considerable problems arising from its use. In particular, there were widespread reports of coughing, and these were confirmed in house-to-house visits. The community was also only too aware of the other challenges created by paraffin use, including poisoning of children and contributing to the initiation of fires.

A survey of monthly expenditure on a range of goods and services showed that the total expenditure was very close to the known household income. However, for many the cost of energy constituted a huge portion of the monthly expenditure. About a quarter of all homes lived in energy poverty, with energy costs more than 25% of monthly household income.

It could only be concluded that almost any intervention that would reduce paraffin use without imposing any financial burden on the community would be welcomed.

Acknowledgements

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References

Lloyd P.J., Dick A. and Howells M. The energy profile of a rural community. *Journal of Energy in Southern Africa*, 15 (3) pp 80-87, 2004.

Lloyd, Philip The safety of paraffin and LPG appliances for domestic use Proc 10th IntConf Domestic Use Energy, 12-13 May 2002, Cape Technikon, pp 79-84.