

SUBMITTING AGENCY: WHO-DEPT OF HEALTH IN SUSTAINABLE DEVELOPMENT

TITLE

Community-wide Electricity Provision Programs in South Africa, and the Implications for Indoor Air Quality and Health.

ABSTRACT

For a major portion of the past decade, an aggressive electrification program has been underway in South Africa. As part of this initiative, around 450 000 households are being provided with electricity each year, or around 1000 households each day. An overall target of the program is to increase the proportion of dwellings supplied with electricity from 35% in 1992, to 70% by the year 2000, and around 85% in 2010.

South Africa's electrification program has provided a unique opportunity to assess changing energy use patterns and the impact of changes in indoor air quality (in this case associated with access to electricity) on health status. Research on the association between indoor air pollution and the health of women and young children has been identified as a particular priority in developing countries, in light of extensive use of polluting energy sources for cooking and space heating, and because women and young children are known to be exposed to the highest levels of indoor pollutants, over the longest periods. In this regard, an investigation into the feasibility of a large-scale community electrification, indoor air pollution and health study was recently funded by the World Health Organisation (WHO). Emerging from this feasibility investigation, as well as a number of other research projects focussing on aspects of electrification, have been a number of important issues associated with electricity provision programs, the dynamics of community transition to the use of electricity, and the implications for expected improvements in indoor air quality and health. This report will outline a selection of the key issues.

KEY ISSUE/S ADDRESSED

Accessibility (and use) of energy supplies (electricity), rural energy.

COUNTRY PROFILE

South Africa has a population of over 40 million people, distributed in 9 million households. In *per capita* terms South Africa is an upper-middle-income country. However, with the second highest Gini co-efficient (a measure of inequity) in the world, it is evident that the distribution of wealth and resources across the territory is highly inequitable, in terms of both geography and race. For example, 46% of African black and only 1% of white households live in informal or traditional housing structures. Similarly, solid or liquid fuels are used for cooking purposes by 66% of the African black population, whilst less than 1% of white households use these fuels. In 1995 only half of South Africa's households had access to electricity - 75% and 20% in urban and rural areas respectively. As part of a broad process of addressing racially-based inequities, eliminating environmental threats, reducing exposure to indoor air pollution, and improving community health, a national electrification program was planned and implemented. In terms of this program, around 450 000 dwellings have been provided with electricity each year in recent times, raising the percentage of electrified homes from 35% in 1992, to 70% by the year 2000, and an expected 85% in 2010.

KEY SUSTAINABLE DEVELOPMENT ISSUES ADDRESSED

South African rural areas are generally associated with high levels of poverty, low educational status, and a lack of basic environmental health and development infrastructure. The provision of electricity to rural households in South Africa has been seen as an avenue for the improvement of the quality of local ambient and indoor air, and reducing the threat of associated ill health, as well as a springboard for improvements in overall quality of life, through sustainable local economic development initiatives. This report discusses a number of issues of relevance to attempts to optimise the potential

for promoting sustainable local development, offered by the national electrification program.

OBJECTIVES

The objectives of the South African national electrification programs have been briefly alluded to above.

The overall goal of the WHO feasibility investigation, was to obtain essential planning information in relation to energy use patterns, indoor air quality, and health service infrastructure in electrified and un-electrified areas. Specific elements of the study included :

- A program of indoor air quality monitoring in electrified and un-electrified villages;
- A description of patterns of fuel use in electrified and un-electrified villages;
- An indication of the length of the period of transition to the use of electricity once supplied; and
- An indication of fuel costs in electrified and un-electrified villages.

OUTCOME AND IMPACTS

Basic Methodology

The study was undertaken in the village of Mareetsane, which had been supplied with electricity around 4 years earlier, and the un-electrified villages of Enselsrust and Brooksby. These villages were located around 50 kilometres from Mafikeng, the capital of South Africa's North West province. All the villages were situated in agricultural land, well away from busy highways or industrial sites. All dwellings in the study sites housing a child of 18 months or younger, were included in the study, giving a total of 110 dwellings, of which 57 and 53 respectively were in electrified and un-electrified villages. The study included the administration of a structured questionnaire survey administered by trained fieldworkers, and a program of indoor air pollution monitoring in both electrified and un-electrified areas.

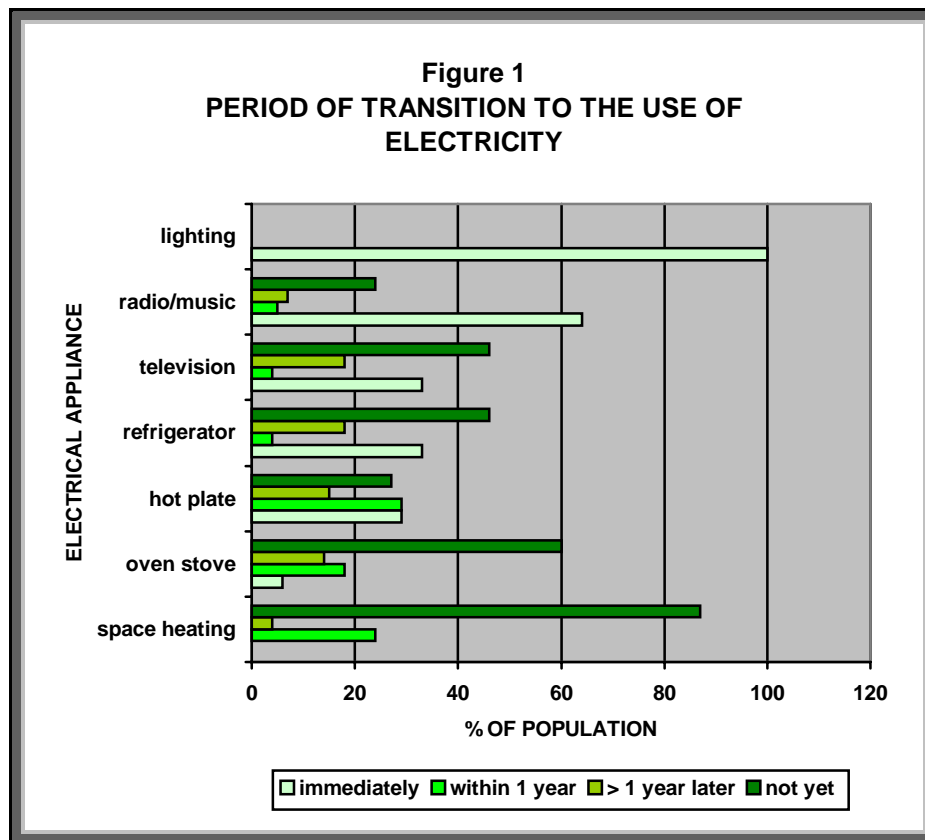
Selected Results

Levels of unemployment in both electrified and un-electrified areas were high, with around 65% of dwellings have no working adults. Levels of maternal education were low. Inquiries about access to a range of commodities showed that very few households had access to a microwave oven, video machine or motor vehicle. Relatively large proportions of households in both areas, on the other hand had access to irons, radios and television sets. There were few statistically significant differences in socio-economic status between the households located in electrified and un-electrified villages.

Inquiries into the period of transition to the use of electricity in the electrified village of Mareetsane showed that all households immediately used electricity for lighting (see Figure 1). A likely reason for this finding is the installation by Eskom, South Africa's electricity utility company, of a standard unit, which includes a light source. Following lighting, entertainment facilities such as radios, music centres and television sets, as well as refrigerators, were the items most likely to be powered by electricity immediately after supply. In respect of cooking, only 28% and 6% of respondents reported the immediate use of hotplates and oven stoves respectively. In 61% of households an oven stove had never been used. Reasons given for the failure to use electricity for cooking related mainly to financial constraints.

When respondents in the un-electrified villages were asked about priorities for the purchase of appliances in the event of electricity provision, the majority (63%) reported an expectation that an electrical cooking appliance would be the priority. This finding differs markedly from what transpired in the electrified village, where cooking appliances were frequently purchased well after the provision of electricity, or not at all. A possible reason for this difference could be the discrepancy between the

perceptions of women (who comprised the main groups of respondents here), and the reality of decision-making and power relationships at the household level. Gender and power issues have also been identified in several other studies, to be an important determinant of energy choices at the household level.



The study showed that during summer months around 19% of un-electrified households were using solid fuels, whilst 43% were using liquid fuels (paraffin/kerosene), and 12% were using LPG for cooking. A further 26% were using multiple fuels for cooking. In electrified villages on the other hand, around 26% reported using electricity exclusively, whilst a further 28% reported using electricity in combination with alternative fuels. The remainder (46%) were making no use of the electricity provided. In contrast to the electrified village, in which fuel use patterns across the seasons



Figure 2 – the use of both an electrical and a coal/wood stove in a rural, electrified South African village

appeared to be stable, considerable fuel switching was reported in the un-electrified villages. For example, solid fuels were used for cooking in 58% of un-electrified dwellings during winter months, compared with 19% in summer. In terms of household expenditure for fuels, the survey showed that weekly fuel costs in electrified villages averaged R44.00 (USD6) per week, compared to R60.00 (USD9) per week in un-electrified areas. These findings are in line with those emerging from studies of energy expenditure in other South Africa settings, which similarly indicate that average household expenditure in un-electrified dwellings exceeds that of households in electrified dwellings.

An indoor air quality monitoring program conducted as part of the study showed that levels of particulate matter (PM₁₀) ranged up to 1328 $\mu\text{g}/\text{m}^3$ over a 24 hour period. In electrified dwellings the maximum PM₁₀ level equaled 472 $\mu\text{g}/\text{m}^3$. The mean PM₁₀ level was significantly lower in electrified (18 $\mu\text{g}/\text{m}^3$) relative to un-electrified (78 $\mu\text{g}/\text{m}^3$) dwellings ($p = 0.028$).

Conclusions

The study indicated that, despite the exclusive or partial use of electricity by only 54% of households in the electrified village, a significant improvement in the quality of indoor air in this setting could nevertheless be measured. The transition to the use of electricity was protracted. At the time of the study, an average of 4 years subsequent to the provision of electricity, 60% of households had no oven stove, and 27% had no hot plate. This despite the finding that average weekly household fuel expenditure was higher in un-electrified relative to electrified villages. Most households had first purchased electrical appliances such as radios or music centers, television sets and refrigerators, all of which have little impact on indoor air quality relative to cooking and space heating apparatus. The pattern of purchase of electrical appliance in the electrified village contrasted sharply with perceptions of what would be the priority purchase in un-electrified villages. This may have been due to the respondents having been mainly women, and that differences occurred, as determined in studies elsewhere in South Africa, between women's perceptions and preferences, and the competing realities of household decision-making and power dynamics once electricity had been supplied.

PROJECT/PROGRAM STATUS

The South African national electrification program is expected to continue towards meeting its target of providing 85% of dwellings in the country with electricity by 2010.

The study outlined in this report was part of a feasibility investigation into the suitability of South Africa as a setting for the implementation of a large study of the impact of a reduction of indoor air pollution (associated with community-wide electrification programs) on the health of young children and women. An international panel is expected to review the findings of the feasibility study during November 2000, and advise on the following phases.

LESSONS LEARNED

- Despite only partial utilisation of electricity services, the study nevertheless demonstrated significantly better indoor air quality in electrified, relative to un-electrified dwellings.
- In rural South African settings, transitions to the use of electricity may be protracted, despite evidence that energy costs in un-electrified settings are higher than costs in electrified villages.
- Over and above financial constraints, a wide range of factors may impact on energy choices at the household level, including, for example, household decision-making and power dynamics, gender, and, as indicated by studies conducted elsewhere in South Africa, cultural traditions, levels of understanding of power consumption rates of various appliances, and of the billing system.
- Extensive poverty may undermine government attempts to improve rural quality of life, environmental quality and health status through, for example, large-scale electricity provision, water supply and sanitation programs.
- What is needed in rural areas of poverty, is a holistic, integrated approach to local development, that takes account of the broad principles of sustainability. In this regard, the South African Independent Development Trust, is currently coordinating the implementation of around 50 pilot projects centred around energy provision, but within the context of holistic, integrated, cross-sectoral approaches to sustainable local economic development. These pilot projects will provide an opportunity to implement strategies aimed at addressing many of the energy choice concerns which have emerged from the WHO feasibility investigation outlined here.

FURTHER INFORMATION

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