

Household energy needs and utilization patterns in the Giyani rural communities of Limpopo Province, South Africa

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Abstract

A study was conducted in the rural communities of the Giyani district in Limpopo Province, with the aim of identifying types of energy resources used and the patterns of utilization of such energy sources. Surveys were conducted in three villages and semi-structured questionnaires were used to interview 20 randomly selected households per village. Focus group discussions were also held in each of the surveyed villages.

Data obtained in all surveyed villages showed that fuel wood is the main source of energy for cooking and heating while paraffin and candles are mainly used for lighting. Wood in these villages is very scarce and communities spend 5 to 6 hours per trip collecting fuel wood. Women using the load-head method of carrying wood and occasionally wheelbarrows are the main source of labour used in collecting fuel wood.

The paper concludes that there is a need to promote sustainable energy resources and technologies such as the use of improved wood and charcoal stoves. Furthermore, the paper recommends the promotion of solar photovoltaic (PV) systems, which have a potential of being adopted in the area. It is also argued that policies which enhance integrated rural development and promote sustainable energy utilization in rural communities need to be put in place and implemented.

Keywords: Giyani rural communities, Limpopo Province, South Africa, households, energy sources, household energy

Introduction

Poverty in a developing country has many facets, and one of them is having to cope with limited means and the use of inefficient technologies for crop production and lack of efficient household energy technologies. In most rural communities in Sub Saharan Africa (SSA), poverty can mean, among other things, having to rely primarily on wood and/ or dung for cooking, heating and lighting. In order to meet their household energy needs, the majority of the rural based and urban poor clear vast tracks of land with its vegetation, with devastating ecological consequences. It has been estimated that Africa is experiencing a net loss of as much as 5 million hectares of tropical forests every year (Awino, 1999). SSA therefore, thrives on a very fragile environment, threatened by deforestation and rampant soil erosion.

Like in many other developing countries, rural areas in South Africa are less privileged in terms of social services and infrastructure compared to urban centres. Where services are available in these areas, they are normally of low quality and limited. Even the energy consumed in the rural areas is mainly from the traditional sources such as fuel wood and cow dung. With a fairly large population living in the rural areas, this has led to problems of deforestation and soil erosion.

Energy is one of the basic requirements in human life, although most of the rural people do not have enough access to efficient and affordable energy resources. The vast majority of rural people are dependent on traditional fuels such as wood, dung and crop residues, often using primitive and inefficient technologies. For many, this combination barely allows fulfilment of basic human needs of nutrition, warmth and light, let alone the possibility

of harnessing energy for productive uses which might begin to allow them to escape from the cycle of poverty (World Energy Council, 2000; Green and Erkskine, 1999).

As mentioned, the aim of the study was to investigate the energy needs and utilization patterns of energy sources in rural communities of Limpopo Province. The following were the specific objectives:

- To identify household energy needs and utilization patterns in rural communities;
- To examine the role of women in household energy systems;
- To assess the availability of energy sources;
- To understand the level of satisfaction of the people with regard to the current utilization patterns, and their willingness to change to meet their household needs.

Materials and methods

The study was conducted in the rural communities of Giyani District in Limpopo Province, located approximately 30 Kilometres west of the Kruger National Park and 15 Kilometres north of the Tropic of Capricorn. The three selected villages were Nkomo, Ribungwani, and Phugwani

The three villages have a total of 300 households and the population is dominated by females, especially of mature to old age. Nkomo alone has less than 100 households. It is usually such small communities that have been ignored when it comes to provision of services including getting connected to the national electricity grid.

The research was conducted by the administering of a questionnaire that was balanced between open-ended and close-ended types of questions. This was done to obtain relevant data that allows flexibility to meet the intended objectives and, at the same time, not restricting respondents to the given options.

Within each selected village, questionnaires were administered to 20 randomly selected households. Focus group discussions were conducted to cross check some of the information collected during interviews.

Survey results

The majority of people in the rural areas of Giyani are unemployed, with low literacy levels. Most households are dependent on pension funds, gov-

ernment grants and subsistence farming. Table 1 is a summary of surveyed households and their occupation. Between 70 and 90 percent of these people receive a monthly income of less than R900.

Types of energy resources used in villages

Almost all the households in the study area are using fuel wood as a main source of energy for cooking and heating. Few households supplement wood with paraffin when wood is not available. Paraffin is also used in case of rainy conditions or when cooking or heating has to be done as a matter of urgency. Candles and paraffin lamps are used interchangeably for lighting even though paraffin seems to be very popular. Figure 1 shows the comparison of using different energy sources for cooking and heating, while Figure 2 shows the extent of using paraffin and candles for lighting.

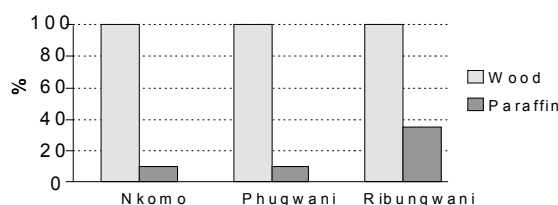


Figure 1: Use of different energy sources for cooking and heating

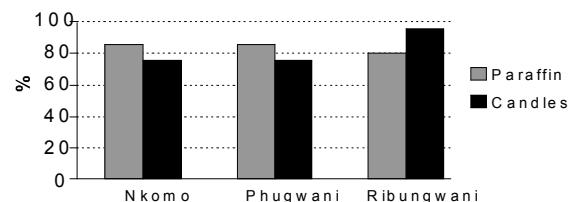


Figure 2: Use of different energy sources for lighting

Table 2 shows the extent of utilization of renewable energy technologies in the Giyani area. The survey has shown that solar photovoltaic (PV) systems seem to be the only type of renewable energy technology that is used in the area. All the respondents who own the solar panels are using them only for operating radios. None of the households interviewed were aware of other systems such as biogas.

Table 1: Number of households surveyed per village and breadwinners occupation

| Village | No. of households surveyed | Occupation of respondents | | | | |
|------------|----------------------------|---------------------------|---------------|------------|----------------|------------|
| | | Hawker | Self employed | Pensioners | Govt employees | Unemployed |
| Nkomo | 20 | - | 5 | 4 | 3 | 8 |
| Phugwani | 20 | 1 | 3 | 6 | 1 | 6 |
| Ribungwani | 20 | 2 | 2 | 2 | 7 | 7 |

Table 2: Number of respondents using renewable energy technologies in surveyed villages

| Village | Not using RE technologies | Using solar energy |
|------------|---------------------------|--------------------|
| Nkomo | 17 | 3 |
| Phugwani | 19 | 1 |
| Ribungwani | 19 | 1 |
| Average | 92% | 8% |

Time spent in acquiring household energy

The acquisition of fuel is a major expense in a resource-poor household, be it in terms of time and energy or money or both. While men are having greater access to cash income activities, women's daily activities revolve around a subsistence economy. Much of women time is devoted to collecting fuel wood and water collection, food preparation, child care, cleaning and household maintenance. The study revealed that women spend between 5 to 6 hours per day collecting fuel wood. This is about 45% of a day, which is spent on fuel gathering (see Table 3).

In a similar study conducted in KwaZulu-Natal, Eberhard (1996) quoting Gander (1984), has reported that in the Mahlabatini district of KwaZulu Natal, the average time spent collecting wood is about 9 hours per household per week in the highlands, and about 7 hours in the valley (lowveld) areas. The average distance travelled to collect one head load varies between 3 and 10 km.

All these activities are usually taken for granted and are seldom monetized. The opportunity cost of these activities prevents rural women from undertaking income generating activities, and this consequently deprives poor families of much needed income.

The role of women and men in acquiring household energy

Women and children play an important role in making energy available for household use. They are the ones who bear the difficulties of chopping, loading and transporting heavy loads of wood. Table 4 indicates the number and percentages of women and men responsible for acquiring wood and the modes of transport in use. Except for a very few who buy wood or those who own a bakkie (pick up) or donkey cart, the majority of households use the head loading method of transport.

In the rural areas of Giyani, more than 80% of energy related work is done by women. Women play a significant role in the domestic energy system by procuring and processing fuel for their families. The involvement of men in sourcing the household energy is relatively low. It is only when the wood is collected for sale or where social constraints restrict women from leaving their homes (for example, when they are heavily pregnant) that men participate. Nevertheless, the involvement of men arises strongly where energy decisions are to be made. In decision-making, it is normally the male head of the family who decides on the purchase of paraffin, candles and the type of cooking device to be used. However, the actual operational duty is left in the hands of women. The implication of this is that

Table 3: The average time spent per day in acquiring various types of energy

| Resource type | Nkomo | | Phugwani | | Ribungwani | |
|---------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|
| | Au. time per trip (hrs) | % of time per 12hr day | Au. time per trip (hrs) | % of time per 12hr day | Au. time per trip (hrs) | % of time per 12hr day |
| Wood* | 4 | 33 | 4 | 33 | 4 | 33 |
| Paraffin | 1 | 8 | 1 | 8 | 0.5 | 4 |
| Candles | 1 | 8 | 0.5 | 4 | 0.5 | 4 |

* The average time for wood excludes time spent by those who buy fuel wood

Table 4: Gender roles and the transport modes used to collect fuel wood

| Village | Human power* (%) | | Donkey cart (%) | | Bakkie (pickup) (%) | |
|------------|------------------|-----|-----------------|-----|---------------------|-----|
| | Women | Men | Women | Men | Women | Men |
| Nkomo | 75 | - | 5 | 10 | 5 | 5 |
| Phugwani | 80 | 5 | 5 | - | 10 | - |
| Ribungwani | 85 | 10 | - | - | 5 | - |
| Average | 80 | 5 | 3 | 3 | 6 | 2 |

* Human power is used through head loading or the use of wheelbarrows

women's participation in other development activities is impaired.

The availability of wood as a main source of energy

As shown in Table 5, more than 72% of the households indicated that energy resources, particularly wood, are very scarce. When wood becomes scarce, people resort to collecting very inconvenient kinds of burnable material (e.g. crop stalks), which create yet even more environmental and social problems. This is because of, firstly, it results in the loss of large tracts of woodlands, damage to vegetation and soil becomes bare making it susceptible to soil erosion. Secondly, the loss of crop stalks and other animal material that could be used as feed for animals and as fertilizers in farmlands occurs (UNDP, 2003). The third dimension is that environmentally, wood scarcity implies a gradual loss of species (local extinction) especially those that are preferred as good sources of energy like Mopane trees, which are the main fuel wood targets in the Giyani area.

Table 5: Availability of fuel wood sources in surveyed villages

| Village | Scarce (%) | Moderately available (%) | Abundant (%) |
|----------------|------------|--------------------------|--------------|
| Nkomo | 65 | 20 | 15 |
| Phugwani | 70 | 15 | 15 |
| Ribungwani | 80 | 20 | 0 |
| Average | 72 | 18 | 10 |

Attitude and preferences of respondents towards alternative sources of energy

On average, 88% of the respondents were not satisfied with those sources of energy they were using (see Table 6). A number of reasons were indicated as to why they were dissatisfied with the current available energy resources:

- Wood is scarce and fuel wood is not reliable in times of long heavy rains;
- Acquiring such fuels is time consuming and cumbersome; and
- Problems of indoor air pollution (e.g. eye irritations, coughs and frequent burns) especially when using candles and paraffin.

Table 7: Percentage of people willing to pay for an alternative household energy source

| | % of people willing to pay | | | | |
|----------------|----------------------------|------------|------------|-----------|---------------------|
| | R20/month | R40/month | R60/month | R80/month | More than R80/month |
| Nkomo | 25 | 20 | 25 | 0 | 30 |
| Phugwani | 30 | 25 | 10 | 10 | 25 |
| Ribungwani | 20 | 25 | 20 | 10 | 30 |
| Average | 25% | 23% | 18% | 7% | 28% |

Table 6: Percentage of people who expressed satisfaction or dissatisfaction with currently used energy resources

| Village | Satisfied (%) | Not satisfied (%) |
|------------|---------------|-------------------|
| Nkomo | 10 | 90 |
| Phugwani | 15 | 85 |
| Ribungwani | 10 | 10 |

There seems to be an overall positive attitude towards renewable energy technologies (particularly solar energy) for those who happen to know about these systems. More than 60% of the respondents would like to use solar energy systems over other forms of renewable energy technologies. 20% are not sure and only 11% of them are not willing to use any of the renewable technologies (see Figure 3). Although some 65% of the population know or have heard about solar energy, knowledge about the system is really inadequate. Other forms of feasible renewable technologies such as biogas are not known.

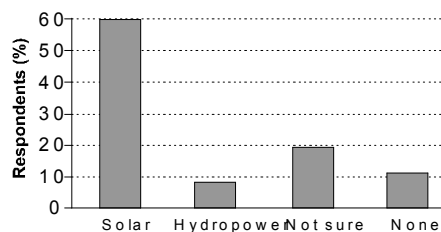


Figure 3: Percentage of respondents who would like to use alternative forms of renewable energy technologies

Respondents' willingness to pay for alternative or renewable sources of energy

The majority of respondents showed some willingness to pay in order to start using renewable energy technologies such as solar, if they are made available. More than 75% of the respondents are willing to pay over R40 per month, and 34% can pay even more than R80 per month (see Table 7).

Discussion and conclusion

Types of energy resources used

In the surveyed areas of Giyani, major household energy resources used are limited to fuel wood, paraffin and candles. Other sources include batteries, which are basically for radio and TV use, and a few use solar panels for this purpose. More than 99% of households in rural Giyani rely on fuel wood as a major source of energy for cooking. Poverty and low income levels are accountable for the use of fuel wood over other sources such as Liquid Petroleum Gas, paraffin and others non-grid sources.

Given the significance of fuelwood in rural Giyani, access to sustainable and secure fuel wood supply is important for many households. Crop residues and animal dung are seldom used. This is because they occur in very small quantities since the agricultural plots in the area are relatively small. Secondly, animal dung produces a lot of smoke due to the high amount of volatile matter (e.g. sand particles), therefore causing great discomfort to the users.

Studies and development work in other countries such as Kenya and Tanzania, have developed ceramic cooking stoves to improve the fuel wood burning efficiency, and have shown that it can save up to 50% of wood and charcoal used. These wood stoves have an improved combustion efficiency of 30% and, hence, they are more efficient than the traditional cooking systems (Kiriamu, 1999; Karekezi and Ewagata, 1996). It might be worthwhile introducing such technologies in the rural areas of Giyani.

The survey has shown that with the exception of a few households that supplement wood with paraffin for cooking, paraffin is basically used along with candles for lighting. Candles are some of the inefficient forms of lighting with some of the impacts derived from gradual (and often unnoticed) emission of carbon monoxide and hydrocarbons. Not only are these sources causing environmental and indoor pollution problems, they also carry within them some health hazards.

Other studies have indicated and identified specific health hazards associated with the use of candles and paraffin. In South Africa, a large number of accidental fires occur every year, usually with devastating impacts on resident's property. The cause of these does not include only accidents with candles and paraffin lamps, but also poor quality appliances that sometimes explode under the conditions of heavy or improper use (TOTAL South Africa, 2003).

Although this research did not quantify the extent of accidents resulting from the use of paraffin and candles, certain reports state that annually, some 23 000 people in South Africa suffer from

severe burns as a result of candles and paraffin fires, while about 4 000 children die after swallowing paraffin and contracting chemical pneumonia from paraffin. A greater percentage of these figures are from rural areas (TOTAL South Africa, 2003).

Opportunities for introducing renewable energy technologies

Solar energy is a potential source of power which can generate both heat and electricity. It can be used for various applications ranging from solar drying, water heating and providing electricity for lighting and powering televisions and radios. Solar (PV) systems can also be used to improve the quality of life: for example, the provision of lighting in a rural school, evening education and community activities. Refrigeration at health centres can be implemented to improve the effectiveness of immunization programmes and also to improve the lives of rural households (Hankins, 1995). With the abundant sunshine available in the region, solar electricity is a realistic alternative in meeting the demand of household energy in rural areas. The sale of solar electric systems can also create jobs for installers in rural areas, as well as opportunities for urban and cottage industries.

South Africa experiences some of the highest levels of solar radiation in the world. The average daily solar radiation in South Africa varies between 4.5 kWh/m² compared to about 3.6kWh/m² in parts of the United States, and about 2.5 kWh/m² in Europe and United Kingdom. Within South Africa itself, Limpopo Province of South Africa has enormous sunlight throughout the year, particularly in the Giyani area, which lies at even lower latitudes, within the tropics. This area receives annual incoming short wave radiation of approximately 8001 to 8500 MJ/m² which is relatively high compared to other parts of the country like the Eastern Cape with higher latitude, which receives less than 6500MJ/m² (Department of Minerals and Energy, 2002).

This study has shown that people in the surveyed areas of rural Giyani are willing to pay for alternative energy sources. More than 75% of the respondents are willing to pay R40.00 per month, while 34% of respondents indicated that they can pay even more than R80.00 per month if the solar (PV) systems are made available. This attitude is an encouraging sign and is a basis for recommending the installation of solar photovoltaic systems as a preferred alternative.

This paper has reviewed various sources of energy in rural Giyani and their utilization patterns. Findings and analysis has shown that these resources (i.e. wood, paraffin and candles) are inadequate in meeting the household energy needs, and can cause numerous health problems. Other problems include the marginalisation of women and

depreciation of woodlot resources. The communities are not satisfied with current utilization patterns and they are willing to divert to more effective energy technologies. The study therefore recognises the need for policies, which will integrate various energy systems including the use of renewable energy technologies to meet energy needs. The use of fuel wood efficient stoves could be one of the possible options for promotion in the area.

References

- Awino, W.O. 1999. Solar ovens in Africa: Status, constraints and strategies. In SEASAE proceedings: Agricultural Engineering, Environment and Development: 251 – 253.
- Department of Minerals and Energy, 2002, White Paper on the Promotion of Renewable Energy and Clean Energy Development – Part One, Government of South Africa.
- Eberhard, A.A. 1986. A directory of appropriate energy technology programmes in Southern Africa. Development Southern Africa Vol. 3 No.1.
- Green J.M. and Erskine S.H. 1999, Solar (Photovoltaic) Systems, Energy Use and Business Activities In Maphephete, KwaZulu Natal: *Development Southern Africa* Vol.16 No.2; South Africa.
- Gwagwa, L. 2000, Linking Energy and Rural development, www.rsup.nrel.gov.
- Hankins, 1995, Solar Electric Systems for Africa: A Commonwealth Science Council and AGROTEC Publication.
- Karekezi, S. and Ewagata, E. 1996. Renewable in Kenya. Maendeleo Stove and Power Alcohol Programme. In Sustainable News Vol. 14: 4 –5.
- Kiriama, L L. 1999. Development and dissemination of renewable energy technologies: Tanzania experiences. In SEASAE proceedings: Agricultural Engineering, Environment and Development: 221 – 225.
- TOTAL South Africa, 2003, Making the use of paraffin safer, www.total.co.za.
- UNDP (United Nations Development Program), 2003, Energy as an Instrument to Socio-economic Development, www.undp.org.
- World Bank, 1996, Rural Energy and Development, Washington DC.
- World Energy Council, 1999-2003, The Challenge of Rural Energy Poverty in Developing Countries www.worldenergy.org.

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