

ProBEC

Programme for Biomass Energy Conservation
in Southern Africa

Energy baseline survey in Ga Maraba and Ga Mogano in the Northern Province (South Africa)

FINAL REPORT

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IN ASSOCIATION WITH
THE NGWAABE AND BOCHUM ENERGY CO-OPERATIVES**

Executive Summary

Biomass still amounts to nearly 80% of total energy demand in SADC countries. Most of this energy is used for household purposes (cooking, baking, lighting, heating) but a substantial amount goes into small-scale businesses like brick firing, fish smoking, processing of agricultural products, beer brewing, and restaurants. In addition, recent statistics suggest that biomass energy use for Africa will have doubled by the year 2020. Main reasons for this are a high population increase, low incomes and a shortage of foreign currency.

An energy baseline study was conducted in the northern Province of South Africa to provide energy specific household data to assist in the planning and design of further actions on the dissemination of improved stoves. The objective of the baseline study was to obtain energy specific household data to assist in the planning and design of further actions on the dissemination of woodstoves and solar stoves in the area.

The average family size in both areas is 6 people. In both areas, in the majority of the households, men are considered to be the heads of the households. This would have implications in the implementation of specific programmes when gender, decision-making processes and power relationships regarding purchasing would need to be considered. Both areas can be considered fairly well off in terms of access to income sources, although Ga Maraba seems to be slightly less well off with more pensioners and less households with someone in employment. In general, both areas seem better off than rural areas in general where unemployment is high and reliance on pensions and remittances very high. The conclusion that Ga Mogano is “richer” or better off is based on the fact that more households have someone formally employed in Ga Mogano than in Ga Maraba (62% vs. 44%) respectively. Also more people farm and sell produce (19,4% vs 11,1%) and lastly, only 15,2% rely on pensions in Ga Mogano in contrast to 30,5% in Ga Maraba.

With regard to appliance ownership, a high level of ownership of electrical appliances seems to indicate that the areas have been electrified for some time. It further indicates the relative wealth of households since appliances such as refrigerators are expensive and normally ownership in rural areas is not that high. Ownership of radio's, televisions as well as fridges is higher in Ga Maraba (identified as a poorer area) than in Ga Mogano.

The use of wood for cooking purposes in Ga Mogano is higher in both summer and winter than in Ga Maraba. Electricity use for cooking is high in Ga Maraba (46,6% in summer and 36,4% in winter respectively). It would seem that wood fuel interventions would be more appropriate in Ga Mogano due to the higher incidence of fuel wood use for cooking purposes. The use of wood for cooking purposes in Ga Mogano is higher in both summer and winter than in Ga Maraba. Electricity use for cooking is high in Ga Maraba (46,6% in summer and 36,4% in winter respectively). It would seem that wood fuel interventions would be more appropriate in Ga Mogano due to the higher incidence of fuel wood use for cooking purposes.

In Ga Maraba, 43% of households buy wood (whether they buy wood only or wood and other fuels) at an average cost of R168 per month. In total, households spend approximately R370 per month on energy. In Ga Maraba, 43% of households buy

wood (whether they buy wood only or wood and other fuels) at an average cost of R168 per month. In total, households spend approximately R370 per month on energy.

The most popular method of cooking in use is boiling and that the method of cooking will be suitable for energy efficient wood stoves. It can further be concluded that enough cooking opportunities exist to justify the introduction of efficient stoves, i.e. households cook often (at least twice daily) as opposed to areas where cooking may only take place once a day due to food scarcities, energy shortages or labour shortages (someone to actually do the cooking). Lastly, it is also clear that the type of food prepared (porridge, vegetables, meat) would be suited to prepare on an energy efficient wood stove.

Conclusions therefore, seem to indicate that both study areas are generally wealthy with a high level of appliance ownership. However, wood fuel use, especially for cooking purposes is still high and wood fuel is considered to be scarce in both areas. Households experience additional problems associated with the use of wood fuel as an energy source as well as problems with the use of conventional energy sources. The combination of wood fuel scarcity, continued high levels of wood fuel use, awareness regarding problems associated with wood fuel use and an indication of the potential of disposable income to be spent on appliances seems to indicate positive conditions for the implementation of an improved stove programme.

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1. Introduction

Palmer Development Consulting was contracted by GTZ to assist in the completion of a baseline study in the Ga Maraba and Ga Mogana districts of the Northern Province in South Africa. The following report will provide a general overview of the findings.

2. Background: Programme for Biomass Energy Conservation in Southern Africa (ProBEC)

Biomass still amounts to nearly 80% of total energy demand in SADC countries. Most of this energy is used for household purposes (cooking, baking, lighting, heating) but a substantial amount goes into small-scale businesses like brick firing, fish smoking, processing of agricultural products, beer brewing, and restaurants. In addition, recent statistics suggest that biomass energy use for Africa will have doubled by the year 2020. Main reasons for this are a high population increase, low incomes and a shortage of foreign currency.

On the other side, the available biomass resources have been significantly reduced due to a growing population requiring more agricultural land and infrastructure development, due to periodic droughts and in some countries due to years of civil conflict. Despite these facts, energy investments in SADC countries have been concentrated on the modern energy sector and only less than 2% of total energy budgets are allocated to biomass fuels.

These were some of the reasons to start the Programme for Biomass Energy Conservation in Southern Africa. ProBEC is a supra-regional Programme, which aims to enhance capacities and commitments of governments and development institutions/organisations to plan and implement integrated biomass energy conservation programmes. Thus, it intends to contribute to the improvement of quality of life for the poor rural and urban populations by enabling them to fulfill their energy needs in a socially and environmentally sustainable manner.

ProBEC is a joint programme between SADC, the European Commission (EC) and the German Government. Most of the financial support comes from the Forestry Sector of the EC. The German Agency for Technical Cooperation (GTZ) is commissioned to implement ProBEC. GTZ has a long and world-wide experience in planning, implementing and monitoring integrated household energy projects and programmes.

In a first phase (1998-2001) ProBEC activities are restricted to six SADC countries: Lesotho, Malawi, Mozambique, Namibia, South Africa and Zimbabwe

3. Methodology

The objective of the baseline study was to obtain energy specific household data to assist in the planning and design of further actions on the dissemination of woodstoves and solar stoves in the area. It was also envisaged that specific health related questions would be included pertaining to HIV/AIDS as well as indoor air

pollution. Due to strong resistance from the enumerators, the health related questions were minimised. The enumerators felt uncomfortable asking HIV/AIDS related questions since they are not health workers and they feared that the community would be offended. An alternative suggestion was to contact the Department of Health to obtain the necessary information if available. It is recommended that ProBEC should liaise with the Department of Health to formalise the request for information and clearly state the purpose for which the information is required.

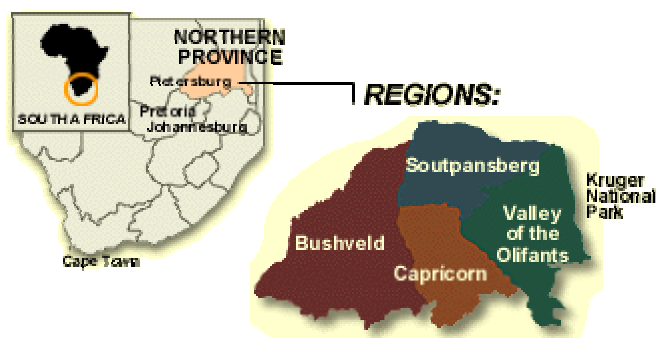
PDC's responsibility was to assist with questionnaire design, training of field workers, piloting and finalisation of the questionnaire. In addition, PDC also had to complete the data capturing and analysis, originally meant to be the responsibility of the enumerators.

The survey was conducted through a structured interview and questionnaire. The questionnaire is attached as Annex 1. The survey areas were pre-selected by ProBEC and households were randomly selected. In total, 175 interviews were conducted, 87 in Ga Mogano and 88 in Ga Maraba. Data capturing was executed by PDC utilising a specific designed database in Access. The full database is available for further analyses.

Palmer Development Consulting provided training to 20 enumerators during a training workshop held in Pietersburg 3-8 May 2001. The training session included a piloting exercise to test and adapt the questionnaire. Not all 20 enumerators attended the training and debriefing session after completion of the pilot study.

4. The study area in context

The Northern Province lies within the great elbow of the Limpopo River and it shares borders with Botswana, Zimbabwe and Mozambique. Pietersburg is the capital city and lies strategically in the centre of the province. Other important Northern Province towns include the major mining centres of Phalaborwa and Thabazimbi, and Tzaneen, producer of tea, forestry products and tropical fruits. A new major road route will be the Maputo Corridor, which will link the province directly with the Mozambique port, creating development and trade opportunities, particularly in the south-eastern part of the province. The province's link with Maputo has been declared a 'main' corridor.



In the Northern Province, more than five million people live on about 123 910 km² of land. The main languages spoken are Sepedi (52,7%), Xitsonga (22,6%), Tshivenda (15,5%) and Afrikaans.

Controlled hunting is often combined with cattle farming. Sunflowers, cotton, maize and peanuts are cultivated in the Warmbaths-Nylstroom area. Nylstroom is also known for its table grape crops. Tropical fruit, such as bananas, litchis, pineapples, mangoes and pawpaws, as well as a variety of nuts, are grown in the Tzaneen and Louis Trichardt areas. Extensive tea and coffee plantations create many employment opportunities in the Tzaneen area. Zebediela, one of the largest citrus estates in the country, is situated south of Pietersburg. The Northern Province has extensive forestry plantations in the Louis Trichardt and Tzaneen districts. Plantations of hard woods for furniture-manufacturing have also been established. Many of the rural people practise subsistence agriculture.

The Northern Province is rich in minerals, including copper, asbestos, coal, iron ore, platinum, chrome, diamonds, phosphates and gold. The province is a typical developing area, exporting primary products and importing manufactured goods and services.

The National Electrification (NELF) database recorded a total of 914 769 houses in the Northern Province of which 11,3% were in urban areas. A mere 5,9% of these houses have tap water in the house and 7,2% have full waterborne sanitation. The National Electricity Regulator indicates that 35% of these houses have access to electricity. Eskom's Matimba power station at Ellisras provides the total electricity generating capacity of the province. There are 17 licensed institutions that distribute electricity in the province. Eskom provides electricity directly to 87% of domestic users in the province.

Table 1: Provincial Characteristics. Source: DBSA, 1998

Indicators	Northern Province
Population, 1995 ('000)	4 934,9
Population growth, 1980-95 (%)	3,6
Density, 1997 persons/km ²	4242,3
Functional Urbanisation level, 1994 (%)	32,4
Human Development Index, 1991	0,470
Personal Income per Capita, 1994 (R)	2 288
Adult Literacy Rate (1994) %	74,3
Pupil/teacher ratio, 1995	36,6
Life expectancy, 1994	62,9
Infant mortality rate, 1994	55,9
Hospital beds/1000 people, 1995	3,1
Labour force, 1995 ('000)	1 119
Unemployment rate, 1995 (%)	41,0
Nominal GGP, 1994 (Rm)	13 791,2
Real GGP, 1994 (Rm)	9 129,0
Real GGP growth, 1980-94 (%)	5,2
Real GGP per Capita, 1994 @	1 712
Real GGP per worker, 1994 (R)	17 836
Personal Income/GGP, 1994 (%)	81,0

Energy services are required by a variety of energy users, who can be grouped into the following three major energy consumption sectors:

- The domestic sector, i.e. households requiring energy for domestic needs such as cooking, lighting, water and space heating, refrigeration, recreation and media;
- The service sector, i.e. community facilities such as clinics, water supply, schools administration facilities, community centers, street lighting, service centers, churches, police stations, etc.;
- The economic sector, i.e. activities such as farming (including subsistence farming), trading, manufacturing, transport, etc.

Generally energy use in rural areas need to be seen in the context of rural poverty, neglect and underdevelopment, as these conditions have largely determined current energy use patterns. At present, domestic uses of energy account for most of the energy consumed in poor rural areas.

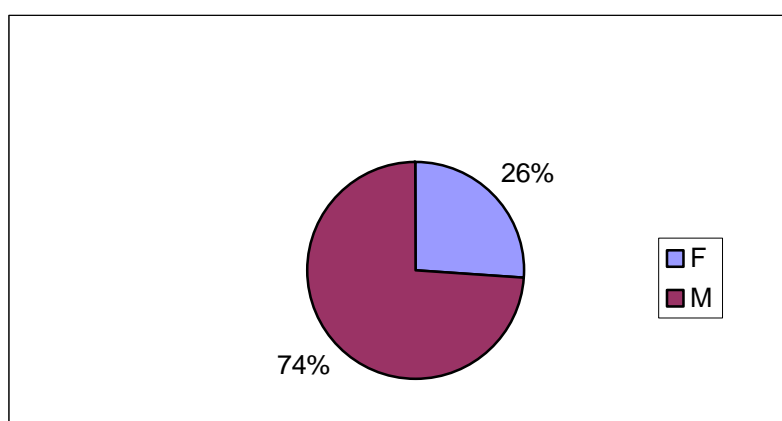
5. The Findings – an overview¹

5.1 Socio-economic information

The average family size in both areas is 6 people. In Ga Mogano and Ga Maraba the smallest families consists only of one person. In Ga Mogano the largest family consists of 11 people and in Ga Maraba the largest family consists of 15 people.

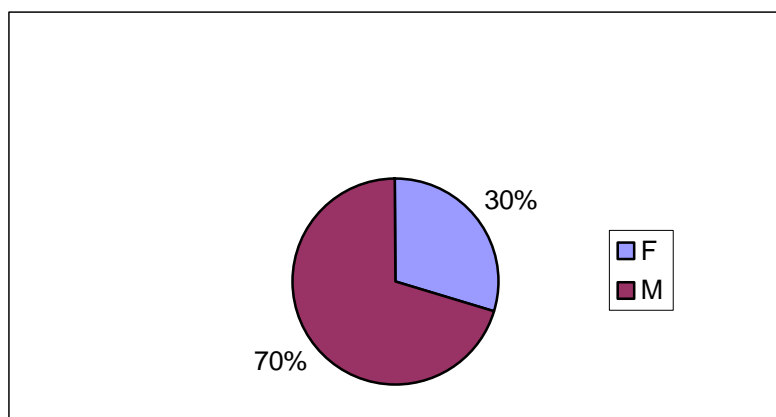
In both areas, in the majority of the households, men are considered to be the heads of the households. This would have implications in the implementation of specific programmes when gender, decision-making processes and power relationships regarding purchasing would need to be considered.

Figure 1: Gender: Head of the Household Ga Mogano



¹ Classification of households – Area 1 refers to Ga Mogano and Area 2 refers to Ga Maraba

Figure 2: Gender: Head of Household Ga Maraba

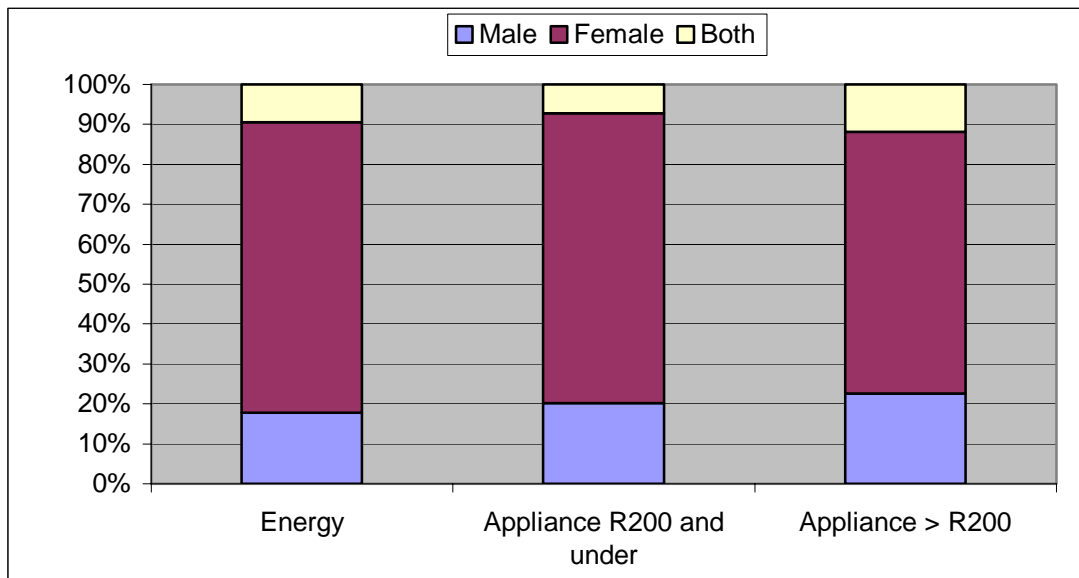


Both areas have a high prevalence of male heads of households. This could indicate more stable household incomes as male headed households are often considered to be better off than female headed households. For example, women are more likely than men to be poor – May et al (as quoted in Thom, 1997:5) found that 59% of women in rural areas are poor compared to 41% of men. The phenomenon of female-headed households also indicates that women are at greater risk since 75% of female-headed households are poor as compared to 64% of male-headed households. Although female-headed households tend to be poorer than male-headed households, May et al found that women in certain categories of male-headed households are among the poorest of the population. It can therefore, not be concluded that only female-headed households are poor, but evidence do seem to suggest that women tend to be worse off, whether in a female-headed or male-headed households. Lastly, May et al (as quoted in Thom, 1997:5) found that female-headed households have less access to services than male-headed households- they are therefore, not only poorer in terms of income but also in terms of access to services.

Decision making responsibility is an important aspect to consider when interventions requiring purchases such as improved stoves are being considered. This will indicate which groups should be targeted for specific activities such as demonstrations, information dissemination and credit facilities.

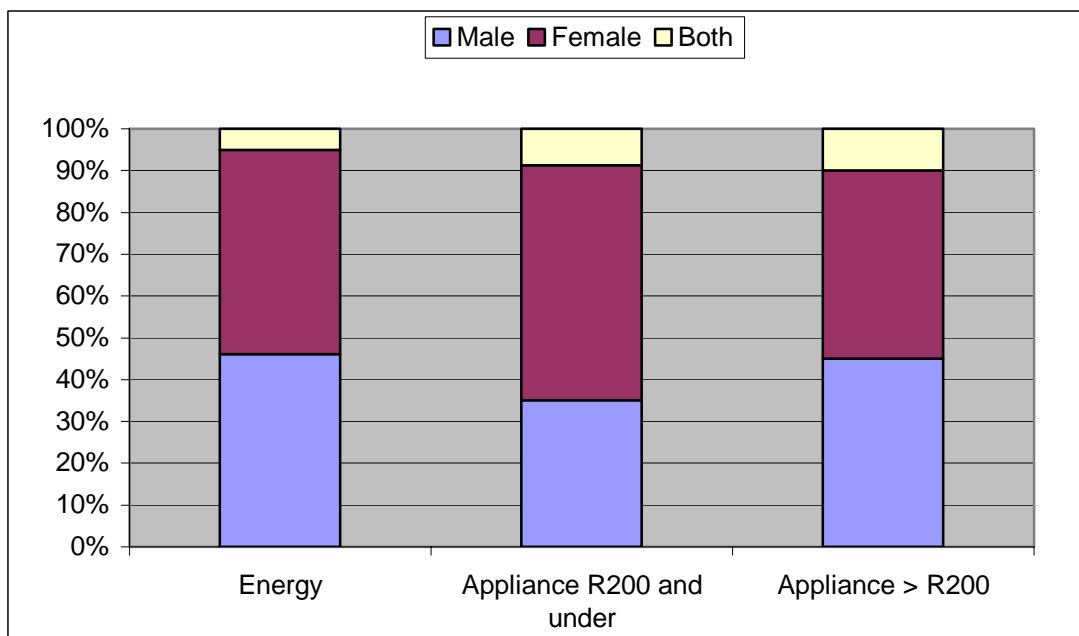
Decision making responsibility within households regarding fuels and appliances in Ga Mogano belongs mainly to women, sometimes to men and sometimes to both. A 5% variation occur when decisions about more expensive appliances have to be made and more men are then involved in the process. In Ga Mogano it can however, be concluded that women are the main decision-makers when it comes to the purchase of fuels and appliances:

Table 2: Decision making responsibility - Ga Mogano



In Ga Maraba, there is a higher prevalence of men involved in decision making about energy as well as appliances:

Table 3: Decision making responsibility: Ga Maraba



It can therefore, be concluded that women seem to have more decision making power in the area of Ga Mogano, even though there are less female heads of households in Ga Mogano (26%) as opposed to 30% female headed households in Ga Maraba.

When taking formal employment in to consideration, Ga Maraba seems less well off than Ga Mogano. In Ga Maraba only 44,3% of households have someone living in

the house, who is formally employed as opposed to 62% of Ga Mogano. It could therefore, be argued that in Ga Maraba where people are poorer and resources scarcer, joint decision making about the allocation of scarce resources is required. This is supported by the fact that no distinguishable difference could be observed between decisions over more expensive appliances in comparison to less expensive appliances, again signalling that it doesn't matter if an appliance is expensive or cheap, but because resources are limited, joint decision making is required. This is in contrast to Ga Mogano where a slight difference between expensive and less expensive appliances can be observed – possibly a case of where resources are not so scarce, joint decision is not required unless the appliance is expensive.

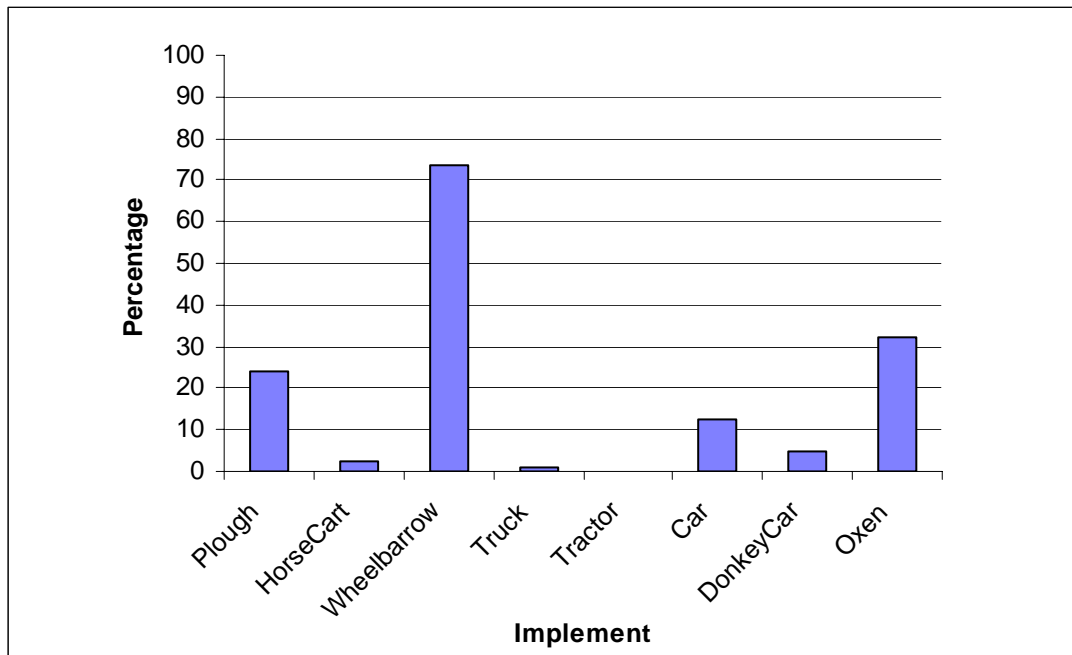
In Ga Mogano 62% of the households have someone living in the house who is formally employed. 15,2% live on a pension, 19,4% farm and sell produce, 2,8% have temporary jobs and 1,4% are self-employed. 35,6% of the households in this area receive outside contributions whether it is food, money or groceries.

In Ga Maraba only 44,3% of the households have someone living in the house, who is formally employed. 30,5% live on a pension, 11,1% farm and sell produce and one person is a part time priest. 27,3% of the households in this area receive outside contributions which include food, money, groceries and in one case clothing. Please note that total percentages will not add up to 100% since households have more than one source of income, i.e people who are formally employed also may receive outside contributions and farm and sell produce.

From the above it is clear that both areas can be considered fairly well off in terms of access to income sources, although Ga Maraba seems to be slightly less well off with more pensioners and less households with someone in employment. In general, both areas seem better off than rural areas in general where unemployment is high and reliance on pensions and remittances very high. The conclusion that Ga Mogano is “richer” or better off is based on the fact that more households have someone formally employed in Ga Mogano than in Ga Maraba (62% vs. 44%) respectively. Also more people farm and sell produce (19,4% vs 11,1%) and lastly, only 15,2% rely on pensions in Ga Mogano in contrast to 30,5% in Ga Maraba.

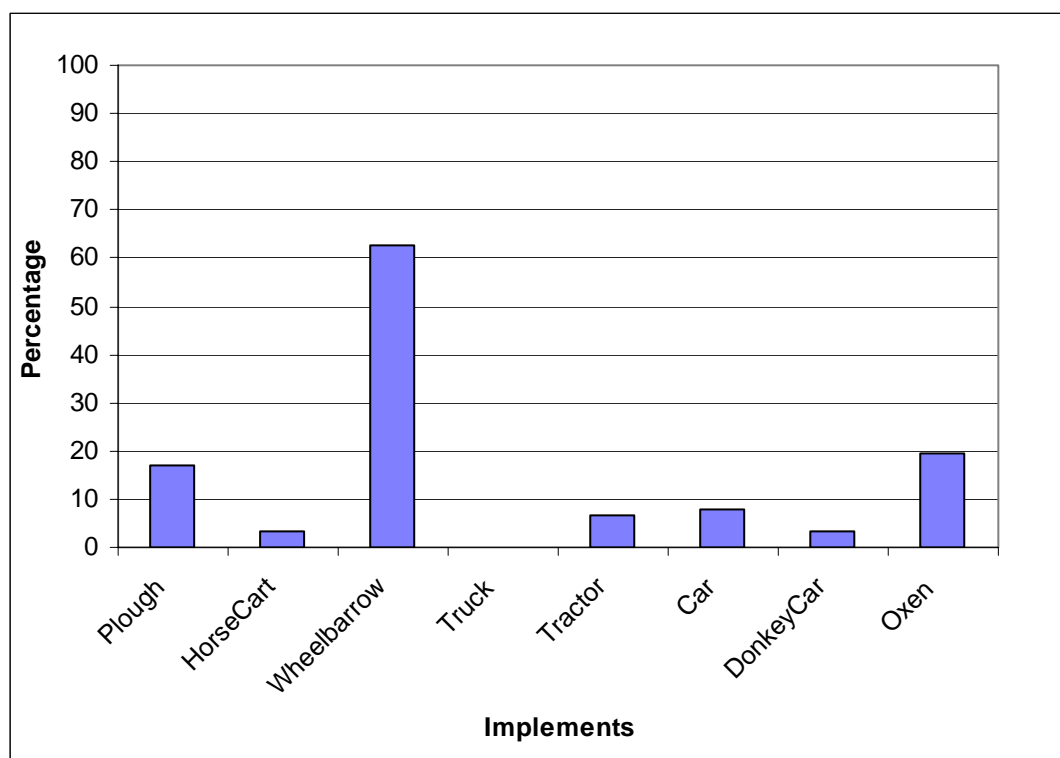
In another attempt to understand household income, the assets of households were investigated. The assets owned by a household were divided into 4 sections: implements, appliances, houses and farming.

Figure 3: Ga Mogano Implement Ownership



Again, the conclusion that the area can be considered fairly wealthy is supported by household ownership of cars and trucks (albeit low) and 32% of households being in possession of livestock and cattle (oxen).

Figure 4: Ga Maraba Implement Ownership



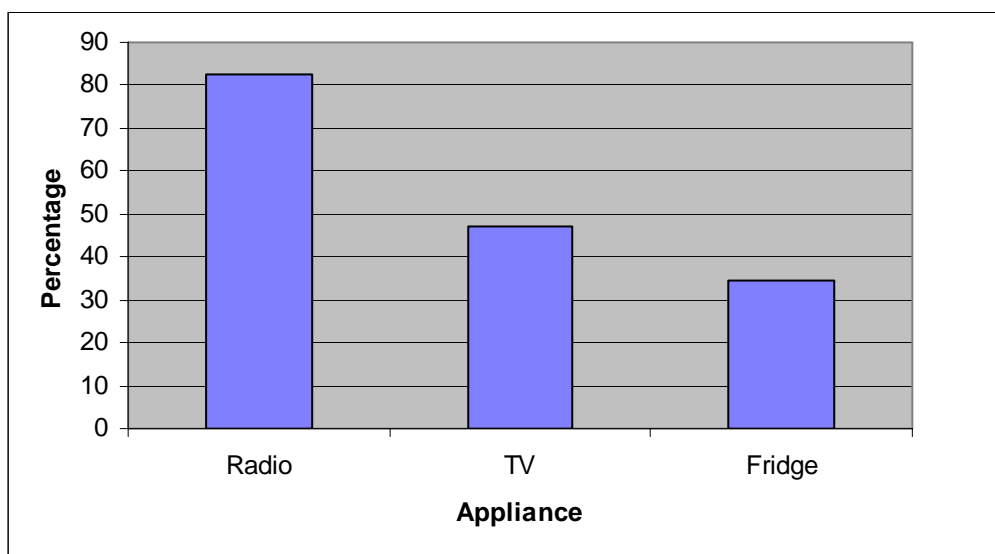
The earlier conclusion that Ga Maraba is less well off than Ga Mogano is supported by the implement ownership figures, in general lower than that of Ga Mogano.

The majority of houses in Ga Mogano is built of brick (53) while traditional houses built with a mixture of brick, zinc and mud can also be found. Of the 87 households interviewed, 53 were involved in farming activities: 49 practised subsistence farming while 4 households indicated that they are commercial farmers. In Ga Maraba, 42 houses are built of brick while 24 are a mixture between brick and zinc. More traditional mud houses are also found in Ga Maraba than in Ga Mogano. In Ga Maraba 74 households practice subsistence farming while 2 households are commercial farmers.

5.2 Appliance ownership

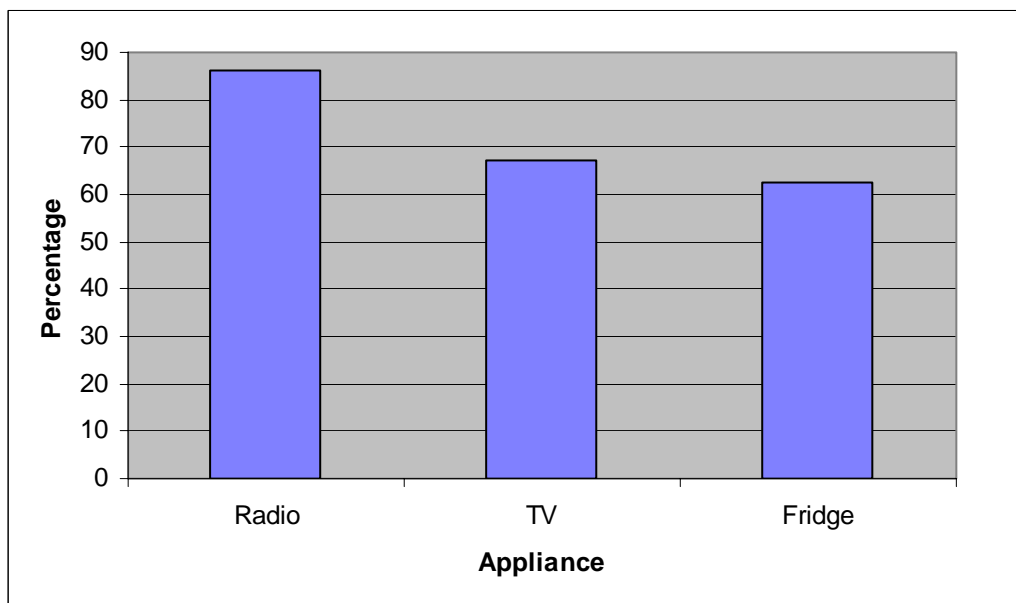
In Ga Mogano the majority of households own a radio, more than 45% own a television and approximately 34% own a refrigerator.

Table 4: Appliance ownership: Ga Mogano



In Ga Maraba, more than 67% of households own televisions and a very high percentage of more than 62% of households own refrigerators.

Table 5: Appliance ownership: Ga Maraba



With regard to appliance ownership, the high level of ownership of electrical appliances seems to indicate that the areas have been electrified for some time. It further indicates the relative wealth of households since appliances such as refrigerators are expensive and normally ownership in rural areas is not that high.

Interestingly, ownership of radio's, televisions as well as fridges is higher in Ga Maraba (identified as a poorer area) than in Ga Mogano. This seems to indicate that the area may not be as poor initially assumed.

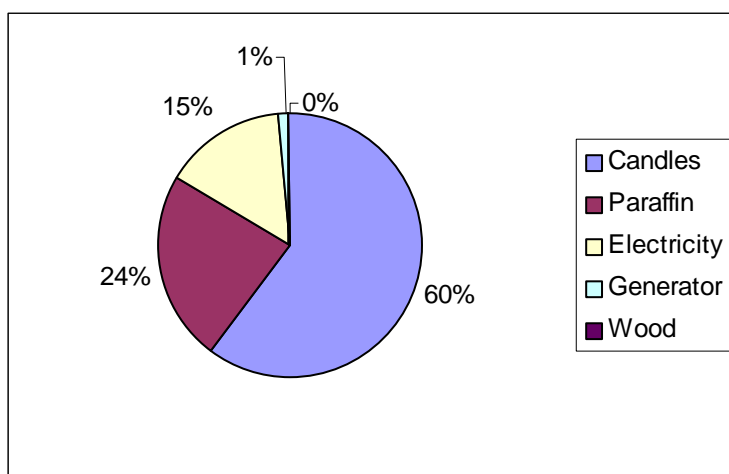
5.3 Energy Use

5.3.1 Daily fuels used per area

Lighting

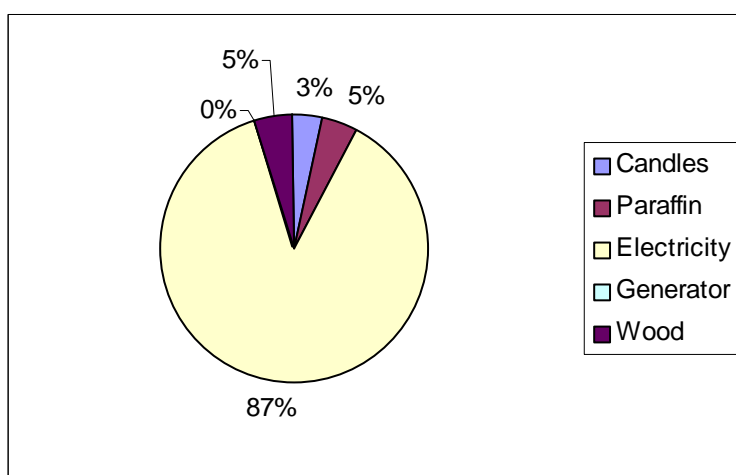
From the breakdown of energy sources for lighting in the two areas, it can be seen that significant differences exist. In Ga Maraba, the most important fuel for lighting is electricity, while in Ga Mogano it is candles. Once more, this refutes the conclusion that Ga Maraba is less well off than Ga Mogano.

Figure 5: Fuel use for lighting: Ga Mogano



No wood is reported being used for lighting in this area.

Figure 6: Fuel use lighting: Ga Maraba



No generators are reported as being used for lighting. Ga Maraba displays energy consumption characteristics of a richer area: a high level of electricity use for lighting and ownership of a generator, although the use of wood for lighting purposes is higher in Ga Mogano (24%) than in Ga Maraba (5%).

Cooking

The use of wood for cooking purposes in Ga Mogano is higher in both summer and winter than in Ga Maraba. Electricity use for cooking is high in Ga Maraba (46,6% in summer and 36,4% in winter respectively). It would seem that wood fuel interventions would be more appropriate in Ga Mogano due to the higher incidence of fuel wood use for cooking purposes.

Table 6: Energy sources used for cooking (Ga Mogano)

Ga Mogano	Wood	Paraffin	Electricity	Coal	Gas
Summer	69	14,9	11,5	2,3	2,3
Winter	71,3	9,2	6,9	9,2	2,3

In summer, 24,1% of the households use only wood as fuel for cooking and in winter 23% of the households use wood exclusively.

Table 7: Energy sources used for cooking (Ga Maraba)

Ga Maraba	Wood	Paraffin	Electricity	Coal	Gas
Summer	30,7	20,5	46,6	2,3	0
Winter	34,1	14,8	36,4	13,6	0

In summer 23% of the households use only wood and no other fuel source for cooking and in winter 20,5% of the households use wood exclusively.

Ga Mogano has a low level of LPG (liquefied petroleum gas) use, as opposed to no gas use in Ga Maraba. It is possible that electricity use has displaced LPG for cooking purposes in Ga Maraba. Both areas use coal for cooking purposes, and both areas display a higher level of coal use in winter, consistent with increased space heating requirements during the colder period. Ga Maraba displays a more varied pattern of fuels used for cooking purposes, consistent with a lower level of reliance on electricity for cooking purposes. As concluded earlier, Ga Mogano may be more appropriate for the dissemination of energy efficient woodstoves due the reliance on woodfuel for cooking purposes. However, energy efficient stoves could also be welcomed in Ga Maraba where monetary savings maybe more important than direct woodfuel savings.

Monthly fuel expenses

In Ga Mogano, 66,6% of households buy wood (whether they buy wood only or wood and other fuels) at an average cost of R175.00 per month. It is estimated that households spend approximately R400 per month on energy (paraffin, gas, electricity and wood).

Table 6: Monthly fuel expenses in Ga Mogano:

Fuel	% of households buying different fuels	Expenses per month
Paraffin	67,8	R34 (approximately)
Gas	11,5	R? (approximately)
Electricity	13,8	R160
Coal	4,6	R60
Wood	6,9	R175
Wood and other fuels	59,8	
Combination	11,5	

In Ga Maraba, 43% of households buy wood (whether they buy wood only or wood and other fuels) at an average cost of R168 per month. In total, households spend approximately R370 per month on energy.

Table 7: Monthly fuel expenses in Ga Maraba:

Fuel	% of households buying different fuels	Expenses per month
Paraffin	50	R40
Gas	4,5	?
Electricity	69,3	R95
Coal	9,1	R60
Wood	4,5	R168
Wood and other fuels	38,6	
Combination	39,8	

In Ga Mogano, more households buy wood than in Ga Maraba – 66,6% as opposed to 43%. This is consistent with a significant higher level of woodfuel use for cooking purposes in Ga Mogano. Households spend more on paraffin in Ga Maraba than in Ga Mogano, both areas spend about R60 per month on coal while Ga Mogano spends more on electricity than Ga Maraba. This is strange, since the level of electrical appliance ownership is significantly higher in Ga Maraba than in Ga Mogano and also because electricity is widely used for cooking purposes in Ga Maraba. One explanation could be that although a high level of electrical appliance ownership is found, it does not necessarily mean that all appliances are always used. From the abovementioned tables, it is also apparent that both areas spend similar amounts on wood, although woodfuel use is lower in Ga Maraba than in Ga Mogano.

5.3.2 Daily diets

Food cooked for the morning meal is the following:

- Ga Mogano: Porridge, Tea, meat, morogo, vegetables or porridge and relish (in order of importance), others also eaten but seldom: bread, cabbage, potatoes and eggs
- Ga Maraba: Tea, Porridge. Other dishes are also eaten but seldom: meat, rice, samp and cereal.

Food cooked for the afternoon meal:

- Ga Mogano: Porridge, vegetables, meat. Others dishes are also eaten but seldom: tea, morrogo, soup, porridge and relish
- Ga Maraba: porridge, tea, eggs. Others dishes are also eaten but seldom: meat, vegetables, cabbage and morogo.

Food cooked for the evening meal:

- Ga Mogano: Porridge, meat, porridge and relish, vegetables. Others dishes are also eaten but seldom: Morogo, tea, cabbage
- Ga Maraba: Porridge, meat, vegetables, rice, morogo. Others dishes also eaten but seldom: tea, bread, fish, soup

56,6% of households in Ga Mogano eat their main meal in the evening, 19,3% in the morning and 27,7% in the afternoon. 85% of households in Ga Maraba have their main meal in the evening, 8% in the morning and 15% in the afternoon.

Cooking Techniques

The percentages were calculated by dividing by 87 and 88 subtracted by the number of no responses in Ga Mogano and Ga Maraba respectively. It does not take into account that some do not eat a specific meal or only made tea and did not mention it.

Cooking techniques used for the morning meal:

- Ga Mogano: The majority boil their food (79%) and some steam (4%) or fry (4%) their food
- Ga Maraba: The majority boil their food (52%) and some fry (4%) their food.

Cooking techniques used for the afternoon meal:

- Ga Mogano: The majority boil their food (38%) and very little steam (6,5%), fry (5,2%), grill (3%) or bake.
- Ga Maraba: The majority boil their food (28%) and 12% fry their food, some also steam and grill their food.

Cooking techniques used for the evening meal:

- Ga Mogano: This is the main meal and 66% of food is boiled, 14% steamed, 10% fried and some stew or bake their food for this meal.

- Ga Maraba: This is the main meal and 87% of food is boiled, 35% fried, and very little steam, grill, bake or stew their food.

Relationship between fuel used, food cooked and the cooking technique used

Morning Meal:

- Ga Mogano: **Fuelwood** is being used 61,5% of the time to prepare porridge (80%), which is being boiled (90% of the time) as opposed to steaming, followed by vegetables (42,5%), which is always boiled. The next most often used fuel is **paraffin** (29,2%) which is being used for porridge (63,2% of the time) and which is always boiled followed by tea (52,6%), which is also always boiled.
- Ga Maraba: **Electricity** is being used 36% of the time for tea (61,1%), which is always boiled, followed by porridge (27,8%), which is also always boiled. The next most often used fuel is both **fuelwood or paraffin** at 30% of the time. Fuelwood is used for tea (66,7%), which is always boiled or porridge (26,6%), which is also always boiled. Paraffin is used for porridge (60%), which is always boiled or tea (40%) which is also always boiled.

Afternoon Meal:

- Ga Mogano: **Fuelwood** is being used 66,6% of the time for porridge (90,9%) which is always boiled, followed by vegetables (50%) which is also always boiled). The next mostly used fuel is **paraffin** (15,2%), which is being used for tea (60%), which is always boiled or soup (40%), which is always boiled.
- Ga Maraba: **Fuelwood and electricity** are both being used 33,3% of the time. Fuelwood and electricity are used for porridge (54,5%), which is always boiled when fuelwood is used and 83,3% boiled as opposed to steaming in the case of electricity. The next most often used fuel is **paraffin** (24,2%), which is being used for vegetables (87,5%) which are boiled (71,4%) as opposed to steamed or porridge (50%) which is always boiled.

Evening Meal:

- Ga Mogano: **Fuelwood** is being used 60,3% of the time for porridge (88,6%), which is boiled (90,3%) opposed to steamed, followed by vegetables (34,3%) which is boiled (83,3%) opposed to stewed or fried. Vegetables are closely followed by meat (31,4%), which is boiled (81,8%) opposed to stewed. The next most often used fuel is **paraffin** (19%), which is being used for porridge (90,9%) which is always boiled or vegetables (54,5%) which is also always boiled.
- Ga Maraba: **Electricity** is used 41,9% of the time for porridge (80,6%), which is being always boiled or vegetables (38,9%), which is being boiled (57,1%) opposed to fried. The next mostly used fuel is **fuelwood** (38,4%), which is used for porridge (97%), which is mostly boiled or vegetables or meat, both at 27,3%. Vegetables are mostly boiled, some fried and meat is 66,7% fried opposed to stewed or boiled.

It can therefore, be concluded that the overwhelming method of cooking in use is boiling and that the method of cooking will be suitable for energy efficient wood stoves. It can further be concluded that enough cooking opportunities exist to justify the introduction of efficient stoves, i.e. households cook often (at least twice daily) as opposed to areas where cooking may only take place once a day due to food scarcities, energy shortages or labour shortages (someone to actually do the cooking). Lastly, it is also clear that the type of food prepared (porridge, vegetables, meat) would be suited to prepare on an energy efficient wood stove.

5.3.3 Problems associated with fuel use

The responses in Table 8 represent the opinions of community members regarding the advantages and disadvantages of various fuels. A summary of advantages and disadvantages associated with the use of alternative fuels when fuel wood is scarce is provided below:

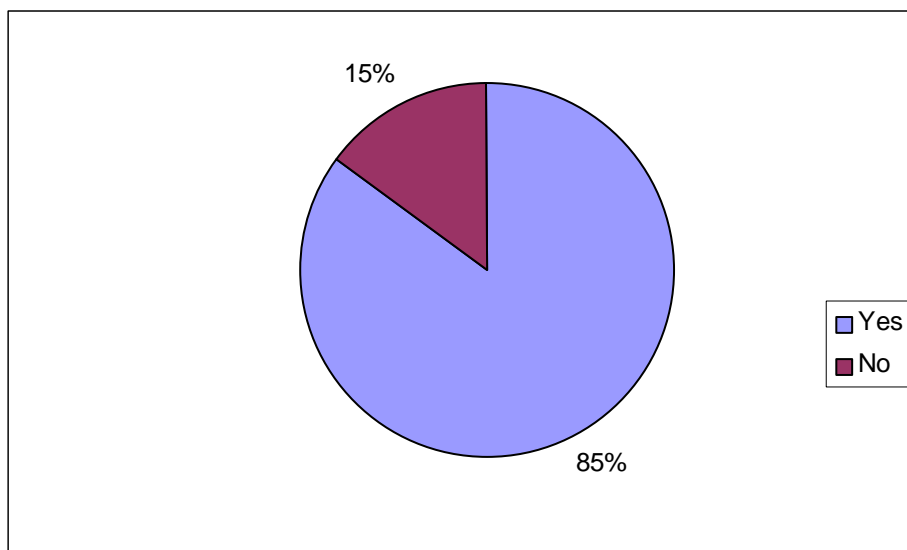
Table 8: Advantages and disadvantages of alternative fuels for both areas

Fuel	Advantage	Disadvantage
Electricity	No smoke	Expensive
	Easy to cook with	Power failure
	Quick	Dangerous to children
	Cheaper	
	Convenient	
	Efficient	
	Readily available	
	Saves time	
	Healthy	
Paraffin	None	None
	Saves time	Expensive
	Easy to obtain	Smelling
	Less expensive	Slow
	Convenient	Smoke
	Can use if it rains	Not safe for children
		Flamable
		Itch eyes
		Cause headache
Gas	Fast	Difficult to obtain
	Convenient	Expensive
	Smokeless	CO ₂ is dangerous
	Saves time	
	Hot	
Biomass (mealy core/cowdung)	Easy to obtain	Burns quickly
	Free	Only available after harvest
	Hot	Smoke
	Efficient	Smelling
		Not enough
		Short lifespan
Coal	Warm house	Smoke
	Less expensive	Expensive
	Burns slowly	Difficult to obtain
	Efficient	Messy
	Multipurpose: iron, bake, cook, warm house	CO ₂ is dangerous

From Table 8 it can be seen that electricity is regarded as having more advantages as disadvantages. It is regarded as clean (no smoke), quick to use, convenient, efficient and readily available. Paraffin is regarded as less expensive, easier to obtain and convenient but with the disadvantages of being smelly, causing itchy eyes, headaches, and not being safe for children. The low level of gas use could be explained by the responses that it is difficult to obtain and expensive. Coal seems to be popular because it is a multi-purpose fuel because you can iron, bake, cook and warm the house with it. It is however, also difficult to obtain, messy and the CO₂ emissions can be dangerous.

It is interesting to observe that communities seem fairly well informed about the associated dangers and draw backs of the various fuels in use. This can form an excellent base from which to raise further awareness regarding health and safety issues associated with fuel use as well information dissemination regarding the use of fuel efficient stoves.

Figure 7: % Households indicating that fuel wood is scarce: Ga Mogano



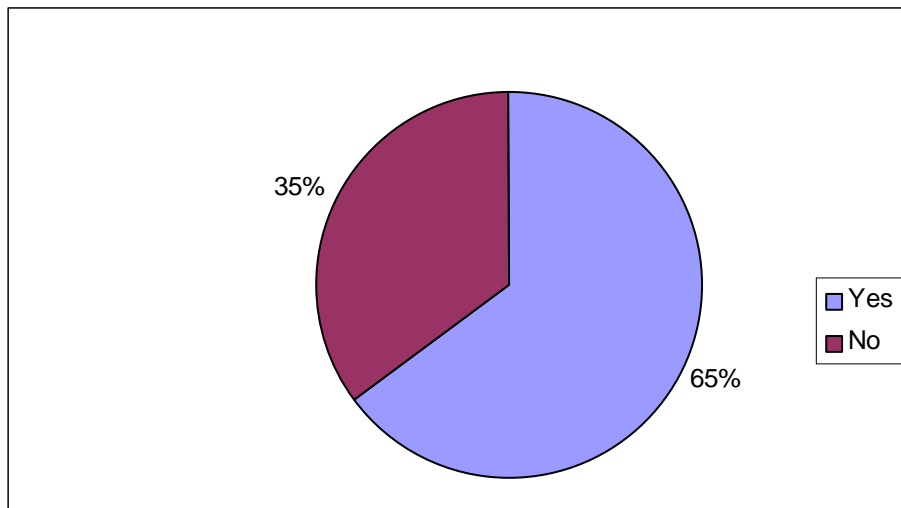
In Ga Mogano, of the 85% of the households who feel that fuel wood is scarce 34% think that fuel wood will also be scarce in the future, while only 8% of those saying that fuel wood is not scarce currently think that it will be scarce in the future. In Ga Mogano, people use paraffin and buy wood in order to cope with the fuel wood scarcity, although the use of gas and biomass i.e. cow dung are other alternatives:

Table 9: Strategies used by majority (85%) of households in Ga Mogano to cope with fuel wood scarcity

Strategy	Number of responses
Do nothing	3 + 8 no responses given
Use electricity	5
Alternative fuels	1
Buy more wood	9
Plant trees	2
Use gas	5
Use coal	4
Use paraffin	30
Use biomass (mealy cores, cow dung)	6
Collect wood far	3
Other (use wood when necessary, new technologies, cook less, use green wood)	4

NB. Some of the respondents gave more than one strategy to cope with fuelwood scarcity.

Figure 8: % Households indicating fuel wood is scarce: Ga Maraba



In Ga Maraba, 23% of the 65% of the households who feel that fuelwood is scarce currently think that it will also be scarce in the future, while 21% of those saying that fuel wood is not scarce currently think that it will be scarce in the future.

Table 10: Strategies used by majority (65%) of households in Ga Maraba to cope with fuel wood scarcity

Strategy	Number of responses
Do nothing	11 + 6 no strategies given
Use electricity	13
Alternative fuels	4
Buy more wood	3
Plant trees	1
Use gas	1
Use coal	3
Use paraffin	12
Use biomass (mealy cores, cow dung)	3
Collect wood far	1
Other (use wood when necessary, new technologies, cook less, use green wood)	7

NB. Some of the respondents gave more than one strategy to cope with fuel wood scarcity.

From the responses in Table 9 and Table 10, it is clear that the most important strategy for people to cope with fuel wood shortages is to make use of different fuels, i.e fuel switching. Multiple fuel use, or the practice that utilises a range of fuels and appliances at the same time or interchangeably because of their availability and accessibility, is the norm in most developing households. The use of multiple fuels or

“fuel switching” is mainly influenced by survival concerns. Multiple fuel use is complicated by the fact that appliances and fuels operate in systems.

Poor households have to spend limited income over a range of necessities of which energy is just one, indicating specific household expenditure priorities. Irregular and unreliable sources of income necessitate energy use strategies that can cope with varying income patterns - when income allows more money can be spent on paraffin, for example – when income is exhausted poor households revert back to wood. All energy sources are therefore considered in terms of their utility and affordability.

5.3.4 Awareness of improved stoves

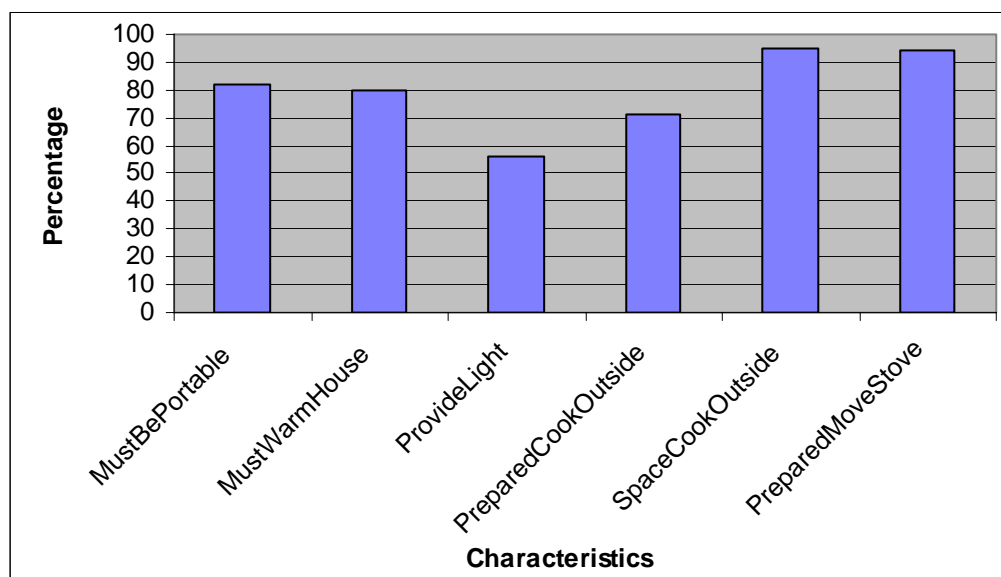
In Ga Mogano, a high level of awareness about the solar cookers were found as opposed to a lower level of awareness regarding other improved stoves. The reason for this may be that a solar cooker demonstration was conducted just before the field work was completed and solar cookers may therefore, still have been in the forefront of people’s minds:

Table 11: Awareness of different improved stoves (Ga Mogano)

Type of stove	% awareness
Solar cookers	43
Probec stoves	4
Turbo	4
Mali	4
Gel	2
Brazier	2

In response to the question what an ideal improved stove should look like, 90% of households in Ga Mogano prefer a stove that is made of metal, 1,2% prefer clay and 1,2% prefer cast iron. On average, households preferred that 3 pots can be used on the stove. Other important characteristics that the households indicated the stoves should have, were the following: be able to bake, be durable and strong, have an alarm and handles. On average, households will pay R486 for an improved stove with some who want it for free and another who would pay as much as R7000. They expect to buy the stoves from Probec, solar cooker agents, local shops, supermarket or furniture stores.

Figure 9: Ideal improved stove: Ga Mogano



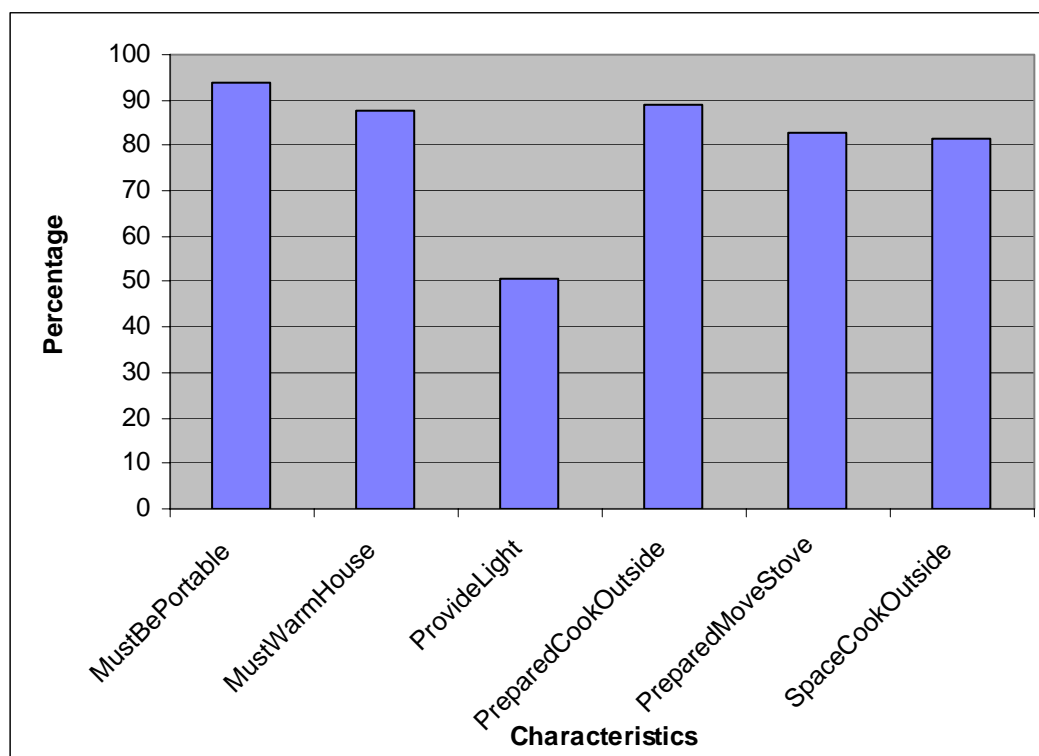
In Ga Maraba, awareness about improved stoves/solar cookers was as follows:

Table 12: Awareness about different improved stoves (Ga Maraba)

Type of stove	% awareness
Solar cookers	62,5%
Probec stoves	0%
Turbo	12,5%
Mali	37,5%
Gel	0%
Brazier	0%
Woodstove	16,6%

In Ga Maraba, 74% of households prefer metal stoves, 4,9% prefer clay and 1,2% prefer cast iron stoves. On average households prefer that the stove must be able to use 4 pots. Other important characteristics that the households think the stoves should have is, be able to bake, durable, have handles and it should be light. On average the households will pay R282 for an improved stoves with some who want it for free and one person will pay up to R1200 for an improved stove or solar cooker. They expect to buy the stoves from local shops, Pietersburg, a factory, supermarkets, a dealer, in Johannesburg, the pension fund points or anywhere.

Figure 10: Ideal improved stove: Ga Maraba



With regard to risks associated with improved stoves, the following summary can be provided:

Table 13: Risks associated with improved stoves (Ga Mogano):

Stove risk responses	% of responses
No response	9,2
No risk	17,2
Tampering	43,7
Theft	47,1
Other	6,9

Table 14: Risks associated with improved stoves (Ga Maraba)

Stove risk responses	% of responses
No response	10,2%
No risk	34,1
Tampering	20,5
Theft	45,5
Other	3,4

From Table 13 and Table 14, the potential of theft emerges as the biggest potential perceived risk associated with improved stoves. The risk could be addressed during demonstrations and awareness raising programmes by informing people on safe storage tips as well as highlighting the point that often people are at home when cooking takes place, and therefore the risk can be minimised.

Problems associated with the use of other stoves were reported as follows:

Table 15: Problems associated with other stoves (Ga Mogano):

Stove	Problems
Electricity	Too expensive, power failure, consume more energy
Paraffin	Smell, expensive, smoke, flames
Gas	Expensive
Coal	Scarce, colouring of chimneys and bricks, consumes too much wood
Open fire	Smoke
Flame stove	Dangerous, can burn

Table 16: Problems associated with other stoves (Ga Mogano)

Stove	Problems
Electricity	Maintenance expensive, electricity expensive, hotplate expand and not durable, power failure, cracks,
Paraffin	Expensive, smell, smoke itch eyes, old stove expand, flames
Gas	CO ₂ emissions, gas leaks, dangerous
Open fire	Smoke itch eyes, wood sometimes wet, wood far, wood scarce, burn children, smoke, damage eyes, smell, messy, ash
Coal	Expensive, smoke, rust

Tables 15 and 16 above, provide valuable information that can be used in the information dissemination campaign. It is clear that smoke and related health problems are major issues. The health benefits of the improved stoves should therefore be highlighted.

5.3.5 Health issues

In Ga Mogano, 41,4% of the households did not respond to the health related questions. Of those who did respond, 74,5% said that smoke in the house is a problem. This is mainly because smoke makes the eyes itch, red and painful and further causes headaches and is inhaled (colds and flu's are also reported). 45% of the responses indicated that smoke causes illness under which eye problems and flu are the most reported (others include headache, coughing and bronchitis). 35% of the responses indicated that smoke is a problem and causes illness.

In Ga Maraba, 34,1% of the households did not respond to the health related questions. Of those who responded 95% said that smoke in the house is a problem. The reasons given are mainly because smoke makes the eyes itch, red or painful, the smoke smells and causes coughing (other reasons reported are causes headaches and flu). 78% of the responses indicated that smoke causes illness under which headaches and eye problems are the most reported (others include coughing, blindness and flu). 72% of the responses indicated that smoke is a problem and it causes illness.

Again, the high level of problems associated with smoke could be used to the benefit of improved stoves during the information dissemination stage. It also illustrates that households are aware of the negative side effects of dirty and unhealthy fuels and that they perceive it as a problem. Improved cook stoves should therefore, not only be offered as an answer to fuel wood shortages, but also as an answer to health related problems associated with the use of other fuels.

6. Conclusions and Recommendations

Conclusions and recommendations can be formulated regarding the following issues:

Socio-economic issues

- Both areas seem to be in somewhat better off than rural areas in general in South Africa;
- Both areas have a high prevalence of male headed households;
- Decision making responsibility is fairly mixed between men and women, indicating a dissemination approach taking strong cognisance of gender issues;
- Sources of income in both areas are mixed and seem to be more stable than in rural areas in general – a smaller dependence on pensions for example is noted in both areas;
- High levels of formal employment were found (62% and 44,3% respectively);
- Both areas are supported by outside contributions ((35,6% and 27,3% respectively);
- Households in both areas reported ownership of cars and trucks as well as livestock and cattle, supporting the conclusion that both areas are fairly better off than rural areas in general in South Africa.

From the abovementioned conclusions, it can be recommended that improved stoves should be introduced in both areas, since both areas seem to be in a position to absorb new technology or interventions. This is opposed to some rural areas where households were found to be so poor that they could not absorb additional appliances or interventions, even when the interventions were aimed at improving their situation. This lead to the conclusion that households need to be at a threshold level of survival, those below the threshold level will be unable to respond to interventions and it could even impoverish them further and place a drain on their already scarce resources. For example, when solar cookers are introduced into a household, the impact would be limited when the household is so poor that they can not afford to buy food to cook.

It can further be recommended that both males and females should be targeted during a demonstration or awareness-raising programme since there is a high level of males present in both areas as well as a high percentage of male-headed households. Further, it was clear that women and men take decisions about fuels and appliances, especially expensive appliances. Both should therefore, be targeted to receive information regarding improved stoves.

Appliance ownership

- Very high levels of ownership of expensive electrical appliances were found, possibly indicating adequate disposable income to purchase appliances as well as the desire to own appliances. This is a positive indicator for the programme, since it could indicate that new appliances such as improved stoves could be well accepted and integrated into the household;
- High levels of ownership of other cooking appliances were also found, such as coal stoves, paraffin stoves and gas stoves;
- The high incidence of radio ownership should be considered when designing an awareness programme;
- A high level of awareness was found regarding the negative effects of stoves using fuels such as paraffin, wood and coal, especially health problems such as smoke, itchy eyes, colds and flu;
- A very high level of awareness regarding solar cookers were found;
- Households displayed their willingness to purchase an improved stove and they were willing to pay R486 and R282 on average per area.

From the above it can be concluded that households are willing to purchase and use appliances and that improved stoves would be purchased. It is recommended that improved stoves be marketed as an additional cooking option, i.e. extending the range of cooking appliances already in use by the household, and therefore expanding choice. It is further recommended that the high level of awareness regarding solar cookers should be expanded to also include other improved stoves. The best way to achieve this would be through extensive demonstrations of all improved stove types.

Fuel use

- Significant differences regarding the use of fuels for lighting purposes were recorded – one area uses mostly candles while the other area uses mostly electricity;
- Wood is used in both areas but it is used more extensively in Ga Mogano;
- Wood is both collected and bought;
- Both areas experienced fuel wood as being scarce;
- Energy expenditure amounts to an average of R385 per month per area;
- Ga Maraba spends more on electricity per month than Ga Mogano, although Ga Mogano used less electricity for cooking and lighting purposes and owned fewer electrical appliances. No adequate explanation could be found for this.
- Boiling is the most often used method of cooking;
- Electricity is regarded as a convenient fuel to use;
- Other fuels are associated with health and safety risks;

- Households cope with fuel wood shortages by switching to other more available and affordable fuels such as paraffin;

It is recommended that improved stoves be disseminated with the message that it can also address health issues and not only fuel wood scarcity. The high level of awareness of health problems associated with fuel use can form an excellent basis for further work and the dissemination of improved wood stoves.

Conclusions therefore, seem to indicate that both study areas are generally wealthy with a high level of appliance ownership. However, wood fuel use, especially for cooking purposes is still high and wood fuel is considered to be scarce in both areas. Households experience additional problems associated with the use of wood fuel as an energy source as well as problems with the use of conventional energy sources. The combination of wood fuel scarcity, continued high levels of wood fuel use, awareness regarding problems associated with wood fuel use and an indication of the potential of disposable income to be spent on appliances seems to indicate positive conditions for the implementation of an improved stove programme.

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ANNEX 1

Questionnaire

HOUSEHOLD ENERGY SURVEY

PIETERSBURG REGION

Programme for Biomass Energy Conservation (Probec)

Questionnaire nr.:

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Area:

Ga- Mogano		Ga-Maraba	
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Date:

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Interviewer Instructions:

Good day sir/madam. My name is (state your name), I represent Probec. We would like to assist you in determining what the fuel use is of households in the Pietersburg region to improve the use of fuel. This information will be treated with the strictest confidence and used for research purposes only. May I ask you a few questions?

1. General information:

Name of interviewer				
Name of respondent				
Address of respondent				
Gender of respondent	Male		Female	
Position in household (grandparent, parent, child)				

1.1 Is there anyone living in your house who is formally employed? Yes () No ()

1.2 If no, what other source of income do you have (farming, selling produce, etc.)?

2. Household characteristics

2.1 Would you tell us about the size and membership of your family living in your house?

	Member	Number
Adults	Men	
	Women	
Children (under 18)	Boys	
	Girls	
	Total	

2.2 Is there anybody else not living in the house currently but who also contributes to the house (contribute money, food, etc.) Yes () No ()

2.2.1 Who is the person(s) (gender and relationship to the respondent)?

2.2.2 What does the person(s) contribute (food, soap, money)?

2.3 Who is the head of the household? (name, gender)

2.4 Which of the following does the respondent have? (interviewer to see for themselves)

Plough	
Horse Cart	
Wheel barrow	
Truck	
Tractor	
Car	

Donkey/Horse car	
Oxen	
Radio	
TV	
Fridge	
Brick house (type) cement , mud, face brick	
Zinc house	
Traditional house	
Commercial farming	
Subsistence farming	

3. Energy consumed by the household

3.1 What type of fuel do you use the most for cooking, lighting, space heating/cooling and water heating?

What is the fuel or energy source used for	Type of fuel/ energy source used			
	Summer		Winter	
	Most used	Other fuels	Most used	Other fuels
Cooking				
Lighting				
Space heating				
Space cooling				
Water heating				

3.2 What else do you use energy for (traditional feasts, appliances, entertainment)?

3.3 What cleaning or other appliances (TV, fridge, radio) do you have which uses fuel/energy? (wood, gas, paraffin, electricity, coal)

3.3.1 Appliance	1	2	3	4	5	6	7
3.3.2 How much did the appliance cost?							
3.3.3 Where did you buy the appliance?(tpe store							
3.3.4 How did you pay for the appliance?							
3.3.5 Type of fuel/energy used by appliance							
3.3.6 Amount of fuel/energy (kW, bundle of wood, litres/bottle of paraffin, etc.) used per week							

3.3.7 How many times a day, week or month do you use the appliance?							
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4. Energy supply

4.1 How much fuel do you buy (gas, paraffin or electricity), for how long does it last?

4.2 Is wood collected for any other use than fuelwood? Yes () No (), If yes,

4.3 For what other purposes (other than cooking, space-heating/cooling, lighting, water heating) is wood collected?

4.4 How much of the wood collected is used for fuelwood?

Very little () Half of it () Most of the wood ()

4.5 What would best describe the appearance of fuelwood collected (tick off)

	Summer	Winter
Logs (more than 30cm diameter)		
Twigs (shorter than 40 cm)		
Seed pods		
Roots		
Bark of trees		
Tree stumps (part of tree left after has been chopped)		
Green branches of live trees		
Dead branches of live trees		
Other		

4.6 How often does someone collect fuelwood for your house in summer and in winter and in what quantities?

Summer _____

Winter _____

4.7 Who collects the wood? () Adult () Child

5.5

How much did you pay for the stove(s)?

Stove	Payment method

5.6 What problems have you experienced with your stove(s)?

Stove/Open fire	Problems

5.7 Are you satisfied with your most used stove/open fire? Yes () No ()

Why? _____

5.8 When do you cook your main meal?

Morning ()

Afternoon ()

Evening ()

5.9 How many times do you cook per day? _____

5.10 How many times do you cook per week? _____

5.11	Time of cooking		
	Morning	Afternoon	Evening
Type of stove/ open fire			
How many pots used at time of cooking			

What sizes are the pots (litres, no.)			
Type of food usually cooked			
Type of fuel used			
What technique is used (boiling, frying, baking, grilling)?			
How long does the cooking take (approximate)?			

5.12 What type of pots do you use for the stove(s) (material)?

Stove	Type of pots

6 Coping with fuelwood scarcity

6.1 Do you find that fuelwood is scarce? Yes () No (), If no continue with 6.3

6.2 If yes, what do you do (strategies) to cope with the fuelwood scarcity?

6.3 Do you plant trees for fuelwood?

() Yes () No

What type of trees? _____

6.4 Do you plant trees for any other purposes (shading, etc)?

() Yes () No

What type of trees? _____

6.5 What other fuels do you use to cope with the scarcity?

6.6 What are the advantages and disadvantages of the alternative fuels?

Alternative fuel	Advantages	Disadvantages

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6.7 If no, do you think fuelwood might become scarce in the future? Yes () No ()

(Do not answer 6.7 and 6.8 if the respondent replied yes at 6.1)

6.8 What would you do if fuelwood become scarce in future?

6.9 Do you know of any specific cooking techniques (ways) that you could apply to save fuelwood? () Yes () No

If yes what techniques?

7 Improved stoves

7.1 Who makes decisions about buying fuel/energy sources?

7.2 Who makes the decision to buy new cooking appliances (what is the person's position in the household) when R200 or under? _____
when above R200 _____

7.3 If it is possible to have a stove that can save on fuelwood, what must it look like and what must it be able to do?

7.3.1 How many pots must it be able to use? _____

7.3.2 What material should it be made of (clay, metal,)? _____

7.3.3 Must you be able to carry it around? Yes () No ()

7.3.4 Must it warm your house? Yes () No ()

7.3.5 Must it be able to provide light? Yes () No ()

7.3.6 Would you be prepared to cook outside? Yes () No ()

7.3.7 What would the risk be to leave the cooker outside during the day?

Tampering () Theft () Other () No risk ()

7.3.8 What other characteristics should an improved stove have?

7.4 Are you aware of any improved stoves or solar cookers in your village or district,
if so which ones? () Yes () No

7.5 How much are you prepared to pay for an improved cook stove?

7.6 Where do you expect to buy an improved stove?

7.7 Would there be enough space to cook outside? Yes () No ()

7.8 Would you be prepared to move the cooker sometimes during the cooking
process? Yes () No ()

8 Energy and Health

8.1 What are the common diseases or ailments attacking people in your village or
district?

8.2 Is smoke in the kitchen a problem? Yes () No ()

If yes, or why?

8.3 Do people become ill because of smoke in the kitchen? () Yes () No

Describe their symptoms.

8.4 Do you attempt to reduce smoke? () Yes No

If yes, how?

8.5 Have the people in your house had any illnesses in the last six months?

() Yes () No, If yes describe the symptoms

8.6 Did you have to use more energy to care for ill people at home? (any special meals, cook more often, put on more lights, more boiling of water)
