REPORT NO. 94

ENERGY CONSUMPTION PATTERNS

IN UNDERDEVELOPED AREAS

IN SOUTH AFRICA

ANTON A EBERHARD

Energy Research Institute

University of Cape Town

Private Bag

Rondebosch 7700

South Africa

November 1986

ISBN 0 7992 1064 1

ACKNOWLEDGEMENTS

Many contributed to the information presented in this volume and acknowledgement is due to the following, who assisted in introductions to communities and in the data collection itself: Father Guido, Franco Bartolini, Beauty Ntshakaza, Sue Baldwin, "Solly" Solinjani, Mavis Nghonyana, Sister Bernadette, Gideon Steyn, Beatrice Futwa, Khetiwe Mboweni, Bart Cox, Jake Archer, Mark Gandar and Norman Bromberger.

Thanks are due to the cooperation and patience of the communities in the study areas.

TABLE OF CONTENTS

Page No

1. INTRODUCTION.....4
1.1 BACKGROUND.....4
1.2 METHODOLOGY.....6
1.2.1 The selection of study areas.....7
1.2.2 Questionnaire / interviews.....9
1.2.3 Fuelwood measurements.....11
1.2.4 Notes and Observations.....12
1.2.5 Problems with surveys.....12
1.3 THE STUDY AREAS.....14
2. ENERGY USE PATTERNS IN RURAL AREAS.....28
2.1 DOMESTIC FUEL CONSUMPTION.....28
2.1.1 Fuelwood.....29
2.1.1.1 Consequences of fuelwood scarcities 33
Social Costs.....33
Economic costs.....35
Health costs.....38
Environmental degradation.....38
2.1.2 Agricultural Residues.....45
Dung usage.....45
Crop residues.....50
2.1.3 Commercial fossil fuels.....52
2.1.4 Fuel consumption summary.....53
2.2 FUEL EXPENDITURE.....55
2.3 FUEL PREFERENCES.....56
2.4 ENERGY USE PATTERNS.....58
2.4.1 Cooking practices.....58
2.4.2 Water heating.....63
2.4.3 Home heating.....64
2.4.4 Lighting practices.....67
2.4.5 Other domestic energy uses.....68
2.5 WATER COLLECTION.....69
2.6 ENERGY IN AGRICULTURE.....72
2.6.1 Draft power.....73
2.6.2 Grain grinding.....75
2.7 PERCEPTIONS OF POSSIBLE SOLUTIONS.....75
2.7.1 Afforestation.....76
2.7.2 Fuel efficient woodburning stoves.....78
2.7.3 Ranking of energy and other needs.. 80
3. PERI-URBAN ENERGY CONSUMPTION PATTERNS.....85
3.1 DOMESTIC FUEL CONSUMPTION.....85
3.1.1 Fuelwood.....86
3.1.2 The use of wastes as fuel.....88
3.1.3 Paraffin.....89
3.1.4 Coal.....89
3.1.5 Gas.....90
3.1.6 Candles.....90
3.1.7 Batteries.....90
3.1.8 Summary of fuel consumption 92
3.2 EXPENDITURE ON FUEL.....93
3.3 FUEL PREFERENCES.....95
3.4 ENERGY USE PATTERNS.....96
3.4.1 Cooking practices.....96
3.4.2 Water heating.....98
3.4.3 Home heating.....99
3.4.4 Lighting practices.....100
3.4.5 Clothes ironing.....101
3.4.6 Other appliance ownership.....101
3.5 RANKING OF ENERGY AND OTHER NEEDS.....102
4. ENERGY CONSUMPTION BY FARM LABOURERS.....104
5. CONCLUSION.....106
5.1 TOTAL DOMESTIC ENERGY CONSUMPTION IN UNDERDEVELOPED AREAS...106
5.2 ENERGY PROBLEMS IN UNDERDEVELOPED AREAS 110
5.3 ENERGY USE IN SOUTH AFRICA'S ECONOMY.....113
5.4 CONCLUDING DISCUSSION.....114
6. REFERENCES.....117

CHAPTER ONE : INTRODUCTION

1.1 BACKGROUND

In parallel to the interest generated by the "oil crisis" of the 1970s has been a growing awareness of the other or forgotten "energy crisis", where some 1500 million people, mostly in developing countries remain overwhelmingly dependent on rapidly depleting fuelwood resources and agricultural residues to meet their basic energy needs.

The underdeveloped areas of South Africa mirror many of the conditions common to Third World countries. However, little attention has been focussed on the energy problems of underdeveloped areas in this country and no national energy policy or investment decisions have been formulated to meet the needs of this sector.

Part of the problem (until recently) has been the lack of local data on energy consumption and demand. There have been three previous detailed local studies of energy consumption in underdeveloped areas in South Africa. Mark Best (1979) looked at fuelwood, dung and paraffin consumption at Jozanna`s Nek in the Herschel District of the Transkei and at Mashunka in the Masinga District of Kwazulu. Christine Liengme (1983) looked at wood consumption in Arid Lowveld/Mopane veld in an area south-east of Giyani in Gazankulu and Mark Gandar (1983) studied two areas in the Mahlabatini District in Kwazulu. The latter two studies concentrated on ecological issues, looking mainly at wood consumption for both fuelwood and for construction purposes, the preferred tree species, as well as estimating the natural regenerative capacity of local woodland. Gandar also included a great deal of mainly sociological information on the time and effort involved in fuelwood collection as well as on fire making and cooking practices.

The present study has been an attempt to fill some of the gaps in our knowledge: to build up a national picture of energy consumption patterns in non-electrified rural and peri-urban areas, looking not only at fuelwood, but the full range of energy sources used, the manner in which they are used, as well as people`s perceptions of energy related problems and preferences as a guide to future interventionist strategies . The objective has been to relate energy consumption patterns in underdeveloped areas to national energy and development questions in South Africa.

Development has seldom been even or equitable. In practice the quantity and form of energy used relates variously to processes of development and underdevelopment. These issues are strikingly evident in South Africa with the existence of a developed energy intensive industrial capitalist economy dependent on fossil fuels supporting a minority population at a high standard of living; alongside an underdeveloped sector where the majority of the population live in relative poverty and are traditionally dependent on scarce fuelwood resources but are increasingly having to shift to the use of some of the more expensive forms of fossil fuels such as paraffin, gas, candles and even coal.

The results of this study should not be seen merely as a fact-finding exercise. Rather it is directed towards the task of identifying specific actions, strategies and technologies which will improve the situation. This study seeks to identify needs and problems as well as peoples responses and perceptions to possible solutions. It forms the first volume of a trilogy of reports - the other titles are:

* A directory and review of appropriate energy technology programmes in Southern Africa; and
* Appropriate energy strategies and technologies to meet the energy requirements of underdeveloped areas in South Africa.

1.2 METHODOLOGY

One of the main problems of data collection from very large populations is attaining detailed and reliable data which is also representative. The former is time consuming and requires expensive, trained personnel, while the latter requires large samples which inevitably have to be studied fairly superficially in order to cover a large enough group. At the one extreme is the open-ended anthropological approach which seeks to understand how a particular system functions by prolonged observation at close quarters of a wide range of phenomena in narrow cultural and geographical areas. The study is usually dependant on a highly trained and motivated individual who is also able to speak the local language. At the other extreme is a highly structured and brief questionnaire which concentrates on those phenomena considered important by reference to both previous experience and to theory. Questionnaires are usually administered by a large number of paid enumerators, often poorly motivated and with little interest in the accuracy of data collected. As Barnett (1982:13) succinctly argues:

> "The researcher´s dilemma is one of balancing insufficient time or money to follow an unstructured approach against a concern over the the possibly tyrannical nature of the preconceived questionnaire; it is a choice between the `deep cut´ which gets inside a system which may or may not be typical and the `more representative´ sample that may miss the point!"

The present study has sought a compromise between the two approaches. In order to build up a national picture, a number of different sample populations have to be studied. Representative areas which are characteristic of different energy consumption patterns have thus been selected. However, in order to obtain reliable data an in depth interview, structured around a questionnaire, has been undertaken with a sizeable sample in each area. Many parts of the questionnaire were open ended, particularly with regard to perceived problems, needs, preferences and

possible solutions. Quantitative data was checked visually as far as possible and fuelwood consumption in control households in different areas was measured at different times of the year as a check against the estimates obtained in the interview.

1.2.1 The selection of study areas

Electricity supplies the domestic energy requirement of practically the entire "white" and most of the "coloured" and "asian" urban population and about half of commercial "white" farms. About a fifth of black urban households also have access to electricity, although this proportion is increasing with large electrification schemes in townships such as Soweto. The focus of this study is the energy consumption patterns of the majority of the black population who reside in underdeveloped rural and peri-urban areas. About 38% of South Africa`s total population reside in the ten so-called rural "homelands", viz. Bophuthutswana, Ciskei, Gazankulu, Kangwane, KwaNdebele, Kwazulu, Lebowa, Transkei, QwaQwa and Venda. This amounted to about 12 million people out of a total population of 31,4 million in 1984. About 4,5 million blacks reside in rural areas outside of the "homelands", mainly as labourers on farms, and about 1,8 million live in towns outside the "homelands" and the metropolitan areas.

Previous studies have indicated that the main energy source in rural areas is fuelwood and that the level of consumption is dependent mainly on local availability of natural woodland which is in turn a function of climate and topography. Climate further influences consumption patterns in that more fuel is used for space heating in colder areas. In order then to build up a national picture of energy consumption patterns in rural areas it is necessary to select study areas which are characteristic of different bioclimatic zones.

There is another important determinant in energy consumption and that is the type of settlement pattern, as this largely determines access to and

availability of particular energy sources. An increasing number of households no longer have access to farm land, they are concentrating in closer settlements within the rural areas and in peri-urban areas on the periphery of metropolitan centres. These households have access neither to electricity (the main source of domestic energy in the developed urban sector) nor to "free" wood resources or agricultural residues (the main energy source in rural areas). The consequence is that households in peri-urban areas (and, indeed, in the townships without electricity) have quite different energy consumption patterns to either urban or rural areas.

Six rural villages were selected which provide a good picture of energy consumption patterns in the three bioclimatic zones (coastal, central plateaux and foothill zones) of the Ciskei and Transkei, in the lowveld of the Eastern Transvaal (Gazankulu) and in the bushveld of the North Western Transvaal (Lebowa). Kwazulu and the North Eastern Transvaal (Gazankulu) were excluded because of previous detailed studies there.[1]

In addition five peri-urban areas were selected which are representative of different degrees of urbanization. The range of different type of settlements may be characterized as:

*	Townships in metropolitan area/towns	MOST URBANIZED
*	Hostel compounds, etc in metropolitan areas	
*	Urban areas in homelands	
*	Informal settlements near metropolitan areas/towns	
*	Closer settlements with relatively high employment	
*	Closer settlements remote from employment with poor amenities	
*	Landless villagers	LEAST URBANIZED

---

[1] It is of course very difficult to generalise from one village to a larger area. This is shown clearly in Best's (1979) study of Mashunka where wood is freely available from the Tugela River, yet 50 km further north at Nqutu (which is also Valley Bushveld) fuel is so scarce that most households buy their fuelwood from vendors who transport logs in from outside the area. Care has been taken to select villages which are characteristic of the area, but the caveat of untypical areas even in close proximity to the study area, needs to be borne in mind.

Other factors relevant to the selection of study sites were introductions to specific areas through contacts and friends, which made the setting up of surveys and the acceptance and cooperation of the communities very much easier.

1.2.2 Questionnaire / interviews

Detailed and lengthy questionnaires were designed which ensured that particular quantitative data was obtained as well as presenting opportunities for interviewees to provide their own perceptions of problems, needs and preferences. Each interview took from 45 minutes to an hour and a half to complete. Different questionnaires were used for the village and the peri-urban areas. These were initially tested on a small pilot sample in Manzimahle and in Crossroads and Vulindlela. Modifications were then made to exclude redundant data and to include additional relevant topics which arose during the trials.

Generally, the person who did the cooking was interviewed and the following topics were covered:

* fuelwood, agricultural residues, paraffin, gas, coal, candles and battery consumption, prices and expenditure;
* problems experienced with the different fuels;
* social, economic and environmental costs associated with wood collection including perceptions of scarcity and species preferences;
* cooking practices, including most commonly cooked meals, stoves and fuels used, fuel preferences, fire making practices and appliance ownership;
* water heating practices;
* home heating practices including preferred building construction and materials;
* lighting practices and preferences;

* energy spent in water collection;
* perceptions of problems and needs and the ranking of energy versus other needs;
* perceptions of alternative solutions, including own suggestions, and attitudes to tree planting and fuel-efficient stoves; and
* income data.

The village energy surveys also included information on:

* field and animal ownership patterns;
* energy use in agriculture for cultivation and grain grinding; and
* perceptions of most difficult and burdensome task undertaken by men and women.

Interviewees were encouraged to talk freely and provision was made for making notes on the questionnaires. As far as possible visual checking of replies was undertaken.

The author visited all sites except Cottondale (Sue Baldwin of the ERI initiated this study) and Lujiko (where Gideon Steyn of the University of Fort Hare organized the interviews). Sue Baldwin also helped organize the Nkanga study and Mark Gandar/Norman Bromberger of the University of Natal organized the Vulindlela study. Questionnaire / interviews were conducted with the assistance of a local interpreter who generally ended by completing the sample with the assistance of trained enumerators

Copies of the questionnaire form are included in appendix 1.

Questionnaires were coded and statistically analysed on the UCT mainframe computer.

1.2.3 Fuelwood measurements

The most important fuel used in underdeveloped areas is wood and it is important to obtain some indication of how much is being used in order to assess fully its associated social, economic and environmental costs, as well as to evaluate alternative forms of energy supply.

Asking villagers how much wood is used for cooking or heating is not unlike asking city dwellers how much electricity their stoves use: people simply do not know and only rough estimates can be made. Nevertheless fuelwood collection is often an extremely time consuming and arduous task and people are very aware of how frequently headloads are collected and used up. If this information is coupled with headload measurements, a reasonable idea can be obtained of total consumption. A number of headload were measured using a 0 - 50 kg spring balance, and coupled with previous studies, estimates of average headload masses were made.

In order to validate fuelwood consumption data, detailed measurements were made in 5 control households each in five different areas during the different seasons.

The procedure adopted was to seek the cooperation of five households who had completed questionnaire interviews. An attempt was made to select households from different income levels. They were asked to put aside a quantity of fuelwood which they estimated would be used over a three day period. A little extra was then added. The bundle was weighed with a spring balance and the mass recorded on a form. The families were asked to use wood only from the weighed bundles and loose pieces of wood around the cooking hut were removed. Each household was visited at the same time for the next three days and the designated bundle was re-weighed. If it looked as though the bundle would be used up, more wood was added and the additional amount also recorded. At the end of three days a daily average consumption figure was calculated.

An attempt was made to repeat the exercise in March, July, September and December in five areas, although logistical and unforeseen events prevented measurements being taken in all seasons at every site. In some instances careful arrangements were made to visit sites, some 1500 km from Cape Town, only to find that measurements could not be taken because women were involved in preparations for a funeral or had to be involved in ploughing or harvesting during the day.

Ideally, measurements should be taken throughout the year in order to take into account seasonal variations.[2] Nevertheless, unseasonal weather and social events or practices such as brewing for initiation ceremonies can result in highly skewed and untypical data. Isolated measurements at fixed periods of the year are thus subject to error and can only provide an indication of likely consumption figures.

1.2.4 Notes and Observations

Finally, community leaders and contacts were interviewed and personal observations noted as corroborative and supporting information to the questionnaire surveys.

---

[2] Christine Liegme undertook a detailed study of 8 households in three different villages (0,8% of population) visiting them 6 times a year for periods of between 7 and 14 days each. Headloads were weighed, and separated into different species which were identified, weighed and size (diameter) distribution counted. Mean daily household consumption was calculated from how long each women said the headloads would last. Gandar also undertook frequent measurements throughout the year.

1.2.5 Problems with surveys

One of the problems with most surveys is that they provide essentially a static snapshot which describes a current situation without providing an historical perspective which would provide an understanding of how the situation has changed in the past and how it might be expected to change in the future. Surveys also do not enable an understanding of the dynamic interactions between elements in the current situation.[3]

An attempt was made to deal with some of these problems by, for example, seeking information from interviewees on how fuelwood resource availability has changed over time. It has also been possible to refer to previous studies in similar areas and to observe shifts in energy consumption patterns, particularly with regard to increased dependence on purchased wood and other commercial fuels.

Nevertheless, it is still important to relate energy problems as part of a wider process of underdevelopment and some attempt has been made in this study to do this. For example, the harvesting of green wood, rather than mere collection of dead wood, marks a significant shift in man`s impact on the environment and irreversible destruction of forests, natural woodland and ultimately soils will proceed apace. Surveys will document some current anecdotal evidence, but they will not explain what has caused this shift from balance to destruction. Reference to historical and social analyses, on the other hand, might point to the restriction of growing populations to confined "homeland" areas with insufficient land for a viable agrarian economy and where people are forced to exploit remaining natural resources in order merely to survive.

One of the important themes, thus, of this study is to locate and understand current energy problems of underdeveloped areas within larger questions of poverty, development and the national allocation of resources.

---

[3] There are of course many other more detailed problems with questionnaires and some of these will be dealt with when discussing the data.

1.3 THE STUDY AREAS

The villages studied were Lujiko in the Fish River Valley near the coast in the Ciskei, Manzimahle near Cala in Transkei, Clarkebury in the central grassland plateau of the Transkei, Nkanga in the Libode area towards the coast in the Transkei, Cottondale in Gazankulu in the Eastern Transvaal and Mokumuru near Bochum in Lebowa in the North West Transvaal. None of these villages are in close proximity to large towns or cities, and combined with the previous studies, they provide a good representative sample of a range of rural South African conditions.

Lujiko

Lujiko is a village of 600 to 700 households located at 33°22`S 27°2`E on the edge of the Fish River Valley less than 20 km from the coast on the border of Valley bushveld, Alexandria Forest and Eastern Province Thornveld. Most of the houses have corrugated iron roofs although the village is still regarded as being fairly traditional. Indigenous wood is available in the valley, although dead wood is becoming scarce and there are restrictions on the harvesting of green wood. As a result a considerable amount of wood is trucked in from a nearby plantation. The annual rainfall is of the order of 1000 to 1200 mm. Forty-nine households were interviewed.

Manzimahle

Manzimahle is a large sprawling village along a ridge about 5 km west of Cala in the Transkei. It is located at 31°37`S 27°37`E in grassveld in the foothills of the escarpment. Some acacia thorn trees survive, but there is very little fuelwood left except in clefts in the hillsides. Almost all wood is obtained from an adjacent state woodlot. Average rainfall is between 700 and 800 mm per annum. Forty-eight interviews were undertaken.

Clarkebury

Clarkebury is located at in the central plateau of the Transkei at 31°18`S 28°18`E approximately 40 km south west of Umtata in what Acocks terms Highland Sourveld. Surveys were conducted in a number of neighbouring small village clusters including Nkwenkwana, Mhlophekazi, Mpindweni, Tyeni, and Ngqurhu

Very little local wood is available. Tyeni was the only village where people had access to some indigenous fuelwood, although written permission has to be obtained from the headman before fuelwood may be collected. Nzqurhu is a little more remote, situated on high ground and accessible by crossing a stream which flows strongly in winter. Most of the wood is trucked in from plantations in the region. Average rainfall is between 600 and 700 mm per annum. Forty-five households were interviewed.

Nkanga

Nkanga is located in Pondoland in the Transkei at approximately 31°28`S 29°12`E in thornveld and close to valley bushveld and remnants of coastal forest, with an average annual rainfall of about 900 mm. It is approximately 20 km north-east of Libode which is about 30 km from Umtata on the Port St Johns road. The village comprises about 200 households centred on a hill, at an altitude of about 900m, between the Umzimvubu and Mngazi rivers, with several arms radiating out along ridges. There was a relocation of homestead sites from the traditional positions midway up slopes above river valleys (in about 1950) Here they would be close to water, wood and homesteads would not occupy land that could be cultivated. Now most villages are on the high flat plateaux and only a few homesteads remain on the mid slopes.

There are two woodlots in Nkanga, one of wattle and the other of gum trees.[4] A section of the gum plantation is felled every July and is sold to the community, mostly as poles for house construction and for kraals. Fuelwood is collected from indigenous forests located in the steep valleys and ravines. Eleven questionnaires had been received at the time of going to press.

Cottondale

Cottondale is located in the lowveld, at approximately 24°35`S 31°10`E, about 10 km east of Acornhoek which is near Klaserie in the Eastern Transvaal. The northern side of the road through Cottondale is in Gazankulu (Shangaan speaking) and the southern side is in Lebowa (Sotho speaking). There was recently some friction between the Sotho and Shangaan which precipitated from the Lebowa government preventing Shangaans from selling vegetables at a market in Acornhoek. The survey was conducted in the Shangaan side of Cottondale.

Cottondale is mixture of the traditional and the modern with a few old thatched huts, but most buildings being rectangular with corrugated iron roofs secured by rocks placed on top. It is a sprawling village, with each homestead surrounded by a piece of land on which they cultivate mielies, ground nuts and various vegetables (mostly indigenous). Families do not have access to any other land. There is a railway station where taxis and bakkies can be hired. Coal can be bought from the coalyard at nearby Acornhoek. The village has a clinic and a large school is being built.

Little fuelwood is still available in the immediate vicinity of the village, but indigenous wood is found in the Ndovla area which is 6 to 8 km downstream next to the Timbavati River.

---

[4] Clumps of wattle trees are evident next to many homesteads in the coastal zone.

The Timbavati river flows through the village, dividing it more or less in half and water is collected from depressions dug in the river bed into which water seeps. Average rainfall is about 700 mm per annum . Forty-eight interviews were completed.

Mokumuru

Mokumuru is located at 23°15'S 29°5'E near Bochum in Lebowa, about 80 km north west of Pietersburg in the Northern Transvaal. The average rainfall is between 400 and 500 mm per annum and it lies on the border of what Acocks has termed Arid Sweet Bushveld and Mixed Bushveld.

The area was farmed earlier by German settlers, and after the 1913 Land Act was bought by a number of African families. About 80% of households still have access to land, some of which surrounds homesteads. The area is apparently still well wooded and large woodpiles are evident next to households. However, little surplus dead wood is available in the immediate vicinity of the village and villagers have to walk to the slopes of a nearby hill/mountain where desired species may be found. No wood is trucked into this area. Mokumuru is typical of many of the villages in the North West Transvaal / Lebowa which are close to well wooded mountain outcrops. There are many villages, however, which are located on the flat plains, where fuelwood is very much more scarce, and the collection of wood very much more costly in terms of time and money. 30 households were interviewed.

The villages taken as a whole, reflect many of the characteristics of the rural environment, particularly in terms of poverty, lack of local resources and dependence on the metropolitan centres for pensions and migrant labour remittances. The latter dependence is shown in the table below:

	Percentage Households With Migrant Worker	Mean Number Workers Away Per Household
Lujiko	79	1,5
Manzimahle	65	1,1
Clarkebury	60	1
Nkanga	90	1,4
Cottondale	77	1,6
Mokumuru	80	1

There are few rural areas in Southern Africa which have been untouched by the mining and industrial economy of the region. The movement from traditional lifestyles and consumption patterns is thus altering rapidly and some of these shifts will be apparent in the results of the survey.

These shifts are most apparent in the peri-urban areas which were studied: Crossroads in the Cape, Vulindlela outside Pietermaritzburg, QwaQwa, Amatelang - a resettlement camp in Bophuthutswana in the Western Transvaal, and the township of New Bethesda in the Karoo.

Crossroads

Crossroads is a large informal shanty settlement on the periphery of Cape Town which has mushroomed over the past decade. Previously under threat from government bulldozers, its existence has now been accepted, although the government is still determined to relocate much of its population to Khyalitsha (a large new planned township 40 km from Cape Town) and to upgrade the rest of the site. Households are dependent on wage labour in Cape Town. There is no access to land for cultivation or animals. Some wood is available from the surrounding vigorously invasive alien trees - Rooikraans and Port Jackson (Acacia cyclops and Acacia saligna). Eighty-five interviews were completed.

Vulindlela

Vulindlela is a mixed peri-urban, semi-rural area extending up a valley from the non-metropolitan but expanding urban centre of Pietermaritzbug which is 80 km inland from Durban. Although some households (17%) still have access to fields, their size has been reduced by in-migration to the valleys. The concentration of housing increases closer to the town. About a quarter of the families, mostly further away from town, own cattle, and this proportion decreases towards town. Wood suppliers are crucial in an area such as this and there is an extensive fuelwood trade. 110 interviews were completed.

QwaQwa

This is one of the 10 "homelands" and is situated on the northern boundary of Lesotho. The population has increased from about 24 000 in 1970 to over 400 000 today, largely through relocation and the movement of families off "white" farms. The land area of QwaQwa comprises a little over 50 000 ha of which about 30 000 ha could be described as mountainous terrain. The area has thus become one peri-urban sprawl wholly dependent on migrant labour, commuting labour and pensions. There is no local agriculture to speak of and little local industry. What little indigenous woodland existed has all but been removed and households are mostly dependent on imported fuels.

Forty-seven interviews were conducted in the Monontsha, Makeneng, Tshesheng, Thaba Bosiu, Mmakwane, Bochabela, and Mphatlalatsane areas.

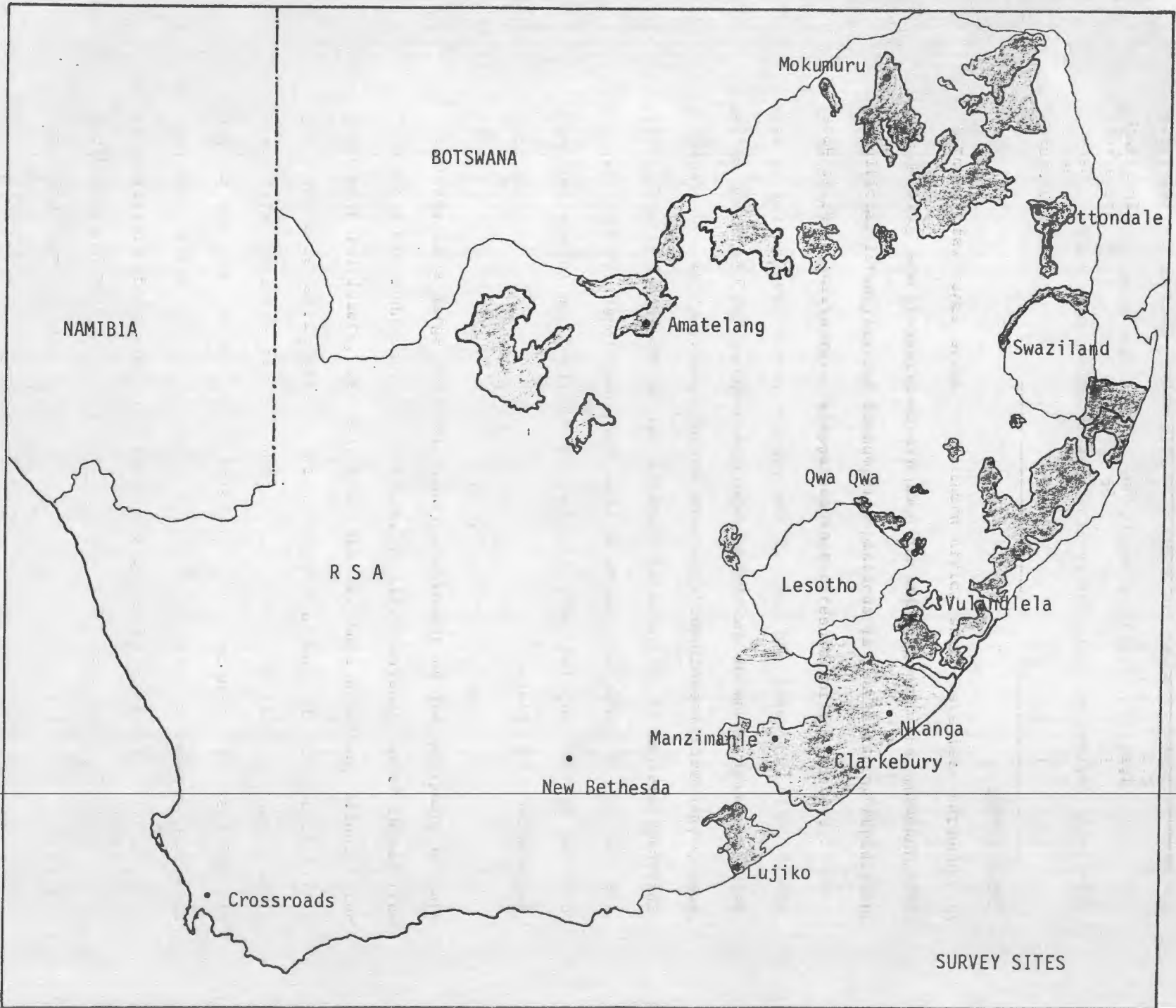
Amatelang

Amatelang is another resettlement area which is in an area of Bophuthutswana West of Lydenburg. Residents had been resettled there from so-called "black spots" in the Western Transvaal. The area is desperately poor. It is practically equivalent to a remote, densely settled village, but there is no

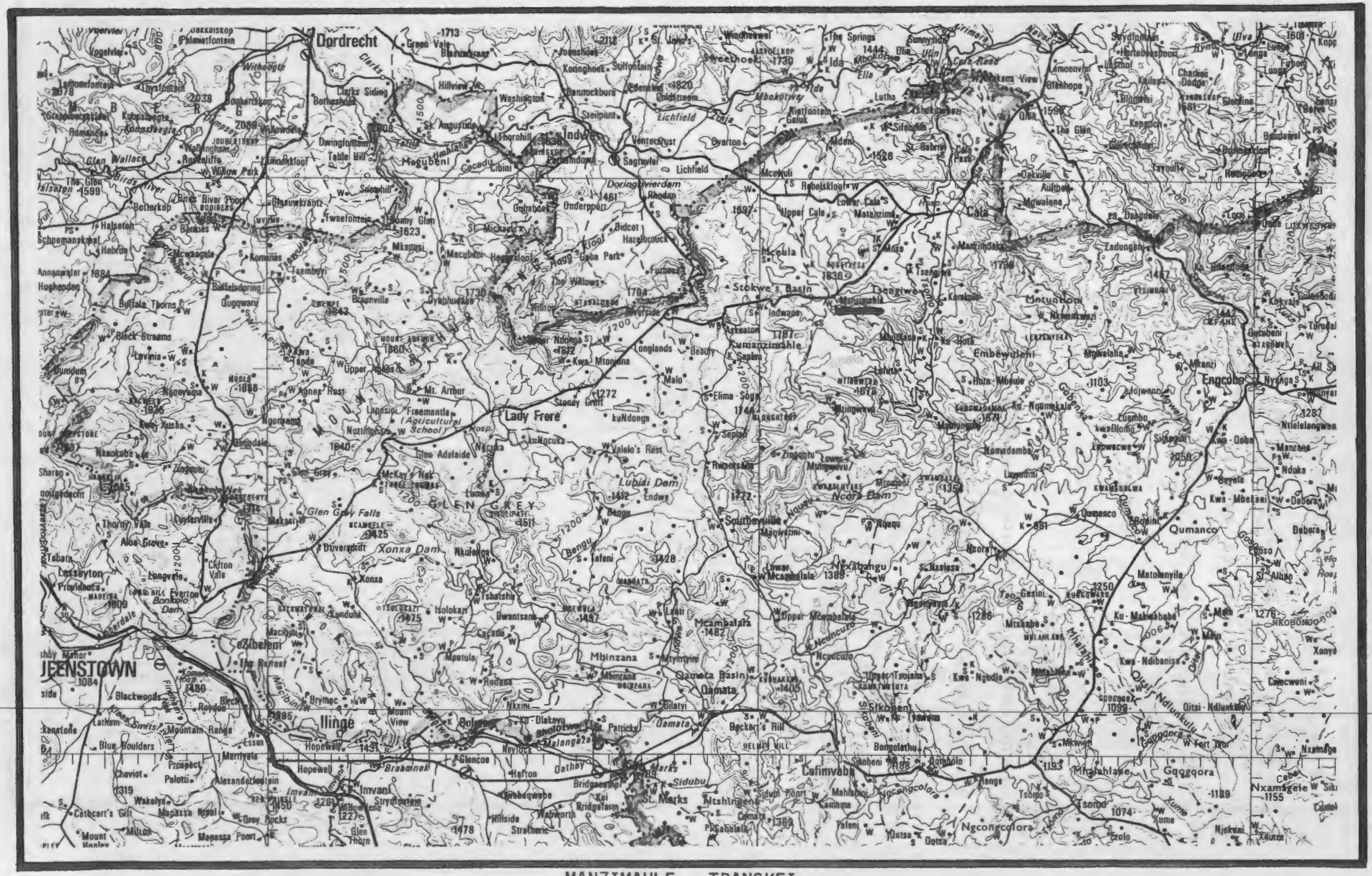
agricultural activity and residents are dependent on either migrant or commuting labour. There is little local wood available, other than a mature gum woodlot which is under the control of the chief. This is the poorest of the areas studied. Families could not afford to cook every day and frequently ran out of fuel. Thirty-nine questionnaires were completed.

New Bethesda

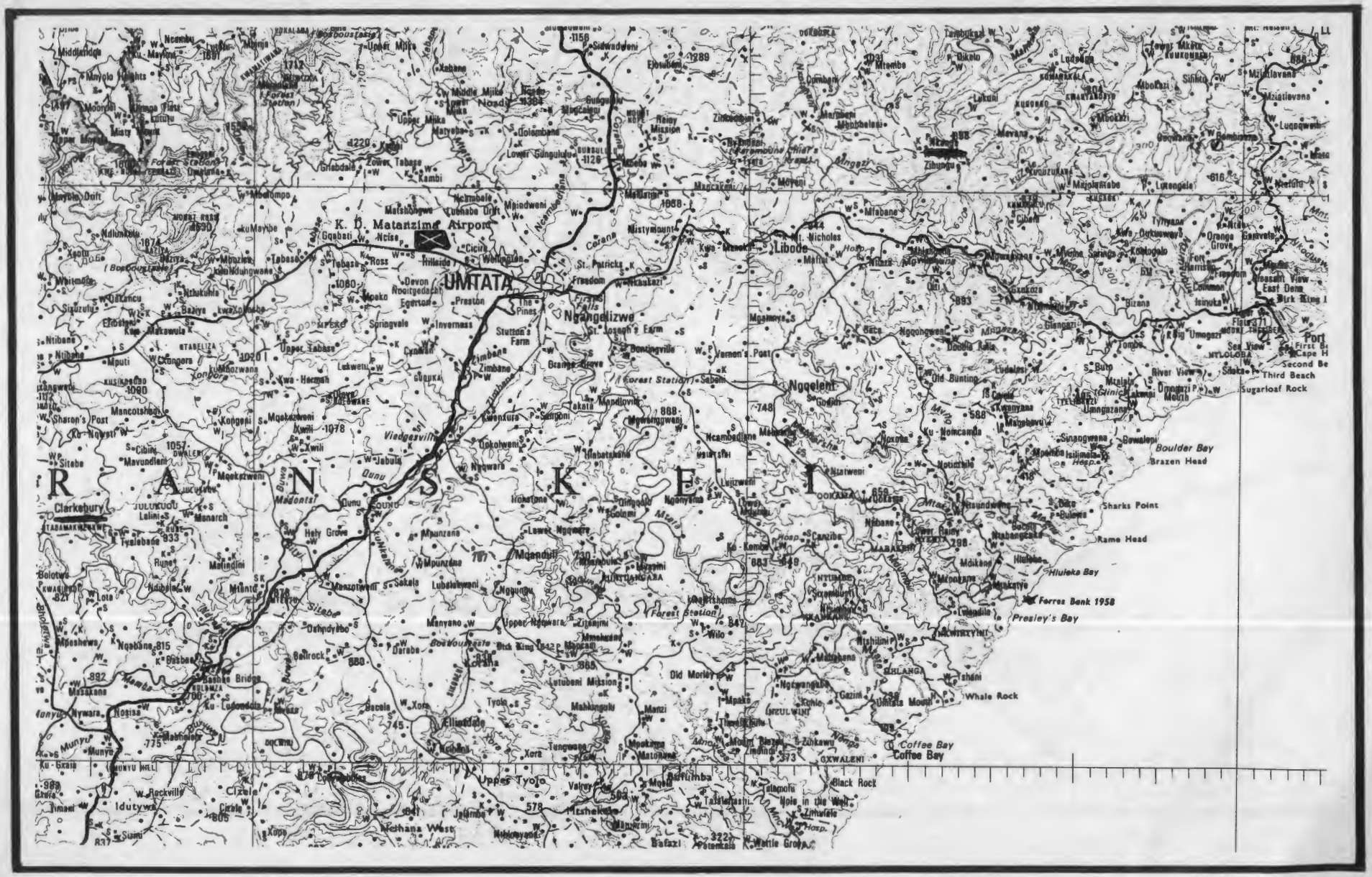
This village is situated 50 km north of Graaff-Reinet in the Karoo in the Cape Province and is fairly typical of the small "platteland" towns or black townships in the region which do not have access to electricity. The town is economically depressed and many of the younger people are leaving to seek work in larger towns or in the metropolitan centres. All families in the town itself were interviewed (the more established families - "coloured & white"), 6 out of 11 of the black families in the "location" (the poorest), and one out of three households in the "coloured location" (the largest section of the population). A total of thirty-five interviews were satisfactorily completed.


Mokumuru
BOTSWANA
Ottondale
NAMIBIA
Amatelang
Swaziland
Qwa Qwa
R S A
Lesotho
Vulandlela
Nkanga
Manzimahle
Clarkebury
New Bethesda
Lujiko
Crossroads
SURVEY SITES

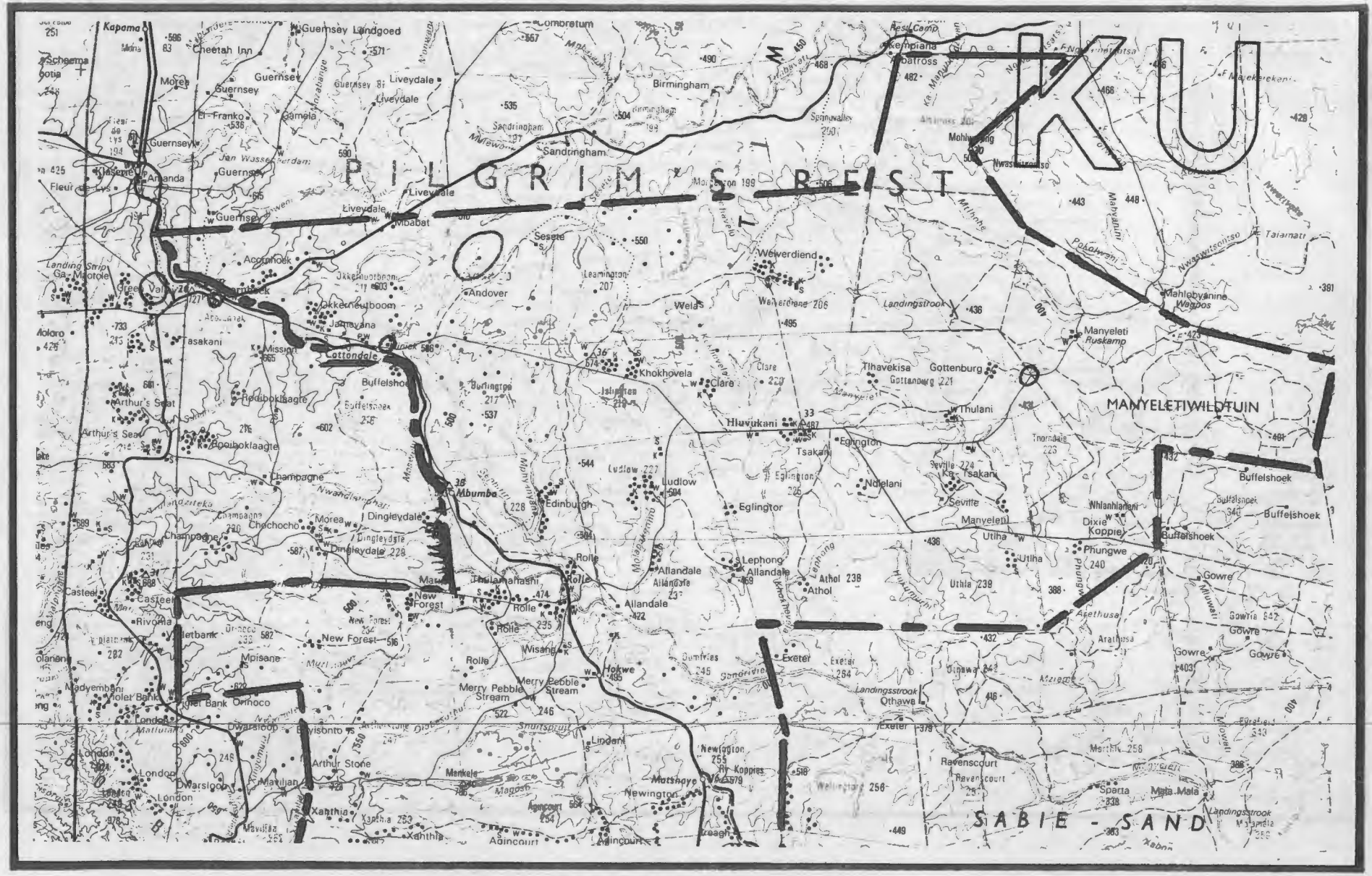
LUJIKO : CISKEI



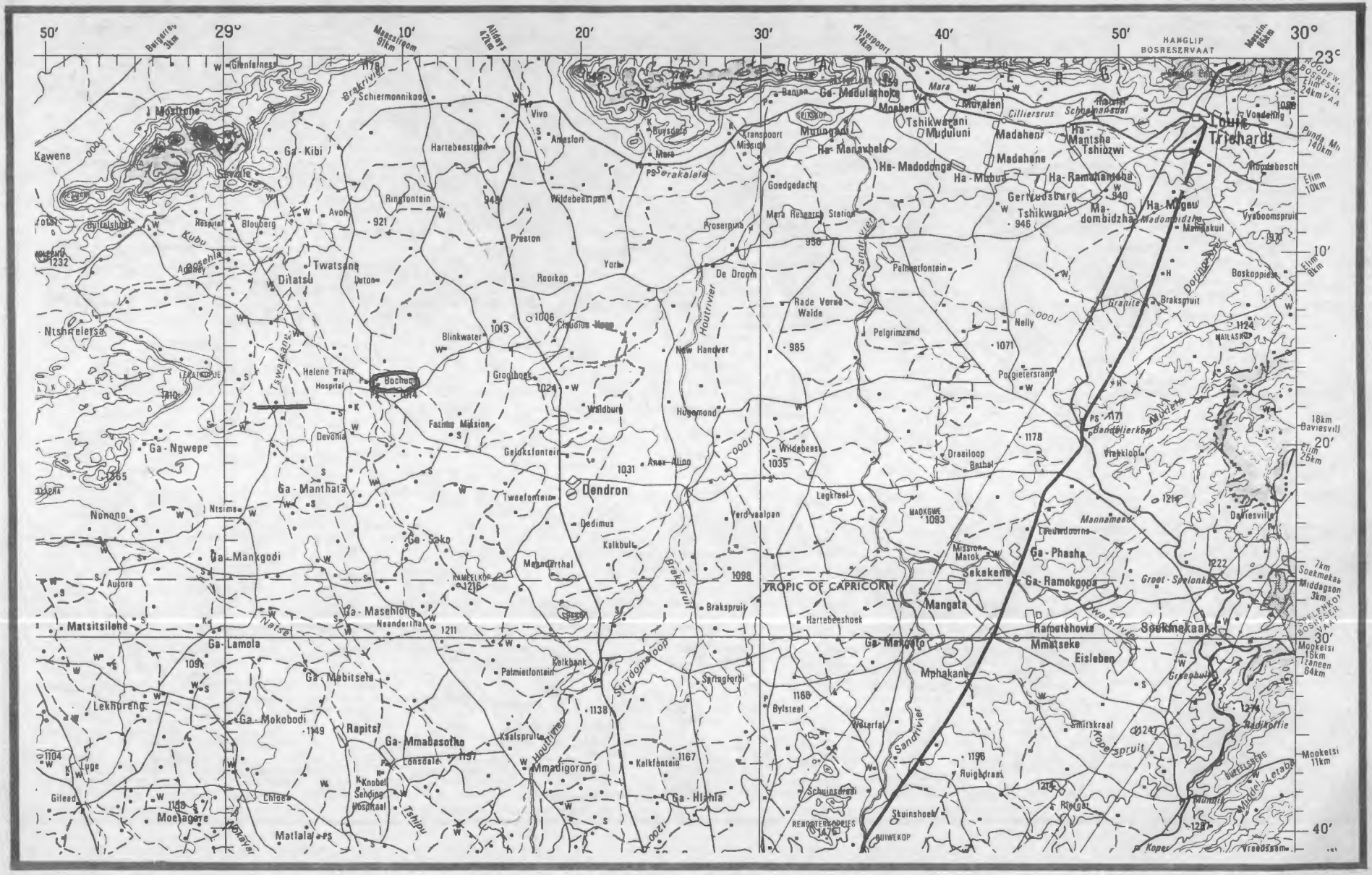
MANZIMAHLE : TRANSKEI



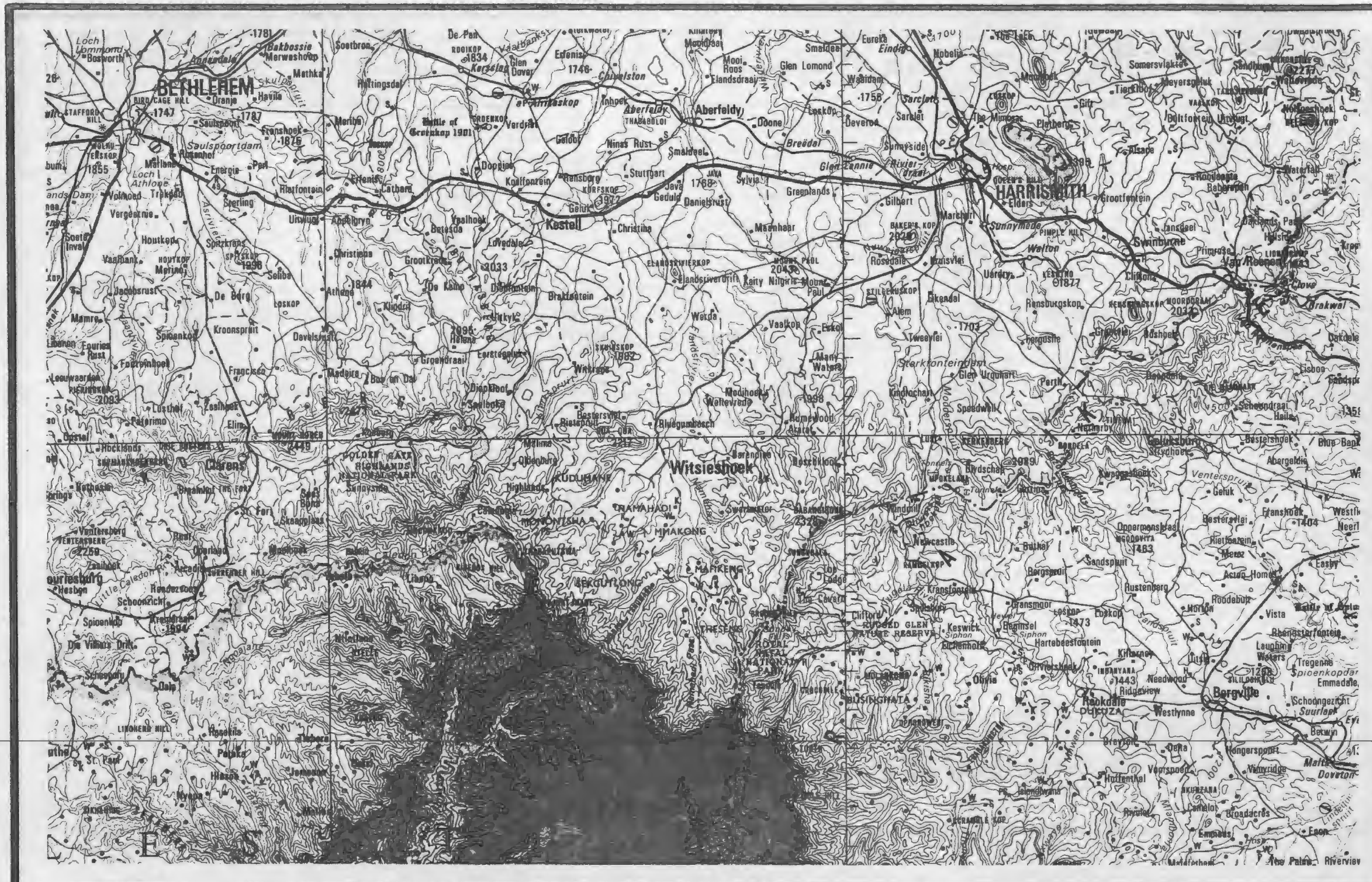
CLARKEBURY & NKANGA : TRANSKEI



COTTONDALE : GAZANKULU



MOKUMURU : LEBOWA


BETHLEHEM
HARRISMITH
Witsieshoek
Kestell
Aberfeldy
Clarens
Swinburne
Bergville
Fouriesburg
GOLDEN GATE HIGHLANDS NATIONAL PARK
ROYAL NATAL NATIONAL PARK

QWA QWA

CHAPTER TWO

ENERGY USE PATTERNS IN RURAL AREAS

The major requirement for energy in underdeveloped rural areas is for meeting basic domestic needs such as cooking, heating and lighting. Other important energy requirements are for water lifting, grain grinding and draught power for agriculture.

2.1 DOMESTIC FUEL CONSUMPTION

The table below indicates the number of families using particular fuels for cooking, heating and lighting in the six villages:

	Per cent households using fuel							
	Fuelwood	Dung	Wastes	Paraffin	Candles	Coal	Gas	Batteries
Lujiko	100	63	89	100	45	-	-	71
Manzimahle	100	50	81	96	58	6	4	29
Clarkebury	100	100	100	98	98	16	9	36
Nkanga	100	100	100	100	91	-	9	36
Cottondale	100	13	2	85	85	38	8	73
Mokumuru	100	97	87	97	63	10	-	83

Wood is clearly the dominant fuel, although it is noticeable that other fuels are also extensively relied upon - particularly paraffin and also agricultural wastes such as dung, mielie cobs and stalks. The exception is Cottondale where crop failures and restricted access to land have limited these alternatives. There has been the beginnings of a shift to the use of commercial fossil fuels such as coal and gas. The use of each of these fuels is discussed below.

2.1.1 Fuelwood

The mean annual household and per capita fuelwood consumed for cooking and heating is shown below.[5] The amounts were derived from respondents estimates of head loads used per week coupled with average head load mass measurements.[6]

	Mean annual domestic fuelwood consumption (kg)	
	Per household	Per capita
Lujiko	3402	766
Manzimahle	2845	650
Clarkebury	2753	484
Nkanga	3777	498
Cottondale	3580	572
Mokumuru	3358	655

The above estimates are clearly subject to error as fuelwood consumption varies at different times of the year, and the fact that villager estimates are not exact. Households, though, were asked to provide average or "normal" headload consumption data, and the mean household consumption which was calculated from the total sample is probably close to actual consumption.

This is shown when the above amounts are compared with the measured fuelwood consumption of five control households at different times of the year in each of the following areas.[7]

---

[5] All fuelwood masses refer to wood as it is used, ie. air dried with approximately 15% moisture content (dry basis).

[6] Wood consumption figures are for fuel consumption only. Wood is also used for fencing, kraals and building purposes. Liegme (1983) estimated the mean volume of wood used per hut to be 2,3 m^3. Gandar (1983) estimated the amount of wood used for structural purposes as being between 0,25 and 0,55 m^3 per household per annum.

[7] It was hoped that measurements could be made in each of the areas in each season. However, time and logistics allowed for measurements to be taken only during the months indicated. On occasion, careful arrangements would be made to visit a community, only to arrive and find that someone had died in the village and the control families were involved in funeral preparations, or it was harvest time, or the weather was unseasonal and normal cooking operations could therefore not be performed.

	Calculated annual household fuelwood consumption (kg) from daily measurements during month of				
	July 84	September 84	December 84	March 85	Mean
Clarkebury	-	-	-	2366	2400
Nkanga	-	-	3629	-	3900
Cottondale	-	-	3010	1703	?
Mokumuru	4440	-	2895	-	3700
Bendell[8]	-	3080	2788	3154	3100

There is a relatively good correspondence between measured and estimated consumption figures which gives one a degree of confidence in the data. The exception is Cottondale where a very much lower wood consumption figure was measured in March than was estimated. One possible explanation is that more coal is used in the colder winter months, and proportionately less wood may be used, mostly only as kindling. This does not fully explain the large discrepancy, and the estimated wood consumption data for Cottondale may be too high.

It appears from the above measured data that wood consumption varies by between 10 and 20 per cent in winter and summer from the annual mean. Although great care and effort was taken to ensure accuracy in the measured consumption of the control households, too much store should not be placed on these figures. Even in summer, one of the three measured days, was on occasion colder than usual or even raining and thus households might have been recorded as having used more fuel than is usual for that time of the year. The reverse could be true for some of the measurement days in Winter. The measured data should thus not be viewed as absolute, but rather a check that the estimated consumption data are in the right range.

Seasonal variations in fuelwood consumption may be great. These may not only be determined by weather (more fuel is required for heating in winter than summer), but also by social custom. For example, Liegme (1983) found that

---

[8] Bendell is a resettlement village in Bophuthutswana, north of Kuruman. Fuelwood measurements were taken during the months indicated, and the data is included here as an indication of seasonal variations and also annual totals for this different bioclimatic zone.

the highest fuelwood consumption occurred in August, which is a time of initiation of young girls and considerable quantities of sorghum beer are brewed for the celebrations, requiring additional amounts of fuelwood to that normally used.

The above data may be compared with the previous three fuelwood studies in South Africa which are summarized below:[9]

	Mean annual domestic fuelwood consumption (kg)		
	Per household	Per capita	Source
Jozanna`s Nek, Transkei	1705	271	Best (1979)
Mashunka, Kwazulu	4824	1124	Best (1979)
Mahlabatini, Kwazulu			
High grassland	4800	620	Gandar (1983)
Valley Lowveld	7700	740	Gandar (1983)
Giyani area, Gazankulu	5440	760	Liegme (1983)

Care should be taken when comparing per capita consumption data as these are very much dependent on the household size. Per capita consumption may seem to be extraordinarily high at Mashunka, but the average household size was only 4,3 people compared to 10,4 in valley lowveld areas at Mahlabatini. There can often be confusion about the total household size. Interviewees will sometimes include those who are away, and subgroups of the family may cook around different fires. The criteria for household size (to determine per capita consumption) used in this study was the number of people cooked for in one household.

In general, the variation in fuelwood consumption reported in previous studies is very much wider than in this study where annual household consumption varied from 2750 kg to 3780 kg, and per capita consumption between half and three-quarters of tonne fuelwood.

---

[9] Other comparative fuelwood consumption data are Gay´s (1982) estimate of 1250 kg per household per year in the East of Lesotho, Steele´s (1983) estimate of 1,8 - 2,6 tonnes in the North of Lesotho, and Wickstead (1984) - 1 - 1,5 tonnes per household per year in the South of Lesotho. Jellenic (1981) studied two villages in Botswana with per capita annual consumption of 350 and 259 kg.

It has been previously argued that fuelwood consumption has been found to be closely linked to availability (Best:1979 & Gandar:1983). Availability of wood should not be interpreted merely in terms of the prevalence of local natural woodland cover. The availability and price of wood from plantations will also affect fuelwood consumption levels.

All the villages which were studied experience indigenous wood scarcities, although many are now dependent on plantation wood. This is particularly evident at Manzimahle and Clarkebury in the Transkei where very little natural woodland survives within convenient walking distances and households have to pay for wood from plantations. In Lujiko, local scarcities have also forced households to truck wood from neighbouring plantations.

In Cottondale, wood is collected 6 to 10 km from the village. Very little dead wood is available in the immediate vicinity, although villagers sometimes use roots dug up for fuel. Some women said that they even went as far as the Manyeti Game Reserve, about 30 km away by track, where they climbed a fence and braved whatever wild animals there were just to be able to collect some wood. Some wood is also available from state and commercial plantations in the area.

The majority of respondents claim that it is more difficult and they have to go further to collect fuelwood than a few years ago. (The percentage households claiming this were: Lujiko - 96%, Manzimahle - 63%, Clarkebury - 84%, Nkanga - 82%, Cottondale - 98% and Mokumuru - 93%).

Not all areas in South Africa, though, experience acute indigenous fuelwood scarcities. Villages along parts of the well wooded Transkei coastal valleys have access to abundant supplies of natural woodland, although control is still necessary in some areas to ensure that only dead wood is removed.

Ardington (1984:132) reports that fuelwood is "plentiful and free" in her area near Nkandla State Forest[10] near Eshowe in Kwazulu. 80% of respondents had access to free fuel from natural forests or their own small woodlots (established by past generations of workers at the Wattle plantations at Melmoth who had brought back seedlings), but 15% of households buy all their wood. 69% of households considered the supply of wood plentiful and that their was no danger of it running out, although a fifth considered that the supply was running out.

However, many, many other areas experience indigenous fuelwood scarcities. Schneider (1984) and Harries (1984) report desperate shortages in parts of the Giyani district in Gazankulu, for example. The heavy reliance on fuelwood by growing populations confined to restricted "homeland" areas has meant that wood has in many areas become increasingly scarce and this has given rise to a number of serious social, economic and environmental consequences.

2.1.1.1 Consequences of fuelwood scarcities

Social costs

The most immediate effect of natural woodfuel scarcities is the increased social cost to households. An enormous amount of effectively unproductive time is spent collecting head loads from the remaining natural woodland. Generally a group of women set out together early in the morning for fuelwood collection trips. On average women collect headloads weighing about 30 kg[11], two or three times a week, walking the following distances and times[12]:

---

[10] Dead wood may be collected from the ground at 5c per trip. One guard controls the entire forest - not too effectively.

[11] Liegme (1983) measured headloads with varying means of 15,77 kg to 39,31 kg between households, and an overall mean of 29,95 kg. Her highest measured headload was 67,2 kg, but few weighed more than 50 kg.. 60% of headloads weighed 25 - 45 kg. Best (1979) measured average headloads of 15 and 21 kg at Jozanna`s Nek and Mashunka with maximums of 34 and 40 kg. Gandar (1983b) reports a mean measurement from 40 headloads of 37,9 kg)

[12] Best (1979) records women spending an average of 3,5 to 4 hrs collecting fuelwood at Jozanna`s Nek and Mashunka, or 12 to 15 hours a week, which appears to be an overestimate when compared to his consumption data. Gandar (1983b) records an average distance of 8,3 km and time of 4,5 hours

	Mean Time and Distance Spent Collecting Fuelwood Per Trip	
	Hrs	km (one way)
Lujiko	4,0	3,4
Manzimahle	6,2	4,2
Clarkebury	4,5	2,8
Nkanga	3,7	3,8
Cottondale	2,6	4,7
Mokumuru	3,2	3,0

Villagers understandably find it difficult to estimate distances and time accurately, and so the above figures have to be treated with caution. From local observation, however, fuelwood trips would rarely be less than 3 km in distance, and often considerably longer if preferred fuelwood species were sought. Dead wood is rarely available close to the villages and women have to go very much further afield.

Frequent wood collection trips are undertaken in those villages which still exploit natural woodland. In the dry season and when crops are not being planted or harvested, women go out more frequently to collect wood so as to stockpile it for use at a later date. Large fuelwood stockpiles were most evident at Mokumuru, to a lesser extent - at Nkanga, and least evident in Cottondale where wood is more scarce, but where people were also evasive where they stored the wood which they used for cooking, probably because they had illegally cut live trees. Some families would use whatever was available in the area, including roots recently dug up during ploughing.

Fuelwood collection is less frequent in villages such as Manzimahle and Clarkebury where large loads are collected with hired vehicles from woodlots and plantations.

---

per trip or 9 hours per week for fuelwood collection trips in a high grassland area and 3,6 km and 2,5 hours per trip or 6,75 hours per week for valley lowveld areas. In one extreme case he reports encountering a group of women who had spent 9,5 hours gathering single headloads of approximately 40 kg each and having walked a round trip of 19 km.

	Frequency of Wood Collection						
	1/day	1/2days	1/3days	1/week	1/month	1/3month	1/6month
Lujiko	3	58	33	8	-	-	-
Manzimahle	14	4	2	-	-	20	60
Clarkebury	51	-	11	-	12	19	8
Nkanga	27	36	27	9	-	-	-
Cottondale	24	17	12	40	2	-	-
Mokumuru	38	22	37	3	-	-	-

Economic costs

A rather startling factor to emerge from this study is the extent to which this once "free" resource has become commercialized. When local resources are depleted, wood has to be trucked in, often at considerable cost. With the exception of Mokumuru[13], a substantial number of households purchase wood[14]:

	Per Cent Households Which Sometimes Purchase Fuelwood
Lujiko	51
Manzimahle	77
Clarkebury	42
Nkanga	27
Cottondale	44
Mokumuru	0

In Lujiko, there is strict control over the taking of only dead wood from the natural forest, and all additional wood is trucked in from adjacent farms.[15]

---

[13] There is a relative abundance of woodland on a range of hills 2 to 3 km from Mokumuru. However, other villages which are further way do not have access to this resource and fuelwood availability is very much more of a problem.

[14] Other studies have confirmed this trend. Schneider (1984:3&9) records that wood is scarce at Dzumeri and Ngove in the Giyani district of Gazankulu and people pay R 2-00 a load which lasts a family about 2 weeks.
Moller (1985) reports that 45% of households in rural Kwazulu and Lebowa purchase wood.
Gandar (1983b) reports that less than 1% of households in Mahlabatini in Kwazulu sell or buy indigenous wood, but 18% in the valley lowveld region and 72% in the high grassland bought fuelwood grown in plantations.
These proportions are much higher than in Malawi where less than 10% of rural households purchase a proportion of their fuelwood (Malawi Energy Unit, 1981).

[15] Liegme (1983:254) reports that in the Giyani area of Gazankulu, permits

Households in Manzimahle and Clarkebury[16] generally hire a tractor and trailer or a pickup truck, typically every three to six months, to fetch a large load (about a tonne on trailers or half a tonne on pickup trucks) from a forestry plantation. Wood may be in the form of sectioned logs or consumers may be required to collect thinnings and dead branches from the plantation themselves, a task which can take a whole day and requires the assistance of many friends.

	% Households Obtaining Woodfuel From		
	Natural woodland	Woodlots	Vendors/Hired Vehicle
Lujiko	82	-	18
Manzimahle	8	86	4
Clarkebury	62	-	38
Nkanga	95	5	-
Cottondale	54	-	46
Mokumuru	100	-	-

	% Households in Which Wood is Collected By		
	Headloads	Truck Load	Tractor Load
Lujiko	100	-	-
Manzimahle	29	7	64
Clarkebury	62	7	31
Nkanga	100	-	-
Cottondale	61	39	-
Mokumuru	100	-	-

In many cases, thus, the traditional picture of women being the sole collector of fuelwood (mostly in the from of headloads), no longer holds. Men have become more involved in the collection of fuelwood, particularly if tractors have to be hired, trees cut or logs sectioned.

---

may be bought (R1 - R3) to cut growing indigenous trees for building purposes.

[16] Tyeni is one of the few villages in the Clarkebury area where some natural woodland still exists. Fuelwood can only be collected with the written permission of the head or sub headman.

	% Households in Which Wood is Collected By			
	Women	Children	Men	Combination
Lujiko	95	5	-	-
Manzimahle	53	8	32	7
Clarkebury	98	2	-	-
Nkanga	36	-	5	55
Cottondale	63	22	15	
Mokumuru	97	3	-	-

Scarcity of wood from natural woodland thus results not only in social hardship in terms of time and effort involved in wood collection, but also economic costs which take up an increasing proportion of the households budget. The major costs tend to be for transport for the collection of wood rather than the wood itself. In the case of Manzimahle a large load (1 tonne) may cost only R 2, but transport will cost between R 30 and R 50. In Cottondale, too, a load of wood from the forestry department at Mariepskop costs R 2 (for about a half tonne) and transport costs R 18, while a load from the SAPPI Green Valley plantation in the same area costs R 10 and transport R 15.

It thus no longer makes sense to draw a distinction between non-commercial and commercial fuels and to characterize fuelwood consumption in rural areas as being predominantly non-commercial. Wood has in many areas become a commodity for sale. However, there are very few cases of individual entrepreneurs planting and selling fuelwood. Rather, most fuelwood which has been sold has been from state woodlots. In some areas these were handed over to the tribal authorities and individual chiefs have been able to profit from them.

Indigenous wood is sometimes also collected by rural dwellers and transported by "scotch cart", truck or trailer for sale in towns.[17] In Cottondale, villagers can obtain a permit from the tribal authority for R10 to collect a pickup truck load of indigenous wood. People hire trucks and

[17] See Liegme (1983:249) and Kgathi (1984) who studied the fuelwood trade from rural areas to Gaborone.

their drivers to collect wood for them for a cost of R 15 to R 30 depending on the distance and load.

Health Costs

One aspect which has not been directly studied here is the potential deleterious effects on health from both the scarcity of wood and rural people`s dependence on it.

Many households are perilously close to the minimum energy required to meet basic needs and some are below this level. A lack of fuel means that cooked meals are skipped; extra foods or meat cannot be cooked with the staple mielie meal because it requires more fuel; hot water cannot be heated to increase hygiene and water collected from contaminated sources cannot be boiled before drinking.

Another aspect of health related to fuelwood use is the potential for nasopharyngeal cancer from inhaling the dense smoke which builds up within huts where cooking or heating fires are made. Gandar (1983b) reports that soot scrapings from the inside of huts have been shown to contain a number of polycyclic aromatic hydrocarbons which are carcinogenic. For those unused to it, the smoke filled atmosphere is unbearable. There is much circumstantial evidence that the smoke is harmful to those who commonly experience it, and that it can also lead to eye diseases such as trachoma.

Other health dangers associated with fuelwood use are burns from open fires and possible spinal damage from carrying heavy headloads.

Environmental degradation

Perhaps the most serious long term effect of growing fuelwood demand and scarcities is the environmental degradation associated with the denudation of woodland cover; for whenever the rate of wood collection exceeds the

natural regenerative capacity of trees and shrubs and green wood is cut then forests and woodland cover is stripped and denuded and this may exacerbate soil erosion, ultimately resulting in diminished agricultural yields.

The effects of fuelwood collection, even in relatively well wooded areas[18], in the immediate vicinity of villages are often readily observed: tree stumps and severed branches; lower density of trees; smaller shrubs; no dead wood on the ground and generally only larger stemmed trees.

Rural people are usually unwilling to divulge whether they have been cutting green or live trees, particularly where fines are possible. However, when asked whether (other) people in the village do so, a large number of households admitted that green wood is cut. The percentage of households which acknowledged this was Lujiko - 2%, Manzimahle - 89% , Nkanga 73% and in Cottondale - 7%. The low figures for Cottondale and Lujiko are indicative of the fear of heavy fines imposed for cutting growing trees.[19]

The extent of denudation is not as severe in all areas. In Liegme`s study area, for example, (Gazankulu) the annual rate of fuelwood collection (423 kg/ha) would still appear to be lower than the annual wood production for savanna woodland (600 kg/ha).[20] Gandar (1984) also argues that savanna rangeland such as valley lowveld does have considerable resilience to human encroachment. Many species, particularly the favoured fuelwood species are vigorous coppicers and he reports observing that the radial growth of coppicing Acacia nilotica was greater than that of equivalent sized stems of plants which had not been felled. The impact of fuelwood gathering in this area has been to lower the ratio of trees to shrubs and to convert open parklike areas into shrublands.

---

[18] Best (1979) reports that in Mashunka where wood is readily available, it was noticeable that a number of large trees had been ring barked, an action which eventually kills the tree.

[19] Gandar (1983) observed 8% of fuelwood harvested in valley lowveld in Kwazulu was green and that 42% was green or live wood amongst that collected in high grassland areas.

[20] The wood wasted or discarded (pieces which are too small or too large) when collecting should also be taken into account, and some tree species are also avoided, which would make the balance between supply and demand very much less secure.

In some areas local custom, tribal law, and state fines have provided some protection for trees and forests, and there is some evidence that some forest areas have been protected. McKenzie (1985), for example, argues that the extent of natural forests in Transkei has altered surprisingly little over the past century. Forests are clearly demarcated in Transkei and in many areas there has been the tradition of forbidding the taking of sharp implements into the forests, so as to prevent the cutting of growing trees, but at the same time to allow the taking out of dead wood.

It is questionable, though, whether many of the forests in the Transkei will survive intact in the future. At Nkanga, for example, sharp instruments such as pangas are taken into the forested ravines and there is much evidence of growing trees and branches having being cut.

Restrictions on cutting have also not been as effective elsewhere and forests can prove to be extremely vulnerable. Although there is apparent control over the Nkandla forest near Eshowe in Kwazulu, it has in fact receded over time. Ardington (1984) records dramatically that Cetawayo's grave which was originally hidden in the forest 100 years ago is now a couple of kilometers from the nearest tree. Murless (1983) states that of the 250 forests which were proclaimed in the Kwazulu areas in the Land Act of 1936, less than 50 survive. This evidence is in stark contrast to that of Mackenzie for Transkei.

One also has to draw a distinction between forests and general woodland which has been severely denuded in many areas. Certainly, in the Manzimahle/Cala area of Transkei the author observed green wood in head loads and much evidence of growing bushes and tree branches having been cut.

Harries (1984) reports that Ntlaveni, in the Giyani District, is now badly denuded. It was excised from the Kruger National Park in 1968/9 and the area produced an abundance of fuelwood which people as far afield as Louis

Trichardt and Sibasa collected unhindered until 1977. A Conservation Act, two years previously, prohibited the felling of trees, but attempts by tribal police to stop the destruction of trees proved ineffectual and control has now been transferred to the Gazankulu police. A tax on fuelwood collection was introduced in 1982; failure to pay the tax may result in a fine ranging from R20 to R50 or 1 - 3 months in prison.

There is much anecdotal evidence of denudation of woodland. Francis Wilson, for example, writes of the slopes of the Leolo mountains near Maandagshoek in Lebowa being completely covered by trees 20 years ago, and today lots of bare ground and rock is visible as people come up from the plain to cut down trees for fuelwood. Only scattered bush is left.

The greatest impact on the environment in the form of removal of tree cover has undoubtedly occurred around resettlement sites. This has been abundantly clear on visits by the author to Bendell near Kuruman in the Northern Cape and Thornhill in the Eastern Cape. Many of these areas are suited to extensive stock-farming and with dense human settlement the consequences on the physical environment have been disastrous. Daniel (1984: 6) writes:

> "The Thornhill resettlement provides an example of vegetation annihilation. In 1976/1977 about 40 00 people (were) moved from the Herschel District and were settled on the flanks of the Ntabathemba, the hill of hope.....From the air, this area (now) stands out as a reddish patch of bare soil, virtually devoid of vegetation. In 1976 Ntabathemba had a good cover of thorn trees and bush. By 1981 hardly a tree was to be seen on the slopes of the hill. These slopes are now subject to greater runoff and erosion by water and wind. What has happened here is happening in all areas of denser settlement, unless located near plantations. The influx of large numbers of people has upset the balance that may have existed before between man and his environment. The change is readily observed but there is no hard data as a result of measuring it. This type of political development can only hasten the decline in vegetation cover forecast by Acocks."

The rate of environmental degradation is often difficult to quantify or measure. An attempt can be made to relate fuelwood consumption to the natural regenerative capacity of the woodland and this will require painstaking botanical and ecological analysis of tree species used for fuelwood and construction purposes, inter tree competition and growth rates,

analysis of aerial photographs and perhaps Landsat satellite images over time. Such work is necessary if more objective and documented evidence is to be obtained.

Villagers recognize the growing problems associated with wood use and respondents listed the following problems:

	Per Cent Households Indicating Specified Problems With Wood at					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
% Sample	90	79	96	55	92	97
Scarce	18	13	12	50	57	17
Too Far	59	48	6	33	14	79
Heavy burden	23	16	32	17	-	3
Expense	-	18	53	-	9	-
Transport problem		13	2	-	11	-
Child care when collect.		5	-	-	-	-
Fines for cutting green wood			-	-	11	-

Households generally have a very detailed knowledge of natural flora and have different vernacular names for even the most subtle of botanical differences. They also have very definite preferences for different species for specific tasks.

Per Cent Households Listing Tree Species In Top Five Preferences	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Acacia karroo (Umnga - (Xhosa), Mooka (N Sotho) or Mimosa)	8	-	24	100	-	10
Combretum apiculatum (Mohweleri (N Sotho) or Xikukutso (Tsonga))	-	-	-	-	2	97
Acacia mearnsii (Wattle)	-	79	2	9	-	-
Eucalyptus spp. (Gum)	-	6	78	-	10	-
Scutia myrtina (Ubobo or Sipingo)	-	-	44	73	-	-
Ptaeroxylon obliquum (Umthathi or Sneeze)	12	-	-	72	-	-
Acacia burkei or robusta (Mokgwa)	-	-	-	-	-	63
Cussonia paniculata (Motshe or motshetse?)	-	-	-	-	-	50
Dalbergia obovata (Uzungu)	-	-	-	45	-	-
Pinus spp. (Pine)	-	-	40	-	15	-
Grewia lasiocarpa ((U)hlolo)	-	-	-	36	-	-
Combretum imberbe (Mmondzo - Tsonga, Motswere - N Sotho)	-	-	-	-	6	33
Acacia tortilis (Moswana or mosu)	-	-	-	-	-	30
Aloe spp.	-	-	29	-	2	-
Rhus lancea (Umhlakotshane)	-	-	-	27	-	-
Olea europaea spp. africana (Umnquma or Olive)	20	-	-	9	-	-
Maytenus heterophylla (Umqaqoba)	20	-	-	9	-	-
Schotia brachypetala (Molope)	-	-	-	-	-	20
Turraea floribunda (Umvuma)	-	-	-	18	-	-
Calodendrum capense (Umbaba)	-	-	-	9		-
Zanthoxylum capense (Umnungu mabele)	-	-	-	9	-	-
Combretum erythrophyllum (Modibo or Moduba)	-	-	-	-	-	3
Strychnos innocua (Nkwakwa)	-	-	-	-	2	-
Dichrostachys cinerea (Ndzenga (Tsonga) Moretshe (N Sotho))	-	-	-	-	8	-
Diospyros mespiliformis (Ntoma)	-	-	-	-	2	-

Most of the above species are preferred for fuelwood, although some are also used for the construction of kraals and fences. There is also a definite aversion to using certain tree species for fuelwood: eg. in Mokumuru, the Marula (Sclerocarya caffra), Mogorogoro (Strychnos spinosa), Morekuri (Spirostachys africana) because of its smell, Mmilo (Vangueria infausta), and Mogale because it is believed that if burnt cows will produce bull calves only.[21]

Data from other areas is also of interest here. Liegme (1983) reports that in her area of study in Gazankulu, Colophospermum mopane and Combretum apiculatum were regarded as the best fuelwood species and these were also the two which were most often used. Other species also mentioned as producing good firewood were Combretum imberbe and Acacia nigrescens. Altogether, 42 species were found to be used for fuelwood in her study area, but 3 species made up 77% by weight of wood collected and 8 species over 90%.

Expressed preferences for fuelwood species do not necessarily coincide with those actually used, as the former, not infrequently, have become more difficult to find.

Cunningham (1984) reports that the main fuelwood in Maputaland coastal plains in the Ingwavuma district in Northern Kwazulu/Natal were Sclerocarya caffra, Dialium schlecteri, Strychnos madagascariensis, Acacia burkei, Syzigium cordatum, Terminalia sericea, Trichilia emetica, Albizia adianthifolia and Macaranga capensis.

Gwaitta-Magumba (1983) writes that the preferred species in Swaziland are Acacia nigrescens (umkhanga) and A. davyi (umgambe).

---

[21] Gandar (1983b) also reports that certain species are avoided for fuelwood. It is believed, for example, that the burning of Euclea spp causes strife in the family; Vangueria infausta and Diospyros lycioides are believed to attract lightning; and Spirostachys africana and Euphorbia tirucalli are generally only burnt outside because of their unpleasant or toxic smoke.

Kgathi (1984) reports that fuelwood traders who collect fuelwood in the Kaneng District of Botswana and sell it in Gaborone preferentially select Combretum imberbe and C. apiculatum. Less desired fuelwood species are Acacia erubescens, A. karroo, A. tortilis, and Dichrostachys cinerea.

And Gandar (1983b) states that preferred species at Mahlabatini in Kwazulu are Maytenus heterophylla, Acacia caffra, A. karoo, A. nigrescens, A. nilotica, A. robusta, A. tortilis, Combretum apiculatum, Ziziphus mucronata, Dichrostachys cinerea, Cassine transvaalensis, Berchemia zeyheri (this is a royal tree and generally protected), and Olea africana.

2.1.2 Agricultural Residues

Another consequence of fuelwood shortages is the use of agricultural residues as a fuel.[22]

Dung usage

The tables below detail the patterns of usage of animal dung.

	% Households Using Dung	Mean Annual Per Capita Dung Consumption (kg)	% Obtained From Kraals or Veld	
Lujiko	66	125	14	86
Manzimahle	73	137	73	50
Clarkebury	100	231	73	98
Nkanga	100	126	91	64
Cottondale	23	53	50	97
Mokumuru	100	112	100	100

The majority of households in all the villages except Cottondale use dung as a fuel. The low percentage in Cottondale may be attributed to the

[22] In countries such as Malawi where fuelwood is more abundant, the use of crop residues is not nearly as wide spread. (Malawi Energy Unit, 1981). The use of dung is most widespread in Lesotho, and to a lesser extent in Botswana, but is uncommon in Zimbabwe.

availability of alternative fuels, particularly coal, and also to the small proportion of households which own cattle in that village.[23] Mainly cattle dung is used, but also horse, donkey, sheep and goat manure.

The following animal ownership patterns were observed:

	% Households Owning Animals						
	Cattle	Horses	Donkeys	Sheep	Goats	Pigs	Chickens
Lujiko	31	2	2	31	41	84	86
Manzimahle	73	10	4	69	31	56	92
Clarkebury	58	16	2	51	15	33	84
Nkanga	100	18	0	27	27	82	100
Cottondale	15	0	0	0	25	15	85
Mokumuru	47	0	10	20	63	23	90

	Min and Max Animals Owned in those Households which Have Animals			
	Cattle	Sheep	Goats	Chickens
Lujiko	1 - 12	2 - 35	3 - 45	2 - 49
Manzimahle	1 - 20	3 - 200	1 - 8	1 - 20
Clarkebury	2 - 15	2 - 100	1 - 30	1 - 30
Nkanga	3 - 16	3 - 26	6 - 26	5 - 30
Cottondale	2 - 10	-	2 - 50	1 - 30
Mokumuru	1 - 7	1 - 10	1 - 12	1 - 11

	Mean Number of Animals Owned in those Households which Have Animals						
	Cattle	Horses	Donkeys	Sheep	Goats	Pigs	Chickens
Lujiko	4,7	1	4	15	14	1,8	9
Manzimahle	5,6	1,8	2	30	4	1,4	7
Clarkebury	4,7	2	2	13	8	2,2	10
Nkanga	8,6	3	0	14	13	2,1	12
Cottondale	6,9	0	0	0	11	3,2	9
Mokumuru	4,0	0	3	3	5	1,9	4

We may calculate the total amount of dung theoretically available from the above figures, assuming that about 8 tonnes/annum of dung are produced per unit of cattle, 1,5 tonnes/annum for pigs, 0,5 t/a for sheep and goats and 0,03 t/annum for chickens:

[23] In those areas where fuelwood is still relatively freely available, little dung is used. Ardington (1984:132) reports that only about 3% of households use dung in her study area near Eshowe.

	Mean Dung Available Per Household (tonnes/annum)					
	Cattle	Sheep	Goats	Pigs	Chickens	Consumption
Lujiko	11,6	2,3	2,9	2,3	0,2	0,5
Manzimahle	32,7	10,3	0,6	1,2	0,2	0,46
Clarkebury	21,8	3,3	0,6	1,1	0,3	1,31
Nkanga	68,8	1,9	1,7	2,6	0,4	1,06
Cottondale	8,3	0,0	1,3	0,7	0,2	0,22
Mokumuru	15,0	0,3	1,6	0,6	0,1	0,54

The above figures assume that dung from those who have animals is available to all villagers. This is generally true if the animals are free ranging. If animals are kept in kraals, the amount of dung available for those households which have cattle would be very much higher.

The moisture content of fresh dung is about 80% (on a dry basis) and that of sun dried dung - about 40%. The mass of sun dried dung available is thus about three-quarters of the figures calculated above.

When one compares the above figures with actual dung consumption for fuel it is clear that consumption is very much below the total average dung production. Obviously only a small proportion of the dung will be able to be collected if the animals are free ranging. Nevertheless, dung consumption for cooking and heating is on average less than 1% of total dung production.

	Mean household dung consumption per annum (kg)
Lujiko	504
Manzimahle	460
Clarkebury	1312
Nkanga	1064
Cottondale	222
Mokumuru	545

It cannot therefore be argued that the burning of dung is significantly diverting it from use as a fertilizer. In the villages studied dung is in fact used extensively as a fertiliser.

	% Households Which Have Used Dung as a Fertilizer
Lujiko	52
Manzimahle	90
Clarkebury	67
Nkanga	91
Cottondale	23
Mokumuru	54

A small proportion of households consider the use of dung as a fuel to be problematical.

	% Households indicating problems with Dung				
	Smoke	Smell	Scarce	Poor Fire	Unhealthy
Lujiko	12	18	16	-	-
Manzimahle	8	-	-	-	-
Clarkebury	2	-	-	-	-
Nkanga	36	-	-	-	-
Cottondale	4	4	-	2	13
Mokumuru	20	-	-	-	-

Dung gives off a pungent smoke when burnt and it is thus not surprising that a high proportion of complaints centred on these two problems. As a result dung is mostly burnt outside.

Few cases were discovered of people buying or selling dung, presumably because it is relatively freely available, although in Cottondale it was reported that some families sold dung from their kraals at a high price.[24] Women, though, did complain of the effort involved in collecting bags or basins of dung. It is used primarily for beer brewing (dung provides a low temperature smoldering fire), and sometimes for cooking and heating water for washing. It is also recognized that dung burns better in windy weather.

[24] Gay and Khoboko (1982) report that sales of dung (R2-50/bag) occur in Mokhotlong in Lesotho.

Crop residues

A high proportion of households also use crop residues as a fuel, in winter or after harvest, and mostly for a few weeks until they run out. Crop residues are used not only as a kindling fuel but also as the main cooking fuel.

	% Households Using Wastes as a Fuel			
	Mieliecobs	Mielie Stalks	Sorghum Res	Bean Res
Lujiko	90	18	8	22
Manzimahle	92	82	25	29
Clarkebury	100	47	-	7
Nkanga	100	82	-	-
Cottondale	2	-	-	-
Mokumuru	87	13	7	-

There is no record of residues being sold or bought. Residues are perceived to be an inferior fuel; they burn very rapidly without liberating much heat, and people also complain of the smoke and large flames. The use of residues is a measure of forced substitution because of local scarcities of fuelwood, and the effort and costs involved in wood collection. Crop residues are used mainly for heating water.

The incidence of residue usage as a fuel is higher than field and garden plot ownership. Households which do not have fields sometimes ask permission from those who have planted and harvested a crop, to collect some of the residues.

	% Households With Fields and	Garden Plots
Lujiko	88	69
Manzimahle	67	75
Clarkebury	60	55
Nkanga	81	73
Cottondale	94	4
Mokumuru	77	3

No measurements were taken of residue consumption, but a rough estimate of the quantity of residues available might be obtained from data on grain

production. The table below indicates the mean number of bags of mielies available for grinding in 1984/5 and the calculated residue availability based on 1 bag = 70 kg and 0,4 tonnes residue / tonne grain (pers. comm. Dept of Agriculture, 1985).

	% Households Which Produce Mielies	Mean No of Bags of Producers	Mean Household Mielies Kg	Mean Household Residues Kg
Lujiko	10%	3,8	27	11
Manzimahle	73%	2,0	102	41
Clarkebury	88%	13,0	800	320
Nkanga	100%	2,6	182	73
Cottondale	63%	5,5	243	97
Mokumuru	83%	3,8	221	88

It is clear that in the year of the survey, crop residues were not a major fuel, even if it is assumed that all crop residues were burnt. The possible exception was Clarkebury, although the higher figures here cannot readily be explained: Clarkebury is one of the least favourable areas for agriculture amongst the villages surveyed.

These figures should be treated with some caution. The survey was undertaken in a drought year and the production of mielies was extremely low, although not untypical of many other areas[25]. Nevertheless, it would seem that the potential of crop residues as a fuel for rural households is limited. Even for a family which produces 20 bags of mielies a year, the available crop residues would be 560 kg. If two thirds of this were used as a fuel the total contribution to household energy use would be less than 7%.

[25] eg Gandar & Bromberger (1984) report a mean maize production of 4,5 bags per household in the Mahlabatini District in Kwazulu.

2.1.3 Use of commercial fossil fuels

The shortage of fuelwood has also led to a greater shift to the use of commercial fossil fuels such as paraffin, gas, coal and batteries.

	Mean annual per capita domestic energy consumption in total sample			
	Paraffin l	Candles No	Coal Kg	Gas Kg
Lujiko	28	5	-	-
Manzimahle	43	24	5,5	0,5
Clarkebury	23	39	29,7	1,6
Nkanga	10	20	-	0,3
Cottondale	24	42	82,5	1,6
Mokumuru	10	33	4,0	-

Paraffin is almost universally used[26] and a substantial number of households use coal in Cottondale which is close to a railway siding, and at Clarkebury where there are almost no local wood resources left. In the case of Cottondale, coal is transported to Acornhoek by train and people travel to Acornhoek by taxi to collect their coal. The cost of a coal stove can be extremely high (up to R 1000). The stoves can also be quite wasteful of energy, as they generally have more plates than are used and they can not be used effectively for short cooking operations.

Quite a large number of those interviewed stated that they experienced problems with the use of paraffin, particularly with regard to its cost.

	Percentage households which experience Problems associated with Paraffin		
	Expense	Smoke/Smell/Messy	Unhealthy
Lujiko	94	-	-
Manzimahle	15	-	10
Clarkebury	4	-	-
Nkanga	91	-	-
Cottondale	17	23	13
Mokumuru	47	-	-

[26] Again, there are exceptions. Ardington (1984) records less than 2% of households using paraffin for cooking, although others used limited amounts for lighting.

The expense of coal and gas were also seen as problems, and in the case of gas there was the added difficulty of getting to town for refills.

	% Households Which Use	
	Dry Batteries	Car Batteries
Lujiko	69	-
Manzimahle	29	2
Clarkebury	40	4
Nkanga	36	3
Cottondale	73	6
Mokumuru	83	-

The majority of households use batteries, usually PM9s and sometimes PM10s, mainly for radios and sometimes hifi sets. Car batteries are also sometimes used to power hifi sets or lighting. Cottondale was the only village where a car battery powering a television set was observed. One household in Clarkebury had a small generator. No solar cells were observed.

2.1.4 Summary of fuel usage for cooking, heating and lighting

The following tables summarize the fuels and energy used for cooking, heating and lighting in rural villages.[27]

	Mean annual household domestic energy consumption in total sample					
	Fuelwood Kg	Dung Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Lujiko	3402	504	130	31	-	-
Manzimahle	2845	460	191	117	25	2
Clarkebury	2753	1312	139	220	179	12
Nkanga	3777	1064	84	180	-	5
Cottondale	3580	222	167	305	554	11
Mokumuru	2920	545	52	174	18	-

[27] Crop residues are also used, but consumption was not measured

	Mean annual per capita domestic energy consumption in total sample					
	Fuelwood Kg	Dung Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Lujiko	766	120	28	5	-	-
Manzimahle	650	94	43	24	5,5	0,5
Clarkebury	484	231	23	39	29,7	1,6
Nkanga	498	126	10	20	-	0,3
Cottondale	572	28	24	42	82,5	1,6
Mokumuru	655	108	10	33	4,0	-

These figures may be compared to studies elsewhere in Southern Africa

Domestic Rural Energy Consumption Per Capita Per Year In Southern Africa

Reference	Area	Char-coal tonne	Fuel-wood tonne	Agric residues tonne	Petro-leum litres	Overall GJ
Bhagavan (1983)	Angola	-	(,523)	(,025)	(3)	9,35
Wisner (1982)	Botswana	-	(,797)	(,059)	(2,3)	14,46
Frolich (1982)	Lesotho	-	(,463)	(,348)	(11,1)	13,44
Best (1979)	Lesotho (East)	-	,288	,260	5,08	(8,2)
Scobey (1982)	Malawi	-	(,628)	(,033)	(0,3)	11,16
Jackson (1981)	Malawi	-	(,587)	x	x	(9,98)
Munslow (1982)	Mozambique	,001	(1,135)	(0,134)	(3,1)	21,35
Munslow (1982)	Swaziland	-	(,495)	(,033)	(5,1)	9,37
Susman (1982)	Zambia	,017	(,94)	(,035)	(1,7)	17,32
Hosier (1982)	Zimbabwe	-	(1,031)	(,013)	(,013)	(3,1)
Banks (1981)	Zimbabwe	-	(,616)	x	x	10,47

Sources: Beijer Institute (1982), Output Tables, and indiv. quoted papers.

The tables below record mean consumption data for those families which use the particular fuel.

	Mean annual per capita domestic energy consumption in households using fuel					
	Fuelwood Kg	Dung Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Lujiko	766	190	28	12	-	-
Manzimahle	650	187	45	41	88	11,7
Clarkebury	484	231	24	40	191	17,9
Nkanga	498	126	10	22	-	3,3
Cottondale	572	229	28	49	220	19,5
Mokumuru	655	112	10	52	40	-

	Mean annual domestic consumption per household using fuel					
	Fuelwood Kg	Dung Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Lujiko	3402	797	130	68	-	-
Manzimahle	2845	921	199	201	392	48
Clarkebury	2753	1312	142	225	1148	130
Nkanga	3777	1064	96	197	-	59
Cottondale	3580	1777	196	358	1477	129
Mokumuru	3358	565	54	273	179	-

The table below presents the equivalent energy value of fuels used, based on the following values: air dried wood of 15% moisture[28] (d.b.) - 17 MJ/kg, sun dried dung of 40% moisture (d.b.) - 12 MJ/kg (Bialy, 1979), paraffin - 37 MJ/l, Coal - 27 MJ/kg and Gas - 49 MJ/kg. The calorific value of candle wax is also used , but candles (like batteries) contribute very little to overall energy consumption.

	Mean annual domestic nett energy consumption in total sample GJ per household						GJ Per capita	
	Fuelwood	Dung	Paraffin	Candles	Coal	Gas	Total	Total
Lujiko	57,8	6,1	4,8	0,1	-	-	68,8	15,5
Manzimahle	48,4	5,5	7,1	0,4	0,7	0,1	62,2	14,0
Clarkebury	46,8	15,7	5,1	0,8	4,8	0,6	73,8	12,9
Nkanga	64,2	12,7	3,1	0,6	-	0,3	80,9	10,4
Cottondale	60,9	2,7	6,2	1,1	14,9	0,5	86,3	13,4
Mokumuru	57,1	6,6	1,9	0,6	0,5	-	66,7	13,0

2.2 FUEL EXPENDITURE

The amounts spent annually on fuel are:

	Mean Annual Household Fuel Expenditure (1984/5 Rand)						
	Fuelwood	Paraffin	Candles	Coal	Gas	Batteries	TOTAL
Lujiko	104,36	62,27	3,69	-	-	?	170
Manzimahle	109,53	96,56	14,04	6,23	2,48	?	229
Clarkebury	115,63	72,16	26,35	35,16	19,99	?	269
Nkanga	117,71	41,73	21,56	-	6,42	?	187
Cottondale	82,16	99,29	36,66	44,85	8,00	?	271
Mokumuru	-	30,79	20,80	3,07	-	?	55

[28] Gandar (1983) measured fuelwood from woodpiles with moisture contents of 10 - 37% with a mean of 17%.

Expenditures on fuel are highest in Manzimahle, Clarkebury and Cottondale where fuelwood from natural woodland is scarcest. As a result larger amounts have to be spent purchasing wood and also on substitute fuels such as paraffin. Except for Mokumuru, where no wood is bought, wood constitutes the largest expenditure, followed by paraffin.

Fuel prices are reasonably constant between different areas, other than coal which is highly dependent on transport costs.

	Mean Fuel Prices (1984/5 Rand)		
	Paraffin c/l	Coal c/kg	Gas c/kg
Lujiko	62	-	-
Manzimahle	52	27	125
Clarkebury	53	19	?
Nkanga	52	-	120
Cottondale	59	8	74
Mokumuru	59	17	-

The income data which was collected was not reliable and has thus not been included here. However, it is apparent that expenditure on fuel can amount to a sizeable proportion of total income - (10 per cent , on average, in the five areas.)

2.3 FUEL PREFERENCES

The following fuels are preferred for cooking and heating:

	Fuel Preferences for Cooking (% households)				
	Wood	Gas	Coal	Paraffin	Electricity
Lujiko	92	-	-	8	-
Manzimahle	65	4	13	7	11
Clarkebury	47	4	36	9	4
Nkanga	44	-	33	22	-
Cottondale	8	6	39	4	42
Mokumuru	13	-	53	10	23

	Fuel Preferences for Heating (% households)				
	Wood	Gas	Coal	Paraffin	Electricity
Lujiko	94	2	-	4	-
Manzimahle	53	9	4	23	11
Clarkebury	38	11	35	13	3
Nkanga	36	-	18	45	-
Cottondale	6	4	38	13	40
Mokumuru	7	3	28	28	31

It seems that people generally express preferences for fuels with which they are familiar. Thus fuelwood ranks fairly high and gas very low, presumably because very few rural households have experience with gas.

However, it is noticeable that, although very few households use coal (other than in Cottondale) and none use electricity, a sizeable proportion of respondents expressed preferences for these energy sources, which would suggest that these energy sources should not be ignored when considering alternative energy supply strategies for these areas. In Cottondale, an electricity line passes through the area. All are aware of its benefits, but few believe that it is likely or probable that they will be able to gain access. Surprisingly, in Mokumuru, which is perhaps the most "rural" of villages surveyed, both coal and electricity are also preferred in spite of, but also perhaps because of, their existing overwhelming dependence on firewood.

Although paraffin is almost universally used, a very much smaller proportion expressed a preference for this fuel, indicating a high level of dissatisfaction with it.

It is interesting to note that more households prefer the use of gas and paraffin for heating rather than cooking. These fuels are seen to be able to provide rapid heating. Conversely, more prefer coal for cooking than heating. Coal is preferred because it provides long lasting fires.

In Lujiko wood is preferred as the cooking and heating fuel because it is either still "free" or freely available from vendors. Smaller numbers of households prefer this fuel in Manzimahle and Clarkebury where it is mainly available from plantations.

The following fuels are preferred for lighting:

	Fuel Preferences for Lighting (% households)			
	Gas	Paraffin	Electricity	Candles
Lujiko	4	94	-	2
Manzimahle	2	51	23	23
Clarkebury	9	44	7	40
Nkanga	-	11	33	56
Cottondale	9	36	47	8
Mokumuru	-	53	33	13

Paraffin ranks the highest, perhaps because it is the most familiar and available of lighting fuels. Candles are seen to be the cheapest and electricity is preferred because it is able to provide bright and problem free lighting.

2.4 ENERGY USE PATTERNS

2.4.1 Cooking practices

Details were collected on cooking patterns in order both to understand the way in which fuels are used and also as a guide to interventionist strategies such as fuel-efficient woodburning stoves or solar cookers.

The average number of people cooked for in the various villages is shown over page.

	Mean No of People Which Are Cooked For
Lujiko	5,4
Manzimahle	5,3
Clarkebury	6,7
Nkanga	9,2
Cottondale	7,2
Mokumuru	5,6

Nearly all households cook at least once a day, although about 5 -7% of respondents in Lujiko, Cottondale and Mokumuru cook less often, presumably because of fuel and cash deficiencies.

	% Households Which Cook		
	Once/Day	Twice/Day	Thrice/Day
Lujiko	45	36	14
Manzimahle	2	8	90
Clarkebury	-	12	82
Nkanga	18	27	55
Cottondale	27	29	44
Mokumuru	-	90	10

There does not seem to any obvious relationship between fuelwood scarcities and performing fuelwood-consuming tasks such as cooking less often.

	% Households Which Cook				
	Early Morn	Mid-Morn	Midday	Afternoon	Evening
Lujiko	96	0	65	-	49
Manzimahle	100		81	13	94
Clarkebury	100	0	80	76	27
Nkanga	100	0	82	36	18
Cottondale	66	0	80	8	44
Mokumuru	100	-	10	-	93

A high proportion of households do their cooking indoors. The proportion is generally higher in the evening because fires and stoves are also used for home heating.

	% Households Which Cook Indoors		
	Morning	Midday	Evening
Lujiko	73	69	100
Manzimahle	88	34	78
Clarkebury	45	16	25
Nkanga	82	30	90
Cottondale	83	90	95
Mokumuru	100	98	100

Primus and gas stoves are used more often in the morning. The food which is most often cooked is maize porridge (primarily in the morning) or samp and vegetables (mostly at midday or in the evening) and sometimes bread or meat.

Most cooking involves long simmering. Thin mielie meal porridge (usually made in the morning) is made by adding one part of mielie meal porridge to 3 to 6 parts water. The porridge is cooked within 20 minutes but is usually simmered from 1 to 2 hours. Puthu, or stiff porridge, requires 4 parts of mielie meal to be added to 1 to 2 parts water. It should be cooked over a low heat for at least 20 minutes, but frequently from 1 to 2 hours to improve the flavour. Samp and beans are cooked in water for approximately 3 hours.[29]

The types of fires/stoves most often used in the different villages are shown below:

	Most Common Stove & Fuel Used (%)			
	Openfire/Brazier	Wood/Coalstove	Primus	Gas Stove
Lujiko	92	-	8	-
Manzimahle	47	25 / 4	23	1
Clarkebury	69	/ 12	15	4
Nkanga	82	-	18	-
Cottondale	67	/ 24	7	2
Mokumuru	100	-	-	-

Wood is the most often used fuel in fires and stoves, although both dung and

[29] A useful book on African cooking practices is Renato Coetzee's Funa : food from Africa, Butterworths, Durban & Pretoria, 1982.

coal are also widely used.[30] Fires are used for both cooking and space heating and as a fire often serves both functions it is futile to estimate how much fuel or wood is used for each purpose.

The cooking fuels and appliances most often used may be compared to actual appliance ownership below, which would seem to indicate that although most households have paraffin stoves, only a minority regularly use these for cooking - wood fires, of course, being the dominant practice. Paraffin stoves are used frequently for quick and short cooking tasks such as tea making for unexpected quests. A surprising number of households have either coal or wood stoves and a number also gas cookers.

	Appliance Ownership (% Households)						
	Primus Stove	Paraffin Wickstove	Gas Stove	Coal Stove	Wood Stove	Tripod	Haybox
Lujiko	96	6	-	-	-	-	-
Manzimahle	83	44	10	15	8	48	2
Clarkebury	9	40	9	13	-	12	-
Nkanga	82	55	3	-	-	73	-
Cottondale	69	4	6	35	2	71	-
Mokumuru	63	10	-	13	-	100	-

Many households have iron tripod stands for pot supports for open fires. Most families make 2 to 3 fires per day and a high proportion move fires, usually when its cold and when cooking fires are used for home heating as well.

	Mean Number Of Fires Made per Day	% Households Which Move Fires
Lujiko	2,4	96
Manzimahle	3,0	94
Clarkebury	2,0	74
Nkanga	3,0	100
Cottondale	2,1	43
Mokumuru	2,0	96

[30] Moller (1985) reports 30% of households use dung and 50% use coal for cooking and heating in rural areas in Lebowa and Kwazulu.

	Reasons for Moving Fire				
	Wind	Rain	Cold	Night	House Heating
Lujiko	78	2	17	-	3
Manzimahle	22	11	38	-	30
Clarkebury	10	3	87	-	-
Nkanga	56	-	22	11	11
Cottondale	6	82	6	-	6
Mokumuru	-	-	96	-	-

Villagers are aware that wind causes unnecessary heat losses from the cooking operation and most cooking fires are also shielded.

	% Households Shielding Fire
Lujiko	96
Manzimahle	92
Clarkebury	98
Nkanga	91
Cottondale	83
Mokumuru	73

The method most often used to shield fires is simply a corrugated iron sheet. Braziers are also used. Many of the areas have purpose build low walls often constructed in the form of a cross so as to provide a least one corner which is sheltered from the wind. In Cottondale, special cooking shelters, made from bamboo or wood are used for most cooking operations. On occasion even mielie bags and branches are used to shield fires.

	Method of Shielding Fire						
	Ironsheet	Brazier	Xwall	Wall	Shelter	Miliebags	Branches
Lujiko	76	-	-	4	-	13	6
Manzimahle	91	-	9	-	-	-	-
Clarkebury	71	21	7	-	-	-	-
Nkanga	78	-	-	22	-	-	-
Cottondale	3	3	-	3	88	-	-
Mokumuru	59	-	41	-	-	-	-

An open fire undeniably also serves a social function. It is usually made in the centre of the cooking hut which serves as a focus for the family and visitors. It has been observed that households in which men are at home use very much more fuelwood, probably because of a higher incidence of sitting

and chatting around the fire.

Each household owns a number of three-legged cast iron pots and flat bottom aluminium saucepans.

	Appliance Ownership (%)			
	Iron pots	Saucepans	Kettles	Irons
Lujiko	98	94	96	88
Manzimahle	83	77	77	40
Clarkebury	98	89	98	64
Nkanga	100	91	100	64
Cottondale	88	92	71	28
Mokumuru	100	83	100	87

2.4.2 Water Heating

Water is heated for both tea making and also for washing purposes. Although wood fires are used extensively for heating water for tea, so are paraffin stoves.

	Tea Making Stove & Fuel Used (%)			
	Openfire	Wood/Coalstove	Gas stove	Paraffin stove
Lujiko	62	-	-	38
Manzimahle	19	28 / 2	2	49
Clarkebury	45	5 / 9	2	39
Nkanga	33	-	-	67
Cottondale	57	/ 16	4	23
Mokumuru	96	-	-	4

The fire used for cooking is invariably also used for heating water. Typically, a tin would be placed alongside the fire. Water is heated primarily for bathing and washing dishes in the morning, often with the same water. Hands and faces may be washed again in the evening with the dishes and pots. Hot water is seldom heated for laundry, which is commonly done in cold water with heavy scrubbing on flat rocks next to a stream or in big tubs.

	Heating Water for Washing Stove & Fuel Used (%)				Quantity
	Openfire/brazier	Wood/coalstove	Gas Stove	Primus Stove	1 / day
Lujiko	66	-	-	34	10
Manzimahle	63	24 / 3	3	8	19
Clarkebury	61	28 /11	-	-	49
Nkanga	44	-	-	56	17
Cottondale	69	/23	7	1	15
Mokumuru	100	-	-	-	-

The majority of water is heated in the morning and also evening. This has implications for the potential for simple, very low cost solar water heaters - about half of the hot water could not be effectively met from this source without expensive insulated water storage containers.

	% Households Which Heat Water In				
	Early Morning	Mid-Morning	Midday	Afternoon	Evening
Lujiko	98	-	-	-	69
Manzimahle	92		17		38
Clarkebury	100	-	-	-	82
Nkanga	86		24		29
Cottondale	95	2	14	-	55
Mokumuru	100	-	36	-	82

Many households also heat water occasionally for brewing beer. Average quantities of water used are about 70 litres per brew.

2.4.3 Home Heating

Space heating is accomplished most often with:

	Home Heating (%)			
	Openfire	Wood/Coalstove	Paraffin Heater	Gas Heater
Lujiko	90	-	10	-
Manzimahle	92	4	4	-
Clarkebury	80	2	9	9
Nkanga	100	-	-	-
Cottondale	69	25	-	-
Mokumuru	100	-	-	-

It is interesting that except in the case of Cottondale, stoves are used relatively little for home heating, whereas fires are used by most households. It would seem to indicate that stoves are used primarily for cooking purposes and that space heating is completely secondary. On the other hand open fires are preferred for heating, probably because of social preferences associated with people sitting and talking around a fire.

As with cooking appliances, many more heating appliances are owned than regularly used. Part of the reason would be the expense and irregularity of the supply of paraffin and gas.

	Appliance Ownership (% Households)		
	Paraffin Heaters	Braziers	Gasheaters
Lujiko	14	16	0
Manzimahle	29	89	8
Clarkebury	16	-	9
Nkanga	9	18	0
Cottondale	0	0	0
Mokumuru	7	-	0

Requirements for space heating depend largely on the type of dwelling structure - a thatch roof and heavy mass walls will greatly reduce the amount of heating required at night and in cold periods.

Because of extended families and the practice of having separate cooking, sleeping and storage huts, many households have more than one house and have experience of different construction types.

	Mean Number of Houses Per Household
Lujiko	3
Manzimahle	2,4
Clarkebury	3,1
Nkanga	4,7
Cottondale	2,7
Mokumuru	2,7

	Type of House Roof (and Preference) %			
	Thatch	Iron Sheets	Thatch&Iron	Asbestos
Lujiko	2 (14)	96 (86)	-	2
Manzimahle	23 (51)	23 (36)	49 (13)	4
Clarkebury	44 (66)	7 (33)	49	-
Nkanga	50 (91)	- (9)	50	-
Cottondale	6 (42)	54 (56)	40	-
Mokumuru	20 (27)	33 (80)	47	-

Many more households prefer thatch roofed dwellings compared to their existing roof type, although a majority in Lujiko, Cottondale and Mokumuru prefer corrugated iron roofs. Some of the reasons for expressed preferences are listed below.

	Reasons for Roof Preferences					
	Warmer	Durable	Available	Aesthetic	Cheaper	Water Runoff
Lujiko	13	64				23
Manzimahle	70	26				
Clarkebury	67	5	2	-	-	26
Nkanga	64	-	9	-	-	27
Cottondale	25	32		14	5	-
Mokumuru	23	60	17	-	-	-

The thermal insulation properties of thatch are definitely recognized and thatched houses are seen to be warmer. A minority worry about the fire hazard with thatch, and thatching grass is often scarce. Iron sheet roofing construction is seen to be easier, more modern, and it has the added advantage of being able to collect rainwater.

The majority of houses are constructed with wooden pole frames and roof supports with mud or mud/cement blocks or bricks.

	House Wall Construction				
	Mud	Bricks	Wood	Concrete Bl.	
Lujiko	92			8	
Manzimahle	93	2	-	3	
Clarkebury	100	-	-	-	
Nkanga	100	-	-	-	
Cottondale	32	-	2	66 (mud cement block	
Mokumuru	78	22	-	-	-

In many areas, particularly in the Transkei, traditional dwellings have been very carefully orientated with open door ways generally facing north or north-east so as to maximize the penetration of solar radiation, which reduces the requirements for space heating.[31]

2.4.4 Lighting practices

Candles and paraffin are the most common fuels used for lighting

	% Using Fuel For Lighting			And Mean Number of Candles Used Per Household Per Week
	Candles	Paraffin	Gas	
Lujiko	42	98	-	1,3
Manzimahle	40	70	4	3,9
Clarkebury	73	42	10	4,3
Nkanga	64	36	-	3,8
Cottondale	44	60	2	6,9
Mokumuru	53	67	-	5,3

	Appliance Ownership (%)		
	Paraffin Lamps	Gaslamps	Torch
Lujiko	96	2	57
Manzimahle	79	4	44
Clarkebury	69	6	22
Nkanga	64	-	18
Cottondale	71	2	31
Mokumuru	90	7	50

Paraffin lamps are usually wick lamps, but pressure lamps are also used as are homemade lamps consisting of a jam jar and a piece of thick rope knotted through the lid.

Most families use lighting from sundown to about 21h00 or 21h30, although some families light their houses for the entire night because they are afraid of evil spirits or tsotsis.

---

[31] See Siegfried's (1984) study of energy conservation in Transkei rural communities.

	Mean Hours Lighting Per Day
Lujiko	2,7
Manzimahle	3,8
Clarkebury	4,5
Nkanga	2,9
Cottondale	4,1
Mokumuru	3,3

2.4.5 Other Domestic Energy Uses

A small number of families use paraffin and gas fridges. No incidence of solar water heating was discovered.

	Appliance Ownership (%)		
	Paraffin Fridge	Gasfridge	SWH
Lujiko	0	0	0
Manzimahle	4	0	0
Clarkebury	0	2?	0
Nkanga	0	0	0
Cottondale	8	2	0
Mokumuru	3	0	0

Most families use irons which are heated with woodfires, coal, paraffin, or gas stoves. Heating flat irons on paraffin and gas stoves may use considerable amounts of fuel as the stoves are kept alight for more than an hour during which time no other task can be performed other than the alternative heating and pressing.

	% Using Fuel for Heating Iron				Ironing Frequency
	Wood	Paraffin	Coal	Gas	Per Week
Lujiko	69	52	-	-	1,9
Manzimahle	35	51	3	11	1,7
Clarkebury	29	54	4	11	1,8
Nkanga	40	90	-	-	2,4
Cottondale	18	55	24	3	2,1
Mokumuru	80	20	-	-	1,3

The use of alternative fuels is usually dependent on the purchase of new appliances, often at considerable expense. The above data indicated that a

number of appliances are already owned by most households, particularly paraffin and wood/coal stoves, paraffin lamps and heaters, and, to a lesser extent, gas appliances. The use of alternative fuels is widespread and is likely to increase as wood scarcities and/or wood prices increase.

2.5 WATER COLLECTION

After fuelwood, the most serious energy related problem is water supply. In every area which was visited, clean, reliable and convenient water supply was seen as a priority need by communities. Water delivery is of interest to an energy study such as this, as at present a great deal of human energy is expended in the collection of water, and alternative strategies to improve the delivery of water will have to incorporate energy supply systems for water lifting.

The average quantities of water currently consumed are shown below:

	Mean Water Collected Per Day (litres)	
	Per Household	Per capita
Lujiko	74	16,0
Manzimahle	70	16,3
Clarkebury	74	13,0
Nkanga	110	13,1
Cottondale	87	14,1
Mokumuru	81	15,5

These figures should be compared to an average daily per capita water consumption of over 300 litres in "white" urban areas and a World Health Organisation recommendation of a minimum of 50 litres. Considerable time and effort is involved in the collection of water.

	Time and Distance Spent Collecting Water Per Trip	
	Hrs	Km
Lujiko	0,6	0,9
Manzimahle	0,6	1,4
Clarkebury	2,3	1,8
Nkanga	0,7	1,1
Cottondale	0,9	0,7
Mokumuru	1,0	0,9

	Per Cent Frequency of Water Collection				
	LTonce/day	Once/day	Twice/day	Thrice/day	GTthrice/day
Lujiko		4	19	60	17
Manzimahle	2	5	27	61	5
Clarkebury	8	5	35	51	-
Nkanga	20	-	20	40	20
Cottondale	9	28	44	19	-
Mokumuru	-	80	-	17	3

During the recent drought, the supply of water became a serious problem in many areas. With the lowering of the water table, many boreholes dried up or had much reduced flows. At Ntshiquo, between Tsolo and Maclear in the Transkei, for example, women have to wait 2 hours pumping intermittently with a hand pump to fill a bucket of water, and in other areas there have been reports of women queueing through the night in order to gain a share of scarce water resources.[32]

Water is obtained either from springs or streams (mostly in villages on the slopes of hills, along the escarpment and near coastal valleys) or from ground water lifted by handpumps or windmills (mostly in villages located on the interior plains).

	% Households Obtaining Water Obtained From							
	Spring	River	Tap	Windmill	Watertank	Dam	Well	Borehole
Lujiko	-	40	2	4	-	53	-	-
Manzimahle	57	34	-	2	6	-	-	-
Clarkebury	22	76	2	-	-	-	-	-
Nkanga	100	-	-	-	-	-	-	-
Cottondale	-	24	4	-	-	-	17	52
Mokumuru	60	-	-	6	-	-	34	-

[32] Reported at the Carnegie conference into poverty and development in Southern Africa held at the University of Cape Town in April 1984.

Most villages have more than one kind of water supply, although not all villagers have equal access to the source of their choice. Protected springs and water from boreholes are generally preferred as the water is not as likely to be contaminated. In Cottondale, for example, water is collected from shallow depressions dug into the Timbivati River bed. Some people use this water for washing only, however, others use it for drinking as well which probably contributes to the high incidence of disease such as Cholera. There is a borehole with a diesel pump in the village which provides clean water and is the most popular water source. However, the supply is not always continuous and the pumping rate is slow. People usually bring their 25 l containers early in the morning and leave them in a queue. An attendant who lives permanently next to the pump to fill the motor with diesel and do repairs, fills the containers which are collected later. The long queues, and irregular supply at the borehole causes some people rather to collect the polluted river water.

Water supply is often a political issue, particularly with regard to access to water sources. In Cottondale, for example, the Sotho side of the village has access to water taps installed by the Lebowa government. However, the Shangaan women are too scared to go across to the Sotho side because they fear intimidation. Even within fairly homogenous villages, certain households traditionally have access to certain water points or springs and some families have to walk farther to collect water than others. Any intervention with new water lifting or supply technologies has to be extremely sensitive to these issues.

The collection of water is not performed exclusively by women. Children commonly assist, and in areas of scarcity where water has to be transported, men are also involved.

	Who Fetches Water		
	Women	Children	Men
Lujiko	55%	42%	3%
Manzimahle	65	20	15
Clarkebury	98	2	-
Nkanga	64	36	-
Cottondale	49	42	9
Mokumuru	97	3	-

Water has also become a commodity with a cost in rural areas, to be paid for by those too weak or sick to fetch their own. At Ntshiquo in the Transkei to hire someone to fetch a 15 litre bucket of water costs 50c.

About a third of the water collected is used for cooking, 15% for drinking, an equivalent amount for washing dishes and about 40% for bathing. Bathing and dish water is often recycled.

2.6 ENERGY IN AGRICULTURE

Many families engage in minimal subsistence type agricultural activities and energy is expended or required for draught power and then for agricultural processing which is generally limited to grain grinding and sometimes sun drying of mielies or sorghum. Few cash crops are grown in underdeveloped areas in Southern Africa and energy is not required for tasks such as tobacco drying or smoking fish which can consume significant amounts of fuelwood in rural areas in East and Central African countries such as Malawi and Tanzania.

Those who do have access to fields or garden plots usually do not have more than one of each. However, a fairly large proportion of families do not have access to either.

	% Households Without Fields & Garden Plots	
Lujiko	12	31
Manzimahle	33	25
Clarkebury	40	45
Nkanga	9	27
Cottondale	6	96
Mokumuru	23	97

2.6.1 Draft power

Common cultivation tasks involve ploughing, harrowing, planting, weeding and harvesting. The table below shows the proportion of households which use either tractors (usually hired), cattle (sometimes hired or used on a share cropping basis) or hand (which can also involve the help of neighbours in share cropping type arrangements).

	Methods of Agricultural Cultivation % Households Which Use Tractors/Cattle/Hand For										
	Ploughing		Harrowing			Planting			Weeding		Harvest
	Tractor	Cattle	Trac	Cattle	Hand	Trac	Cattle	Hand	Cat	Hand	Hand
Lujiko	63	29	9	8	13	-	30	70	-	91	93
Manzimahle	96	33	34	62	4	38	57	5	64	34	98
Clarkebury	78	49	68	32	-	17	79	3	34	66	83
Nkanga	27	91	-	18	-	-	91	-	73	9	91
Cottondale	29	52	4	8	81	2	2	92	-	96	96
Mokumuru	73	7	3	-	-	-	-	73	-	-	60

It is clear that there has been quite a significant shift from animal draft power to the hiring of tractors, although cattle are still an important aid to ploughing, harrowing and planting.

The numbers of cattle used for these tasks differs from area to area depending on the nature of the terrain and the condition of the cattle. Between 6 and 8 animals are used for ploughing in Lujiko, and 2 - 6 in Manzimahle. In Clarkebury 2 draught animals are usually used, although 4 and 6 may occasionally be seen ploughing. In Nkanga mostly 6 are used for ploughing but sometimes also 2, 4 or 8. Fewer cattle are harnessed for tasks

such as harrowing and planting. Weeding and harvesting are most often done by hand.

Not all families have equal access to cattle for draft power and the pattern of cattle ownership is highly skewed towards a wealthy minority. It was also the case that the drought severely weakened animals and that even those families which had a few cattle were unable to use them effectively for draft power. The table below show the pattern of ownership of cattle.

Cattle Ownership Patterns

	% Households Owning Cattle	Mean Number Owned	Minimum & Maximum
Lujiko	31	4,7	1 - 12
Manzimahle	73	5,6	1 - 20
Clarkebury	58	4,7	2 - 15
Nkanga	90	8,6	3 - 16
Cottondale	15	6,9	2 - 10
Mokumuru	47	4,0	1 - 7

In addition to animal draft, some human energy is expended on the various cultivation tasks.

Mean Number of Days Labour Spent Per Annum Per Household For Those Households Tending Fields

	Ploughing	Harrowing	Planting	Weeding	Harvesting	Total
Lujiko	2,0	1,3	1,8	16	5	26
Manzimahle	1,7	1,5	2,0	12	34	50
Clarkebury	1,4	5,3	4,8	11	24	47
Nkanga	5,0	4,4	4,5	62	30	106
Cottondale	7,2	8,1	6,4	21	10	53
Mokumuru	2,2	0	1,7	32	26	61

Cattle are also used for transportation purposes. For example, 22% of Lujiko households, 73% of Manzimahle households and a third in Clarkebury use cattle and sledges for transport, and 6% have ox carts. In Nkanga most households had cattle and sledges for transport.

2.6.2 Grain grinding

One of the most time consuming tasks associated with agricultural processing is the grinding of grain.

	% Households Which Have Grain to Grind (Bags of Grain Ground Per Year By Those Households)		
	Mielies	Sorghum	Wheat
Lujiko	10% (3,8)	0%	4% (3,5)
Manzimahle	73% (2,0)	21% (1,4)	40% (1,6)
Clarkebury	88% (13)	11% (10)	47% (10)
Nkanga	100% (2,6)	0%	0%
Cottondale	63% (5,5)	0%	0%
Mokumuru	83% (3,8)	0%	0%

Nearly all families grind some flour on their own by hand, mostly with a flat stone on a hollowed stone base and sometimes with a hand machine, but larger amounts are typically taken to a trading store to be ground at a fee with a petrol or diesel driven hammer mill. It is also common practice to exchange bags of mielies for refined mielie meal at both a financial and nutritional loss.

	Grain Grinding		% Households Which Exchange Mielies for Flour
	Store	Self/Hand	
Lujiko	2	39	0
Manzimahle	42	27	15
Clarkebury	61	3	61
Nkanga	91	9	33
Cottondale	-	19	2
Mokumuru	93	-	53

2.7 PERCEPTIONS OF POSSIBLE SOLUTIONS TO WOOD & FUEL SCARCITIES

Many villagers do not perceive new solutions to old problems. Those who suffer most from energy related problems consider them as merely their "normal" lot - strenuous wood collecting trips and smoke-filled huts may

hardly seem worth a mention. It is also the case that because of the economic dependence of rural areas on metropolitan centres for their survival, that many villagers see solutions in terms of money and employment for money can purchase alternative fuels and food which must otherwise be laboriously produced with their own labour in an increasingly non-viable and impoverished environment.

Nevertheless, nearly all households are acutely conscious that a major problem is the absence of freely available fuel resources. When questioned, most stated that they experienced fuelwood shortages and a minority suggested solutions to them.

Per Cent Households Suggesting Possible Solutions to Wood Shortages	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale
Cut green trees	-	-	-	9	13
Village woodlots	6	25	7	36	10
Hire trucks	6	40	2	-	2
Hire people	18	8	-	-	-
Use Coal	-	2	-	-	2
Electricity	-	2	-	-	17
Use Gas	9	-	-	-	2
Buy wood	58	-	-	-	-
Use paraffin	3	-	-	-	-

2.7.1 Afforestation

It is interesting that although a minority suggested that woodlots would be a solution to fuelwood scarcities, an overwhelming majority, when asked, considered the planting of trees to be a good idea, although not necessarily for fuelwood only.

	% Households Which Consider the Planting of Trees to be a Good Idea
Lujiko	76
Manzimahle	96
Clarkebury	100
Nkanga	91
Cottondale	91
Mokumuru	100

	% Households Offering Reason Why Trees Should Be Planted					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Fuelwood	5	53	76	55	25	48
Building Material	8	2	-	9	2	-
Wood Nearer		23	4	36	-	52
Shelter	62	16	16	-	10	-
Fruit	-	4	-	-	17	-
Shade	18	2	-	-	11	-
Aesthetics	-	-	-	-	2	-
Conservation	3	-	-	-	2	-
Herbs	-	-	-	-	2	-
Fodder	-	-	-	-	2	-
Against Snakes	-	-	-	-	4	-
Dont Like T	5	-	-	-	-	-
Skollies	-	-	-	-	2	-

It is clear that factors other than fuelwood supply are also considered important in the planting of trees, viz. shelter, fruit, and building material supply. This becomes even clearer when it is observed which trees are planted by villagers. A surprisingly high number of trees have been planted, but this does not seem to be a response to fuelwood scarcities. Most trees planted have been fruit trees, although in Lujiko and Manzimahle some eucalyptus and pine trees were also planted mainly for pole production.

	% Respondents Which Had Planted Trees Last Year	Mean Number of Trees Planted Per Planter
Lujiko	12	2,7
Manzimahle	19	2,0
Clarkebury	7	1,7
Cottondale	50	4,1
Mokumuru	37	4,5

	Type of Tree Planted (%)							
	Fruit	Peach	Apricot	Fig	Orange	Pine	Gum	Aloe
Lujiko	60	-	-	-	-	-	40	-
Manzimahle		31	15	8	15	8	15	8
Clarkebury	-	100	-	-	-	-	-	-
Nkanga	90	-	-	-	-	-	-	-
Cottondale	96	-	-	4	-	-	-	-
Mokumuru	50	-	-	25	25	-	-	-

Most of those who planted trees also stated that some trees had died; reasons given were the drought, cold, clay soil, goats, pests, wind and the lack of fertilizer.

Villagers were also asked who should be responsible for planting trees and who should control their use.

Respondents	Who Should Plant Trees: Community	Government	Chief	Individuals
Lujiko	12	-	-	-	100 (women)
Manzimahle	32	55	7	-	-
Clarkebury	-	54	46	-	-
Nkanga	-	73	27	-	-
Cottondale	5	32	51	5	5
Mokumuru	17	83	-	-	-

From the above, it would seem that people are generally willing and keen to plant trees, that there is a fairly high failure rate, and that trees with multiple uses would be preferred. Agro-forestry would thus appear to have great potential.

2.7.2 Fuel efficient wood-burning stoves

Fuelwood scarcities may be dealt with by either increasing the supply of wood (trees) or by utilizing the wood more efficiently and thus mitigating demand. Fuel-efficient stoves may offer greatly improved efficiencies over an open fire, hence peoples' attitudes were sought on mud stoves (which can be self constructed from local clay) and metal stoves (which are more expensive, durable and "modern" looking).

	% Respondents Who Have		Preferred	
	Seen Stoves	and Liked Them	Mud	Metal
Lujiko	88	80	9	91
Manzimahle	68	85	80	20
Clarkebury	24	83	89	11
Nkanga	91	82	20	80
Cottondale	8	83	25	75
Mokumuru	100	93	60	40

	Reasons Why Prefer Mud or Metal Stoves (% Respondents)					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Mud cheap	7	75	89	22	25	50
Metal Strong	24	3	-	67	75	19
Metal is portable	-	-	-	-	-	-
Wedding Gift	-	-	-	11	-	-
Easy to Use	7	20	11	-	-	31
Only Kind Seen	62	2	-	-	-	-

	Reasons Why Would Like To Use Stoves (% Respondents)					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Savefuel	-	8	11	10	-	3
Multiple pots	13	-	-	40	-	-
Warm House	45	3	11	30	-	-
Better heat	5	6	11	-	25	-
Easy to Use	16	42	11	-	-	3
Includes Oven	3	-	-	-	-	-
Smoke out	5	-	-	-	-	-
Safe	3	-	-	-	-	-
Modern	-	-	-	10	-	-
Mud is Free	-	28	22		50	-
Protect f wind	-	6	11	-	-	-
Uses wood	-	3	11	10	-	-
Reasons Against						
Use more wood	11	-	-	-	-	-
Dont last	-	-	-	-	-	-
Never Seen	-	3	11	-	-	-

It is interesting to note that the fuel saving potential of stoves ranked fairly low and other aspects such as being able to cook with multiple pots, ease of use, space heating, etc. were regarded as being more important. Part of the reason here is that the stoves which are currently available are not particularly fuel efficient, and some respondents actually claimed that stoves used more wood than a fire for equivalent cooking operations.

A number of households already own stoves.[33]

	% Households Owning Wood or Coal Stove
Lujiko	-
Manzimahle	23
Clarkebury	13
Nkanga	1
Cottondale	37
Mokumuru	13

[33] Wickstead's (1984) study in the south-west of Lesotho indicated 3% of households owned coal or wood stoves, but 60% owned braziers.

However, from the previous data on cooking and heating practices, it would appear that fewer households routinely use stoves than actually possess them.

One issue frequently raised in connection with the introduction of stoves is the potential draw back in the fuel preparation required in order to feed small wood pieces to the firebox. This proves to be less of an issue when it is observed that most wood collected in Kwazulu, for example, varies between 1,5 cm and 4,5 cm (Gandar : 1983b). Liengme (1983) notes an average fuelwood diameter of 5 cm. Fuelwood piece sizes were not measured in this study. However, from observation, slightly larger sections (up to 10 cm in diameter) were evident in the woodpiles at Mokumuru, and also the woodlot logs at Manzimahle and Clarkebury. Women used axes or pangas to reduce the sizes of pieces before using them in fires.

2.7.3 Ranking of energy related problems versus other needs

Finally an attempt was made to ascertain how energy related problems ranked in importance with other perceived problems and needs. The question was open ended (individuals were asked to list their most important problems and needs and then to suggest solutions to them), although the previous focus on energy related questions in the interviews probably did result in a slight bias in priorities. It is a danger of all questionnaire type surveys - that responses will be influenced by the identity of the agency which interviewers represent and these biases need to be recognized.

	Perceived Problems and Needs Per Cent Which Listed Issue amongst 3 top problems at					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Water supply	41	43	76	9	77	78
Fuelwood supply	-	29	20	9	64	27
Money + employment	18	50	29	-	36	30
Food	24	23	-	64	43	3
Education	18	2	2	18	-	-
Health	-	4	-	36	-	-
Housing	43	-	2	82	30	3

Water supply was regarded to be the most critical problem or need. Money and employment, food, housing and fuelwood were on average very similarly ranked as the next most important needs.

Generally far fewer households offered solutions than expressed problems. In many areas morale is very low and villagers cannot see any obvious ways out of their difficulties other than relying on employment or remittances from the metropolitan centres. No solutions were offered in Mokumuru other than the drilling of a bore hole, an issue around which some of the community were organizing. In Cottondale, there was generally a stunned silence when interviewees were asked to suggest solutions to their problems and some felt that the government should be responsible for meeting their needs. Again, the provision of better water supplies ranked highly, but only in Manzimahle was the planting of trees mentioned as a possible solution to their immediate difficulties.

	Suggested Solutions Per Cent Which Included Issue in Top 3 Problems				
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale
Money & jobs[34]	90	56	-	100	25
Skills	2	2	-	9	-
Pension	2	2	-	-	2
Tractor	6	10	-	-	-
Better yields	2	6	-	-	-
Dams/taps	-	27	2	18	21
Plant trees	-	25	-	-	-
Own gardens	-	8	-	-	-
Cottage Industry	-	10	-	-	-
Grain grinder	-	-	2	-	-
Government	-	-	-	-	21
Cut green wood	-	-	-	-	2

In Cottondale, there is some resentment with prohibitions and fines on cutting green wood and some respondents saw permission to cut growing trees as a solution to their immediate problem of fuelwood scarcities.

Fuelwood and water collection were also regarded as the most burdensome and tiresome of tasks undertaken by women, although some agricultural tasks such as weeding also ranked highly.

	Most Burdensome and Difficult Perceived Task for Women Per Cent Which Listed Issue amongst 3 Most Difficult Tasks at					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Fuelwood collec.	79	52	89	91	44	97
Water collect.	6	37	80	18	33	47
Hoeing	4	29	-	73	22	7
Weeding	90	8	11	-	92	10
Harvesting	-	2	22	9	2	-
Grinding	6	6	42	9	2	-
Cooking	24	17	22	-	2	-
Cleaning	8	8	2	-	-	-
Child care	-	23	-	-	-	-
Mud plaster, brick	55	10	-	64	4	27

For men, ploughing (a few days a year), house construction and fencing were regarded as the most burdensome tasks.

[34] Includes better wages and employment creation, loan facilities, lower prices, nearer work , etc.

	Most Burdensome and Difficult Perceived Task for Men Per Cent Which Listed Issue amongst 3 Most Difficult Tasks at					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Ploughing	84	50	7	100	17	7
Tree Chopping	2	4	-	64	-	-
Wood Collect	-	8	-	-	2	-
House bldg	10	6	4	64	23	3
Fencing	71	-	27	36	-	-
Planting	-	8	2	-	4	-
Harrowing	2	8	-	-	-	-
Weeding	18	10	7	36	2	3
Harvesting	-	6	-	-	-	-
Livestock	55	20	-	-	-	13
Watering	-	-	13	-	-	-
Mining	-	10	-	-	-	-

Finally, in order to obtain more free ranging types of responses of peoples' needs and wishes, villagers were asked to list which factors would make the village a better place to live in.

	Perceived factors which would make Village a Better Place Per Cent Which Listed Issue in Top Five Suggestions					
	Lujiko	Manzimahle	Clarkebury	Nkanga	Cottondale	Mokumuru
Woodlot	2	17	11	36	19	3
Improved Water	67	49	82	73	65	67
Education	10	4	62	55	-	90
Housing	22	-	-	36	13	-
Job Opportunity	25	11	-	18	27	3
Migratory Job	-	17	-	-	-	3
Hospital/clinic	61	4	64	9	4	97
Agric Develop.[35]	24	33	7	36	-	-
Shop	8	2	-	-	19	23
Irrigation	4		-	-	-	-
Electricity	-	2	9	45	25	-
Grinding machine	-	-	49	9	-	-
Phones	-	-	-	-	10	-
Creche	-	-	-	-	-	33

More households here suggested planting trees or the establishment of a woodlot, but many other factors were regarded as being more important, including improved water supplies, education and health facilities, and even agricultural development. In Nkanga and Cottondale, electricity supply was seen as being more important than woodlots.

[35] Agricultural development includes better crop yields, tractors, the planting of cash crops, communal and individual vegetable gardening.

These points serve to emphasize the fact that any initiative which aims to deal with rural energy scarcities must be integrated with broader rural development needs.

CHAPTER THREE

PERI-URBAN ENERGY CONSUMPTION PATTERNS

3.1 DOMESTIC FUEL CONSUMPTION

An almost totally neglected area in energy research, planning and investments are the closer settlements, the peri-urban sector and the townships around the metropolitan centres. With little access to either agricultural land or natural woodland the opportunities for the collection of "free" fuels are minimal. Neither do these households have access to inexpensive electricity. Sandwiched between the urban and rural areas, this sector experiences energy problems quite different to either. Although still reliant on wood, which is mostly purchased from vendors, these households are heavily reliant on the most costly fuels. The table below summarizes the fuels used in the five peri-urban areas studied:

	Per cent households using fuel						
	Fuelwood	Paraffin	Candles	Coal	Wastes	Gas	Batteries
Vulindlela	98	83	96	3	20	5	87
QwaQwa	68	85	96	96	66	9	21
Amatelang	51	56	64	92	10	10	5
New Bethesda	84	94	88	31	16	9	69
Crossroads	38	100	52	45	-	4	49

Wood, paraffin and coal are the fuels used to meet primary energy needs for cooking and heating.

3.1.1 Fuelwood

It has probably not been fully appreciated how dependent peri-urban areas still are on wood. Indeed, even in the black townships in the metropolitan areas, only about a fifth of households have access to electricity and up to 40% still use some wood for cooking and heating (Moller:1985,43).[36]

	Mean annual per capita fuelwood consumption in total sample (kg)
Vulindlela	742
QwaQwa	39
Amatelang	26
New Bethesda	648
Crossroads	213

Fuelwood is used in all these areas, including relatively large amounts in Vulindlela and New Bethesda, but much smaller amounts in Amatelang and QwaQwa. The small amounts of wood which are available in Amatelang are either in private hands or under control of the chief and access is subject to patronage. In QwaQwa the population has risen seventeen fold since 1970 and pressure on natural woodland has been overwhelming. Less than a fifth of those interviewed sometimes still collect their own headloads. For the most part wood is trucked in along with coal, and wood is mostly used only as a starter for coal.

	% Households in which Fuelwood is			
	All bought	Mostly Bought	Mostly Self Coll	All Collected
Vulindlela	56	11	15	15
QwaQwa	48	25	13	14
Amatelang	37	63		
New Bethesda	52	22	7	22
Crossroads		30	70	

In Vulindlela most households (88%) buy wood from vendors, the rest fetched wood in headloads from woodlots or from farmers. Very few families reported running out of wood (5%) and those that do said that they then use roots or

[36] In Malawi, 90% of urban households use woodfuels for cooking.

paraffin. In QwaQwa, a minority collect wood from natural woodland, the rest buy wood from vendors and wood/coalyards. In Amatelang, 65% of households buy from vendors, 30% from woodlots, and 5% sometimes obtain their wood from natural woodland. In New Bethesda, most wood is obtained from vendors, or farms, a woodlot and returning Cape Provincial roadworks trucks. A third collect themselves from veld and farms. In Crossroads, most households collect wood themselves, either from the surrounding Acacia cyclops and Acacia saligna bushes or from waste wood "liberated" from building sites.

Understandably, households do not have as detailed a knowledge as rural people of indigenous tree species as most wood is from plantations of either gum, wattle, pine or poplar.

	Fuelwood Species Bought (& Collected) %				
	Eucalyptus	Wattle	Pine	Poplar	Indigenous
Vulindlela	12 (37)	79 (50)	9 (11)		(2)
QwaQwa	70		17	13	
Amatelang	95				(5)
New Bethesda	15 (33)	-	-	-	85 (66)

The situation at New Bethesda is slightly different, and the majority of wood is obtained from natural woodland. Acacia spp & karoo (doringbos), Rhus pyroides (taaibos) and Rhus erosa (besem) are the species most often used at New Bethesda.

The tree species which are used do not necessarily coincide with species preferences.

	Fuelwood Preferences				
	Eucalyptus	Wattle	Pine	Poplar	Indigenous
Vulindlela	1	96	3		
QwaQwa	58	-	25	13	4
New Bethesda					100

Wattle is the preferred species in Vulindlela, but it is not always available. It is interesting that in QwaQwa, slightly more people prefer

pine than generally use it, and fewer prefer gum than use it. Generally Eucalyptus trees are regarded as better fuelwoods than softwoods such as pine. It may be that some of the poorer quality gum fuelwoods such as Eucalyptus grandis are being used.

The reasons given for preferring wattle are that it burns longer and with a stronger heat. Preferences expressed for gum trees are because it gives a rapid heat and for pine because it can be cut easily. Paraffin is usually used instead when wood runs out. Acacia karoo is preferred at New Bethesda as it is an excellent fuelwood, being a hard wood which producers good embers.

Many women, particularly in Crossroads and QwaQwa, expressed the fear that they would be molested on fuelwood collection trips. Other frequently stated problems are fuelwood shortages and rising costs.

3.1.2 The use of wastes as fuel

In many areas wood is either too costly or too scarce. Such are the shortages that there have been reports from towns such as Hanover of people chopping out wooden window and door frames from abandoned houses, for fuelwood. There have also been reports of women cutting branches from their own fruit trees. In the Karoo, many households resort to collecting paper, cardboard, milk and beer paper cartons and even grass for cooking fires.

	% Households Using Wastes as a Fuel				
	Mieliecobs	Other Agric Wastes	Cardboard	Grass	Other
Vulindlela	16	4	1	-	1
QwaQwa	15	-	21	-	25
Amatelang	-	-	-	-	10
New Bethesda	16	-	-	-	-

3.1.3 Paraffin

	Mean annual per capita paraffin consumption in total sample (l)
Vulindlela	17
QwaQwa	27
Amatelang	37
New Bethesda	54
Crossroads	96

Many households (Vulindlela - 23%, QwaQwa - 53%) stated that they frequently run out of paraffin, often weekly. Families substitute by using wood, coal or candles. Some respondents expressed dissatisfaction with the use of paraffin.

	Problems associated with Paraffin				
	Expense	Smoke/Smell	Messy	Dangerous	Que
Vulindlela (15%)	59	6	29	6	-
QwaQwa (47%)	-	86	9	5	-
Amatelang (13%)	80	20	-	-	-
New Bethesda (13%)	25	50	25	-	-
Crossroads (68%)	12	36	9	12	31

3.1.4 Coal

Very many more households in periurban areas than in villages use coal as a domestic fuel.

	Mean annual per capita coal consumption in total sample (kg)
Vulindlela	5
QwaQwa	308
Amatelang	195
New Bethesda	54
Crossroads	217

In QwaQwa, two-thirds of those which use coal complained of problems, mainly

related to smoke, and that the coal doesn't last or burn well. In Amatelang, nearly 90% of coal users sometimes run out of coal, and then use paraffin and wood if available. In Crossroads, a third complained of problems with coal related to headaches, bronchial problems, the danger of asphyxiation and the inconvenience of having to arrange to fetch loads.

3.1.5 Gas

A relatively small proportion of households use gas.

	Mean annual per capita gas consumption in total sample (kg)	% Households using gas
Vulindlela	0,5	5
QwaQwa	1,8	9
Amatelang	1,8	10
New Bethesda	3,9	9
Crossroads	1,7	4

3.1.6 Candles

	% Households Which Use Candles	No used per household
Vulindlela	96	62
QwaQwa	96	56
Amatelang	69	45
New Bethesda	88	53
Crossroads	52	37

Problems associated with candles are that of wind, being messy, expensive, dangerous, they do not last and are not bright enough. In addition residents of New Bethesda complained that they go soft in Summer.

3.1.7 Batteries

A large number of households (excluding Amatelang) use dry batteries; a tenth use car batteries, and a small percentage use generators - typically to power TV sets or for lighting. No households were found to be using

photovoltaic panels.

	% Households which use			
	Dry Batteries	Car Batteries	Generators	PVs
Vulindlela	85	9	4	0
QwaQwa	32	6	4	0
Amatelang	8	13	3	0
New Bethesda	66	9	6	0
Crossroads	31	18	4	0

The above data does not include the use of car batteries in vehicles. In Vulindlela, car batteries are used for radios (12%), TVs (75%), and Hifi sets (13%). They last on average 6 to 7 days (range 1-24 days) and are recharged at garages and Battery Centres at an average cost of R 2-50. Dry cell batteries (mostly PM9 and PM10s) used for radios (90%) and Hifis. Expressed problems with batteries are their shortlife, expense and the fact that they are not rechargeable. Approximately 11% of households in Vulindlela own cars and 2% own tractors. In QwaQwa, car batteries are used for TV and HiFi sets; they are charged at garages for between R2-50 and R5. Dry Cell batteries, mostly PM 10s, are used for radios and HiFis. Generators are used for lighting. In Amatelang, only one of the households which were interviewed had a TV and this was powered by a car battery. A higher proportion of households in New Bethesda (13%) and Crossroads (12%) owned TV sets which are generally 12 VDC small portable black and white sets.

In times of dire need, batteries have been known to be used even as a fuel in cooking fires. This can result in severe lead poisoning and brain damage. First dubbed the "depression disease" in 1933 in Baltimore, similar cases of lead encephalopathy were discovered in six black children in East London in 1976 and reported in the South African Medical Journal by Harris in that year. Three of the children were visited at home and all three families were found to have burnt discarded battery casings in open braziers for fuel.

3.1.8 Summary of fuel consumption

Mean annual household domestic energy consumption in total sample

	Fuelwood Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Vulindlela	5213	129	438	32	5
QwaQwa	343	135	301	1661	13
Amatelang	263	157	266	998	7
New Bethesda	3042	248	219	282	5
Crossroads	1527	679	262	1553	14

Mean annual per capita domestic energy consumption in total sample

	Fuelwood Kg	Paraffin l	Candles No	Coal Kg	Gas Kg	Total GJ
Vulindlela	742	17	62	5	0,5	13,8
QwaQwa	39	27	56	308	1,8	10,6
Amatelang	26	37	45	195	1,8	7,7
New Bethesda	648	54	53	54	3,9	14,8
Crossroads	213	96	37	217	1,7	13,3

Mean annual domestic nett energy consumption

	GJ per household					GJ Per capita
	Fuelwood	Paraffin	Candles	Coal	Gas	Total	Total
Vulindlela	88,6	4,8	1,5	,9	,2	96	13,8
QwaQwa	5,8	5,0	1,0	44,8	,6	57	10,6
Amatelang	4,5	5,8	0,8	26,9	,4	38	7,7
New Bethesda	51,7	9,2	0,8	7,6	,2	69	14,8
Crossroads	25,7	25,1	0,9	41,7	,9	94	13,3

Mean annual per capita domestic energy consumption in households using fuel

	Fuelwood Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Vulindlela	755	20,6	66,3	169	11,9
QwaQwa	56	31,4	58,3	322	21,6
Amatelang	50	65,6	70,7	211	17,1
New Bethesda	648	57,6	60,3	172	42,2
Crossroads	566	95,7	71,0	486	48,7

Mean annual domestic consumption per household using fuel

	Fuelwood Kg	Paraffin l	Candles No	Coal Kg	Gas Kg
Vulindlela	5214	156	451	1189	100
QwaQwa	343	159	314	1734	152
Amatelang	263	279	341	1081	73
New Bethesda	3042	264	250	903	49
Crossroads	4019	679	504	3451	346

One would have expected that with the higher levels of disposable income available in periurban in comparison with rural areas, that per capita energy consumption would also increase (Cecelski et al, 1979). The fact that this is not evident is probably explained through a change in the composition of fuels used. Coal, paraffin and gas can be used more efficiently than wood and dung burnt in open fires, and it is probably the greater use of these fuels in peri-urban areas which results in little change in gross energy consumption. In the case of Amatelang, the amount of energy used appears to be substantially less and this is directly related to the lower incomes and severe poverty of this resettlement camp. A quarter of the families in this area reported that they cannot afford fuel to cook every day and it appears likely that the amount of energy used has fallen below that required to meet minimum nutritional requirements.

3.2 EXPENDITURE ON FUEL

Most fuelwood is bought, and along with other commercial fuels, it represents a significant part of total household expenditure. Wood and fuels such as paraffin, coal, candles and batteries have also become increasingly costly.

	Mean Annual Household Fuel Expenditure (1984/5 Rand)						
	Fuelwood	Paraffin	Candles	Coal	Gas	Batteries	TOTAL
Vulindlela	194	66	46	4	7	35	352
QwaQwa	42	79	32	141	14	14	322
Amatelang	58	76	23	108	14	2	280
New Bethesda	162	137	26	18	6	17	366
Crossroads	135	280	29	177	15	59	696

	Mean Fuel Prices (1984/5 Rand)				
	Fuelwood c/kg	Paraffin c/l	Candles c/candle	Coal c/kg	Gas c/kg
Vulindlela	5	53	10	12	147
QwaQwa	19	61	10	9	111
Amatelang	23	52	10	11	195
New Bethesda	8	55	12	10	128
Crossroads	9	50	12	13	110

The prices of paraffin and candles are fairly uniform throughout the

country. As one would expect, coal prices are higher in those areas furthest from the coal fields where transport costs are higher. Prices of wood vary enormously. In general total costs are very much higher than the price of wood sold from state woodlots; the major cost is in transport.[37] Prices of gas also vary enormously and are largely dependent on the extent of local availability. A large proportion of household income is spent on energy.

	Mean Monthly Household Income (1984/5 Rand)
Vulindlela	361.47
QwaQwa	344,49
Amatelang	207,53
New Bethesda	297,81
Crossroads	281,18

	Per Cent of Income Spent on Fuel
Vulindlela	10,7
QwaQwa	14,1
Amatelang	16,5
New Bethesda	15,9
Crossroads	19,9

These amounts may be compared with an average expenditure on electricity of 2,9% of household income in the middle class Cape Town suburb of Pinelands or even 5% and 7,1% in the poorer areas of Heathfield and Bonteheuwel respectively.

Once the initial extension fee has been paid, electricity is in most cases cheaper than other fuels for cooking, heating and lighting.

In a survey by Rivett-Carnac in July 1979 in Umlazi it was determined that households without electricity spent on average R 42 a month on fuel, while typical middle income households with electricity spent on average R 18 a month, using more energy in a safer and more convenient form.

---

[37] Kgathi (1984) reports that fuelwood traders who sell wood to residents of Gaborone charged 7c/kg in early 1983 and 4c/kg in 1980.

A survey by the author in September 1983 in suburbs around Cape Town revealed that families without electricity could pay up to three times as much on domestic energy than those families which have access to electricity. The former spend, on average a fifth of their incomes on fuel (Eberhard, 1984b).

There is thus a strong argument that the absence of an electrical supply impoverishes periurban communities (along with other inadequate and expensive services such as transport) as households are forced to rely on expensive and inconvenient fossil fuels which consume a disproportionate amount of their income. Energy provision is seldom thought to be an important factor in the planning of mass housing projects in urban and periurban areas. Yet, through the denial of electricity, and the poor design, insulation, construction and orientation of houses - which increase their heating requirements - households spend more and consume less useful energy than urban households.

3.3 FUEL PREFERENCES

	Fuel Preferences for Cooking (% households)				
	Wood	Gas	Coal	Paraffin	Electricity
Vulindlela	53	2	4	3	38
QwaQwa	2	5	43	14	36
Amatelang	8	14	24	38	16
New Bethesda	19	13	-	9	59
Crossroads	-	9	1	12	77

	Fuel Preferences for Heating (% households)				
	Wood	Gas	Coal	Paraffin	Electricity
Vulindlela	56	3	6	6	29
QwaQwa	2	2	20	38	38
Amatelang		10	45	35	10
New Bethesda	22	13		6	59
Crossroads	-	5	4	28	63

In Vulindlela, wood is preferred for cooking and heating because it is

familiar, available, free or cheap, and lasts long; and electricity is preferred because it is quick, convenient, clean, versatile and safe. In QwaQwa, electricity and coal are preferred for cooking and electricity and paraffin for heating because respondents consider that they provided a rapid heat. In Amatelang, paraffin and coal are preferred for cooking and heating because they are perceived to be the cheapest available fuels. In New Bethesda and Crossroads, electricity is preferred because it is safe, cheap and fast; wood because it is free.

	Fuel Preferences for Lighting (% households)			
	Gas	Paraffin	Electricity	Candles
Vulindlela	6	8	46	40
QwaQwa	2	-	45	49
Amatelang	3	3	13	81
New Bethesda	6	23	65	6
Crossroads	7	10	84	-

In Vulindlela and QwaQwa, electricity is preferred by the majority for lighting - because it is capable of providing a bright light - followed by candles because they are cheapest and are easy to get. In Amatelang, candles are seen as being the cheapest, and in New Bethesda electricity is preferred because its use is seen to be trouble free.

3.4 ENERGY USE PATTERNS

3.4.1 Cooking practices

The foods most often cooked are porridge and vegetables. A small proportion of families do not cook every day, primarily because they are short of fuel and money.

	% Which do not cook every day
Vulindlela	1
QwaQwa	2
Amatelang	3
New Bethesda	1

Most families, though, cook at least once a day, and most often early in the

morning, or in the evening.

	% Which Cook		
	Once/Day	Twice/Day	Thrice/Day
Vulindlela	31	47	22
QwaQwa	89	11	-
Amatelang	57	38	5
New Bethesda	68	26	6

	% Which Cook				
	Early Morn	Mid-Morn	Midday	Afternoon	Evening
Vulindlela	60	6	28	75	25
QwaQwa	73	2	0	5	27
Amatelang	33	25	42	0	75
New Bethesda	25	3	41	9	69

The average number of people cooked for in the different areas are:

	Mean No of People Which Are Cooked For
Vulindlela	8
QwaQwa	5,9
Amatelang	5,6
New Bethesda	5,3
Crossroads	7,1

The following stoves and fuels are most commonly used for cooking.

	COOKING PRACTICES				
	Most Common Stove & Fuel Used(%)				% Which
	Openfire/Brazier	Wood/Coalstove	Primus	Gas Stove	Cook Indoors
Vulindlela	50	40	2	8	0	97
QwaQwa	0		93	5	2	98
Amatelang	8	-	25	58	8	91
New Bethesda	14	72	10	-	4	97
Crossroads	16		6	75	3	?

The use of wood/coal stoves is very much more widespread than in rural areas. This is particularly evident in QwaQwa and New Bethesda, and less so in Amatelang and Crossroads where the majority of households use paraffin primus stoves for cooking. Nearly all households cook indoors.

A wider range of stoves are owned than are commonly used on an every day basis. In some cases, this is because of the lack of availability or expense of fuels. In Amatelang, for example, most households have coal stoves but very few use them on a regular basis.

	Appliance Ownership						
	Primus Stove	Paraffin Wickstove	Gas Stove	Coal Stove	Wood Stove	Tripod	Haybox
Vulindlela	71	9	3	25	41	83	-
QwaQwa	79	17	2	91	11	15	0
Amatelang	87	3	10	90	5	0	0
New Bethesda	91	0	16	19	88	53	0
Crossroads	97		4	5	-	?	2

Paraffin stoves are used preferentially for quick and short heating tasks such as tea making.

	Tea Making Stove & Fuel Used (%)				
	Openfire	Wood/Coalstove		Gas stove	Primus Stove
Vulindlela	49	20	1	1	29
QwaQwa	0	2	51	5	42
Amatelang	4	-	27	8	61
New Bethesda	6	40		6	48

3.4.2 Water heating

	Heating Water for Washing Stove & Fuel Used (%)				
	Openfire	Wood/coalstove		Gas Stove	Primus Stove
Vulindlela	90	5	-	-	5
QwaQwa	4	-	57	3	36
Amatelang	-	5	38	5	52
New Bethesda	6	57	-	3	34

	Hot Water Heated				
	Early Morning	Mid-Morning	Midday	Afternoon	Evening
Vulindlela	66	14	20	-	-
QwaQwa	96	-	-	-	4
Amatelang	80	-	-	-	20
New Bethesda	50	-	-	6	44

Nearly all hot water is used for washing bodies or dishes, a little for floors and ailments.

3.4.3 Home heating

Wood or coal stoves are commonly used for space heating although the use of paraffin heaters is also widespread, particularly in Crossroads, where coal is also burnt in braziers during the winter.

	Home Heating			
	Openfire	Wood/Coalstove	Paraffin Heater	Gas Heater
Vulindlela	47	43	9	-
QwaQwa	0	73	25	2
Amatelang	7	69	24	-
New Bethesda	11	56	33	
Crossroads	47	5	47	1

	Appliance Ownership		
	Paraffin Heaters	Brazier s	Gasheaters
Vulindlela	13	11	1
QwaQwa	51	2	0
Amatelang	28	28	5
New Bethesda	25	34	0
Crossroads	53	29	1

Heating requirements are affected by the quality of construction and building materials used for dwellings.

	Type of House Roof (and Preference) %				
	Thatch	Iron Sheets	Thatch&Iron	Asbestos	Tiles
Vulindlela	45 (49)	53 (28)	2	-	0 (23)
QwaQwa	4 (6)	92 (40)	-	-	4 (54)
Amatelang	56? (29)	22 (50)	-	22	- (21)
New Bethesda	6 (16)	94 (84)	-	-	-
Crossroads	-	100	-	-	-

	Reasons for Roof Preferences					
	Warmer	Durable	Available	Aesthetic	Cheaper	Water Runoff
Vulindlela	68	23	-	6	1	2
QwaQwa	50	32	2	11	5	-
Amatelang	31	44	19	-	6	-
New Bethesda	67	33	-	-	-	-

	House Wall Construction						
	Mud Bricks		Wood	Stone	Wattle&Daub	Concrete Bl.	Iron Sheets
Vulindlela	43	2	-	-	51	4	-
QwaQwa	26	61	2	2	-	4	5
Amatelang	-	61	-	-	-	39	-
New Bethesda	-	100	-	-	-	-	-
Crossroads	-	-	10	-	-	-	90

3.4.4 Lighting practices

Most households use candles and paraffin for lighting.

	% Using Fuel For Lighting		
	Candles	Paraffin	Gas
Vulindlela	79	24	-
QwaQwa	94	19	-
Amatelang	97	40	-
New Bethesda	78	90	-
Crossroads	51	84	2

A number of households have gas lamps but few use them regularly - presumably gas is regarded as being expensive and also because of the difficulties in arranging to have gas bottles refilled. Torches are also widely used for lighting.

	Appliance Ownership (%)		
	Paraffin Lamps	Gaslamps	Torch
Vulindlela	39	5	45
QwaQwa	45	8	17
Amatelang	41	8	49
New Bethesda	91	3	69
Crossroads	84	2	?

Lighting is used for about 3 to 4 hours every evening.

	Mean Hours Lighting Per Day
Vulindlela	2,9
QwaQwa	3,7
Amatelang	4,2
New Bethesda	3,0

3.4.5 Clothes ironing

Fuel is also used for ironing clothes.

	% Using Fuel for Heating Iron			Ironing Frequency Per Week
	Wood	Paraffin	Coal	
Vulindlela	74	24	2	3,3
QwaQwa	-	49	51	1,8
Amatelang	8	69	23	1,7
New Bethesda	48	42	-	1,6

3.4.6 Other appliance ownership

Refrigeration is much more common in peri-urban areas than in rural areas.

Solar water heating is generally not used.

	Appliance Ownership (%)		
	Paraffin Fridge	Gasfridge	SWH
Vulindlela	8	2	0
QwaQwa	6	0	0
Amatelang	21	0	0
New Bethesda	41	6	0
Crossroads	5	0	0

Fewer households own three-legged cast iron pots than in rural areas.

	Appliance Ownership (%) And mean number owned							
	Iron pots		Saucepans		Kettles		Irons	
Vulindlela	82%	1,8	94%	3,4	98%	1,5	97%	1,5
QwaQwa	17%		64%		66%		72%	
Amatelang	28%		41%		56%		51%	
New Bethesda	6%		81%		94%		88%	

3.5 RANKING OF ENERGY PROBLEMS VS OTHER NEEDS

Households were asked to list major problems and needs, and to suggest possible solutions to them.

	Perceived Problems & Needs Per Cent Which Included Issue in Top 3 Problems			
	Vulindlela	QwaQwa	Amatelang	New Bethesda
Water supply	41	4	2	-
Fuelwood supply	33	4	-	21
Heating	12	-	-	-
Money + employment	24	6	21	47
Housing	13	53	13	-
Transport	10	19	-	-
Education	5	17	-	-
Livestock	2	-	-	-
Consumer goods	2	32	-	-
Nearby Shop	-	17	-	-
Food	-	4	-	-
Electricity	5	17	12	6
Paraffin expense	-	-	-	22

Fuelwood supply ranks fairly highly in perceived problems in Vulindlela, the most "rural" of the peri-urban areas which were studied. The expense of paraffin was a major problem in New Bethesda and the need for electricity was expressed in all areas.

	Suggested Solutions Per Cent Which Included Issue in Top 3 Problems			
	Vulindlela	QwaQwa	Amatelang	New Bethesda
Taps/dams/boreholes	31	-	-	-
Woodlots/tree plant	22	-	-	3
Electricity	13	-	5	34
Money + employment	23	100	3	28
Start business	-	15	-	6
Skills	-		10	-

Better wages and employment opportunities are seen as primary solutions in most areas, and tree planting ranks surprisingly high in Vulindlela. Electrification is also seen as a solution to energy problems in Vulindlela, Amatelang and New Bethesda.

There is little doubt that the aspirations of households in peri-urban areas, particularly those close to the metropolitan centres, relate closely to those of urban households. Electrification, with all its perceived advantages of convenience and versatility, is an energy supply option which cannot be ignored in peri-urban areas.

CHAPTER FOUR

ENERGY CONSUMPTION BY FARM LABOURERS

There are approximately 1,3 million employees on commercial farms in South Africa outside of the homelands - blacks comprise nearly 1,1 million, coloureds and asians - 200 000 and whites about 14 000. If one includes families, there are over 4 million blacks living on "white" owned farms, the great majority of which are without electricity and have to rely mainly on wood to meet their cooking and heating requirements.

Nearly 1100 questionnaires were sent out to farmers throughout South Africa of which 382 had been returned at the time of writing this report (23% in the Winter Rainfall Area, 23% in the Eastern Cape, 11% in Natal, 28% in the Karoo, 1% in the Orange Free State, and 16% in the Transvaal). The relatively high return rate was probably due to questions also having been asked about ESCOM and diesel fuel costs.

The average number of employees per farm was 43.

57% of farms had access to the ESCOM national electricity grid, although only 14% of farms supplied electricity to labourers and their families for lighting and 4% for cooking and heating.[38]

The overwhelming majority of households use fuelwood for cooking and heating (97%), but 5% also use coal, 19% use paraffin and 9% use gas. A small proportion (4%) were also reported to be using cowdung or agricultural residues and one farm reported the use of charcoal.[39]

---

[38] Moller's (1985) survey of 299 farms in Natal and in the Pietersburg district of Transvaal indicated that 10% of farm labourer households had electricity for lighting and 2% for cooking.

[39] Moller (1985) reports very much higher figures of 37% of households using dung for cooking and 31% for heating. She also quotes higher figures for paraffin (52% & 33%), coal (19% & 16%) and lower figures for gas (2%)

For lighting, the majority of black farm households use paraffin (65%), 14% use candles and a like number electricity, and 3% use gas

Fifty-four farmers provided estimates of monthly wood consumption by all their labourers and the mean per capita annual wood consumption has been calculated to be 800 kg. A third of the farms obtained their wood from farm woodlots and the rest from natural woodland. Moller (1985:43) estimates that about 9% of farm households are required to purchase fuelwood.

The questionnaires were kept fairly short in order to increase the likelihood of returns and thus little qualitative data is available on energy use patterns and problems.

CHAPTER FIVE : CONCLUSION

5.1 TOTAL DOMESTIC ENERGY CONSUMPTION IN UNDERDEVELOPED AREAS

If one assumes that the energy consumption data from the 6 villages and 5 periurban areas studied are representative of underdeveloped areas, then the average consumption in these sectors can be calculated as:

	Mean annual household domestic energy consumption in total sample						
	Fuelwood Kg	Dung Kg	Paraffin l	Candles No	Coal Kg	Gas Kg	Total GJ
Villages	3213	685	127	171	129	5	73
Peri-urban	2078	-	270	298	905	8.8	71

	Mean annual per capita domestic energy consumption in total sample						
	Fuelwood Kg	Dung Kg	Paraffin l	Candles No	Coal Kg	Gas Kg	Total GJ
Villages	604	118	23	27	20	0,66	13,8
Peri-urban	334	-	46	51	156	1,90	12,0

Based on these figures one can calculate the total energy consumption in the underdeveloped sector. In 1984 the total black population in South Africa (including the TVBC areas) which did not have access to electricity was approximately 20 500 000. Of this 11 500 000 were in rural areas and 4 500 000 on farms. Thus the total domestic energy consumption in the underdeveloped sector was about 275 PJ. Total nett energy consumption (i.e. energy delivered to end users) in 1984 was officially estimated to be 1 774 PJ.[40] This figure excludes wood consumption which would need to be added to the total nett energy consumption before we could determine the proportion

---

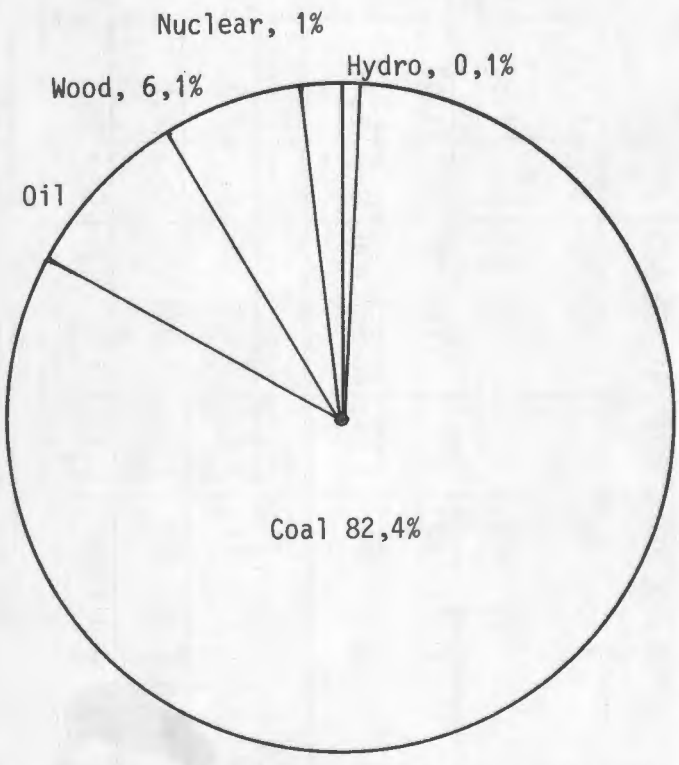
[40] Department of Mineral and Energy Affairs, Annual Report Energy Affairs 1985, Table 1.

of energy consumed in the underdeveloped sector.

It is possible to calculate total wood consumption more accurately, by looking at the breakdown of population in metropolitan areas, towns, farms and the various rural areas, and combining these with estimated wood consumption data. This is shown in the two tables overpage and total wood consumption in 1984 was 12,88 million tonnes (air dried). This is equivalent to 219 PJ.

Adding fuelwood usage, the total nett energy consumption becomes 1993 PJ. Thus energy consumption in underdeveloped areas constitutes about 14% of the total.

Total primary energy consumption (i.e. energy obtained from natural resources before it is converted into other forms such as electricity or synfuels) in 1984 was 3365 PJ without wood or 3584 PJ with wood. Fuelwood consumption thus constitutes 6% of primary energy consumption in the country.



PRIMARY ENERGY CONSUMPTION IN SOUTH AFRICA

TOTAL PUPULATION AND WOOD CONSUMPTION ESTIMATES

POPULATED CATEGORY	1980	REF	1984	REF	GROWTH RATE	REF	% URBI-NIZED	REF	HA	REF	RURAL POP. DENSITY PEOPLE/ HA	1984		
												NO. USING WOOD	AVE. WOOD RATE TONNES	TOTAL WOOD TONNES
TOTAL	28 591 100	1/76	31 370 080	C					122 104 200	2/ 323	0,26			
Whites	4 528 100	1	4 743 760	C	1,17	1/ 78	89	2/ 261				-		-
Asians	821 320	1	882 760	C	1,82	1/ 78	91	2/ 261				79 450	0,65	51 744
Coloureds	2 612 780	1	2 793 930	C	1,69	1/ 78	77	2/ 261				1 117 572	0,5	558 786
Blacks	20 628 900	1	22 957 630	C	2,71	1/ 78	31	2/ 261						
BLACKS														
Metropolitan	3 915 600	3 / 56	4 626 500	C.	4,5	3	100					1 800 000	0,5	900 000
Towns outside homelands	1 691 100	3 / 56	1 839 500	C	2,1	3	100					1 500 000	0,5	750 000
Rural areas outside home-lands.	4 310 000	3 / 56	4 520 630	C	1,2	3	-					4 500 000	0,8	3 600 000
Total home-lands	10 712 200	C	11 980 000	C	2,1	3	13,6		16 024 573		0,75	11 500 000		7 022 475
TOTAL														12 883 000

Refs:

1. Institute for Futures Research (1984). Projections and Analysis of the South African Population for the period 1980-2015, University of Stellenbosch.

2. SAIRR (1983). Survey of Race Relations in South Africa, Johannesburg.

3. Simkins, C (1983), Four essays on the past, present and possible future of the distribution of the black population of South Africa. SALDRV, University of Cape Town.

HOMELAND POPULATION AND WOOD CONSUMPTION ESTIMATES

POPULATED CATEGORY	1980	REF	1984	REF	GROWTH RATE	REF	% URBI-NIZED	REF	HA	REF	RURAL POP. DENSITY PEOPLE/ HA	1984		
												NO. USING WOOD	AVE. WOOD RATE TONNES	TOTAL WOOD TONNES
Gazankulu	512 000	4	569 580	C	2,7	2	2,8	4	675 000	2/ 323	0,84	R 553 630 PU 5 000	,76 ,3	420 758 1 500
Kangwane	160 600	4	177 990	C	2,7		5,4	4	372 000		0,84	R 168 380 PU 6 000	,75 ,1	126 285 600
KwanNdebele	156 260	4	173 830	C	2,7	2	9,7	4	92 000		1,89	R 156 970 PU 10 000	,75 ,1	117 728 1 000
Kwazulu	3 408 200	4	3 791 460	C	2,7	2	22,1	4	3 100 000		1,22	R 3 106 360 PU 500 000	,7 ,1	2 174 452 50 000
Lebowa	1 739 460	4	1 935 070	C	2,7	2	6,3	4	2 200 000		0,88	R 1 813 160 PU 90 000	,66 ,1	1 196 686 9 000
QwaQwa	156 480	4	174 080	C	2,7	2	9,2	4	48 000		3,63	R PU 174 080	,04	6 963
Transkei	2 323 650	2/ 102	2 584 950	C	2,7	A	4		4 200 000		0,62	R 2 481 550 PU 50 000	,65 ,1	1 613 008 5 000
Boputhutswana	1 323 315	2/ 102	1 472 110	C	2,7	A	15,7	4	4 000 073		0,37	R 1 241 000 PU 180 000	,55 ,1	682 550 18 000
Venda	315 545	2/ 102	351 030	C	2,7	A	3		687 000		0,51	R 330 420 PU 15 000	,75 ,1	247 815 1 500
Ciskei	669 340	4	744 610	C	2,7	A	35,8	4	650 000		1,15	R 478 040 PU 150 000	,7 ,1	354 628 15 000
T O T A L			11 974 710						16 024 000		0,75	11 510 000		7 022 473

Refs:

2. SAIRR (1983), Survey of Race Relations in South Africa, Johannesburg.

4. Central Statistical Services, S.A. Statistics 1982, Pretoria.

5.2 ENERGY PROBLEMS IN UNDERDEVELOPED AREAS

We have observed that the primary energy requirement in underdeveloped areas is domestic energy for cooking and heating, and that this is met primarily with wood. This dependence on fuelwood has led to a number of severe social, economic, health and environmental problems.

* The social costs of dependence of fuelwood are high. The average woman spends most of the working day labouring over the provision of basic services which are simply taken for granted and heavily subsidized in most urban areas. Fuelwood and water collection trips are arduous and time consuming and are seen to be one of the key problem areas where alternative solutions would be welcomed.

* Dependence on fuelwood by growing populations has led to enormous and severe scarcities of available fuel from natural woodland. This study has shown the significant shift in many areas to a new reliance on purchased wood from plantations. Problems of having to walk long distances to collect headloads are often replaced with the problem and cost of securing suitable transport to fetch wood loads. The actual price of wood, mostly from state woodlots, is still relatively cheap, but because of the cost of transport (often 80% of a delivered load), wood has become the single largest component of expenditure on fuel. Paraffin is also a large cost item and where wood is not available from either natural woodland or plantations, coal is increasingly becoming a significant fuel, most commonly in peri-urban areas, but also in some rural areas, particularly those near railway stations.

  The continued reliance on wood, even in peri-urban areas, would indicate that for the foreseeable future there will still be a massive market for wood, even as the capacity of natural woodland to meet this demand diminishes. However, largescale planting of woodlots and innovative agroforestry schemes will have to be embarked upon if this demand is to

be met. And because fuel will increasingly have to be paid for, even in the remotest areas, there will be a growing market for new low-cost fuels such as reconstituted or briquetted fuels from discard coals, paper and wood wastes.

Fuels which are still largely free and now extensively used in rural areas, are dung, mielie cobs and stalks. At present, its total contribution to domestic energy supply is still small, although it can be expected to increase as wood becomes more scarce, and will probably start becoming a commodity for sale (evidence of which was found in Cottondale). Most crop residues are currently used but only a small fraction of available dung is used for fuel, thus having minimal impact on soil fertility or environmental degradation.

* Of more serious environmental concern is the evidence of deforestation and denudation of woodland through the harvesting of growing trees for fuelwood. Although the evidence is mixed (and it appears that in at least some areas there has been a measure of control on indiscriminate cutting) the overwhelming evidence from most areas is that fuelwood is becoming scarcer and that demand for fuelwood is shifting the balance towards the destruction of tree cover.

Much more detailed ecological work needs to be undertaken in order to objectively document environmental damage consequent on fuelwood harvesting. This is important if we are to understand the long term and potentially irreversible environmental degradation and declining agricultural production which is likely should there be no effort at securing alternative energy supply options for underdeveloped rural areas.

* There are also serious health and welfare costs related to the shortage and expense of domestic energy. Many households are perilously close to the minimum fuel required to meet basic needs and some are below this

level. Cooked meals are skipped, extra foods or meat cannot be cooked with the staple mielie meal because it requires more fuel, hot water cannot be heated to increase hygiene, and water collected from contaminated sources cannot be boiled before drinking.

There is high degree of dissatisfaction with fuels which are currently being used. A majority considered paraffin, gas, coal, wood and batteries to be too expensive and fuels such as gas and candles to constitute a fire danger. Many complained that paraffin and candles are messy to use, that they provide poor light, that smoke from coal and wood fires permeated clothes and that wood was not always readily available from vendors and was often sold green. There is often the risk of fines for wood collection from natural woodland and the problem of secure storage and thefts from household wood piles was also reported.

The energy problems of underdeveloped areas have been described mainly as a set of symptoms and there is little dispute concerning general statements of growing fuelwood scarcities, social and environmental costs, and the increased economic burden of this sector which is paying more for less. But policy responses require both an understanding of the processes which underlie these aggregate data and an understanding of their causes. It is perhaps easy merely to document and describe shortages of wood for cooking without understanding that it is part of a larger process of under-development. What may seem to some as an insensitive and mindless destruction of natural woodland and forest cover, can also be interpreted as the last desperate act of survival by people who are denied any alternative by the structure of their society which determines unequal access to land, to trees, to alternative sources of energy and indeed to all the other means of production.

It is thus instructive to gain a brief insight into the structure of energy use in the rest of South Africa's economy, in order to understand some of the constraints and options available to underdeveloped areas.

5.3 ENERGY USE IN SOUTH AFRICA'S ECONOMY

There is no doubt that electricity is one of the most sophisticated and convenient forms of energy. South Africa was one of the first countries to use electricity on a commercial basis, soon after the development of diamond and gold mining.[41] Today the Electricity Supply Commission (Escom) ranks among the top seven electricity suppliers in the world.

Electricity is produced almost entirely from coal, except a very small amount which is produced from hydro-power and less than 10 per cent from nuclear power when Koeberg is fully commissioned. Coal is the basis of South Africa's energy economy, contributing about 80% of primary energy consumption. Low labour wages have resulted in inexpensive coal which has supported the fast growing electricity supply and industrial sectors, almost half of our liquid fuel requirement with the Sasol plants and more recently growing coal exports have become the most important source of export earnings after gold.

The State has remained in almost complete control of the energy supply industry in South Africa. Information on oil and nuclear supplies is controlled through stringent secrecy laws; the state regulates coal prices; it initiated the Sasol plants; and it controls electricity supply through the virtual monopoly of Escom.

It is in the electrical supply industry that the role of the state is most apparent in concentrating energy investments almost exclusively in the

---

[41] Electric street lights were switched on in Kimberley in 1882, only three years after Thomas Edison started generating electricity from the famous Pearl Street power station in New York, and before London had electric lights.

interests of mining, transport and manufacture. Since 1905, South Africa has had perhaps the cheapest steam-generated electricity in the world. Cheap power is crucial to most South African production and the amount of energy consumed per unit of gross national product is amongst the highest in the world. Electrification is generally labour saving and the changes in the speed and size of operations made possible by electrical machinery substantially increase labour productivity. Electrical mechanisation is a prime method of increasing capital accumulation.

ESCOM produces approximately 60% of Africa`s electricity, yet the majority of South Africa`s population is denied access to its benefits. Instead the national electricity grid has developed to serve mainly "white" industry and towns. More recently there has been a massive effort to provide electricity to even remote commercial farms, but still the underdeveloped rural areas are bypassed.[42]

5.4 CONCLUDING DISCUSSION

There is no overall shortage of energy in South Africa, only a highly inequitable distribution of and access to energy resources. Energy consumption in South Africa cannot be divorced from patterns of development in the region. It could be argued that the energy problems of underdeveloped areas are largely a result of historical processes and the development of economic structures which required the establishment of labour migration and the restriction of a large growing population to small "homeland" areas. Acute pressures on resources in these confined areas results in scarcity of traditional energy sources, environmental degradation and human hardship.

---

[42] In 1984 a total of 5920 new farms supplies were provided. In the Rand and Orange Free State Region alone more than 3800 km of rural lines were built during that year.

The provision of household energy takes up a substantial part of the resources of poor households either in cash purchases or in the time and effort required to gather wood or agricultural residues. We have seen how women in rural areas spend most of their working day labouring in non-productive activity over the provision of basic services that are simply taken for granted and which are usually subsidized in most urban areas.

It has been argued frequently elsewhere that rural areas in Southern Africa are predominantly reproductive in character. A corollary to the need for our industrial capitalist economy to produce commodities at the maximum possible profit has been the need to reproduce labour at its minimum cost. This situation has had a direct bearing on the quality of services such as fuel and water supply in these areas which themselves do not have the means of production for viable rural development. Among the rural and peri-urban poor, energy is used almost exclusively to satisfy the most basic of human needs, in particular food preparation. In is unlikely that current consumption could be reduced any further without an even further decline in nutritional standards, and a concomitant decline in productive capacities.

In many senses the "homelands" or reserves have become functionally urbanized: they are dependent on remittances and pensions for survival; but what they desire most is physical infrastructure and social services or items of collective consumption such as those commonly demanded in South Africa`s townships: viz. domestic water supply, fuel, electricity, transport, housing, etc. The results of the needs assessment summarized earlier in this report reveal that services are a high priority.

Yet economic structures which allocate energy investments primarily according to the requirements of production mean that rural and periurban areas on the periphery of the industrial centres receive often only the minimum necessary for survival. This is seen most acutely in the resettlement camps of the "surplus people" such as at Amatelang. The environmental and social costs of energy scarcities in other areas are also

mounting. It is perhaps only in the intersection and development of political and economic forces and struggles that different structures may develop which might allow some of the problems described in this report to be mitigated and perhaps reversed.

REFERENCES

ACOCKS, J P H (1975). Veld types of South Africa (veld type map). Mem. bot. Surv. S. Afr. 40.

ANDERSON, D & FISHWICK, R (1985). Fuelwood consumption and deforestation in African countries : a review. World Bank, New York.

ARDINGTON, E (1984). Poverty and development in a rural community in Kwazulu. Conference Paper No 53, Second Carnegie Inquiry into Poverty and Development in Southern Africa, SALDRU, University of Cape Town.

BANKS, P F (1981). The planting of woodlots for the fuelwood requirements of Tribal Trust and populations in Zimbabwe/Rhodesia: a review of past and future development. South African Forestry Journal, Vol 117, pp 13-15.

BANKS, P F (1981). "The indigeneous woodland - a diminishing source of fuelwood", The Zimbabwe Scinece News, Vol 15, No 1, January, pp 12 - 14.

BARNETT, A et al (1982). Rural energy and the third world. Pergamon Press, Oxford.

BEIJER INSTITUTE (1982). Issues in SADCC Energy Planning: Usage Patterns, Resource Potential, and Regional Possibilities. Draft Discussion Document, Beijer Institute, Stockholm, Sweden.

BEIJER INSTITUTE (1984). Energy and Development in Southern Africa, SADCC Country Studies, Part I & II. Energy, Environment and Development in Africa, Parts 3&4. Royal Swedish Academy of Sciences, Stockholm, Sweden.

BEST, M (1979). The scarcity of domestic energy: a study in three villages. SALDRU working paper no. 27, University of Cape Town.

BOND, C (1977). Ten million trees and porridge pots. African Wild Life, Vol 31, No 3, pp 32-33.

BREITENBACH, VON F (1965). The indigenous trees of Southern Africa. Government Printer, Pretoria.

BROKENSHA, D & CASTRO, P A (eds) (1983). Wood Fuel Surveys. Forestry for Local Community Development Programme Report GCP/INT/365 /SWE, FAO, Rome.

CECELSKI, E et al (1979). Household energy and the poor in the third woeld. Research Paper R-15, Resources for the Future, Washington, DC.

CUNNINGHAM, T (1984). Indigenous plant resources: a buffer against rural poverty. Carnegie Conference Paper No 145, op cit.

CUNNINGHAM, T (1985). The resource value of indigenous vegetation to rural people in an area of low agricultural potential. Unpublished PhD thesis, University of Cape Town.

DANIEL, J (1984). Man land relationships in the EAstern Cape. Carnegie Conference Paper No 114, op. cit.

DE WINTER, B (1966). Sixty-six Transvaal trees. Botanical Research Institute, Dept of Agriculture, Pretoria.

EBERHARD, A A (1984). Energy and poverty in urban and per-urban areas around Cape Town. Carnegie Conference Paper No 155, op cit.

EBERHARD, A A & GANDAR, M V (1984). Energy, poverty and development in South Africa. Carnegie Conference Paper No 154, op cit.

ERL Energy Resources Limited (1985). A study of energy utilisation and requirements in the rural sector of Botswana, London.

F A O (1955). Fact finding with rural people - A guide to effective socila survey. Food and Agricultural Organisation of the United Nations, Rome.

F A O (1983). Wood fuel surveys. Forestry for local community development programme - GCP/INT/365/SWE, Food and Agriculture Organisation of the United Nations, Rome.

FURNESS, C K (1981a). Estimating indigenous resources of fuelwood and poles and plantation requirements in the Tribal Trust Lands of Zimbabwe/Rhodesia. South African Forestry Journal, No 117, pp 6-9.

FURNESS, C K (1981b). Some aspects of fuel-wood usage and consumption in African rural and urban areas in Zimbabwe/Rhodesia. South African Forestry Journal, No 117, pp 10-12.

GANDAR, M V (1983a). "Some Social and Environmental Aspects of the Use of Fuelwood in Kwazulu", in Bromberger, N. and Lea, J. (eds) Rural Studies in Kwazuilu, University of Natal Press.

GANDAR, M V (1983b). The Utilisation of Trees and the Impact on the Environment: A study in Mahlabatini District, Kwazulu. Institute of Natural Resources, University of Natal, Pietermaritzburg.

GANDAR, M V (1983c). Wood as a source of fuel in South Africa. Monograph 4, Institute of Natural Resources, University of Natal, Pietermaritzburg.

GANDAR, M V (1984). The poor man's energy crisis: domestic energyt in Kwazulu. Carnegie conference paper no. 156, op. cit.

GANDAR, M V (1984). Wood as a source of fuel, South African Forestry Journal, Vol 116, pp 1-9.

GAY, J & KHOBOKO, M (1982). Village Energy Survey Report. RET Lesotho, Ministry of Cooperatives and Rural Development, Lesotho.

GILL, J (1985). Firewood, cooking stoves, land degradation and deforestation - a systems approach (based on Zimababwe) PhD Thesis, Open University, England.

GWAITTA-MAGUMBA, D A (1983). "Woodfuel and other energy sources in Swaziland", SADCC Woodfuel SEminar, Luanda, Angola, October.

HARRIES, P (1984). Aspects of poverty in Gazankulu: three case studies. Carnegie conference paper no 67, op cit.

JACKSON, J A D (1980). Wood fuel in Malawi. Paper read at the Energy Symposium '80, Salisbury, Oct. 1980.

JELENIC, N E & VAN VEGTEN, J A (1981). A pain in the neck : the firewood situation in south-western Kgatleng, Botswana. NIR Research Notes No 5, University College of Botswana, Gaborone.

JOHNSTON, J C (1981). "Wood fuel : a neglected energy source in Zimbabwe", The Zimababwe Science News, Vol 15, No 1, 99 15-17.

KGATHI, D L (1984). Aspects of firewood trade between rural Kweneng and urban Gaborone : a socio-economic perspective. Working Paper No 46, NIR, University of Botswana, Gaborone.

LE ROUX, P J (1981). Supply of fuel-wood for rural populations in South Africa. South African Forestry Journal, No 117: pp 22-27.

LIENGME, C A (1981). Some plants used by the Tsonga. Bothalia, Vol 13, pp 501-518.

LIENGME, C A (1983)." A study of wood use for fuel and building in an area of Gazankulu," Bothalia, Vol 14, No 2, pp 245-257.

LIENGME, C A (1983). A review of ethno-botanical research in southern africa: Bothalia, Vol 14, Nos 3 & 4.

LIGHTFOOT, C J (1982). "Fuelwood yield potentials in lowveld woodlands", The Zimbabwean Science News, Vol 16, No 3.

MACKENZIE, B (1985). PhD thesis, University of Cape Town.

MALAWI ENERGY UNIT (1981). Malawi Rural Eenergy Survey. Energy studies Unit, Ministry of Forestry and Natural Resources, Lilongwe.

MALAWI ENERGY STUDIES UNIT (1984). Malawi urban energy survey. Energy Studies Unit, Ministry of Forestry and Natural Resources, Lilongwe.

MOLLER, V, (1985). Rural black's perceptions of basic needs fulfillment. Centre for Applied Social Sciences, University of Natal, Durban.

MURLESS, P H (1983). Firewood crop potential in South Africa. Paper presented at NCW workshop on woodlots, Botha's Hill, Natal.

NATIONAL ACADEMY OF SCIENCE (1980a). Firewood Crops. Shrub and tree species for energy production. Washington D.C.

NATIONAL ACADEMY OF SCIENCE (1980b). Proceedings of the International Workshop on Energy Survey Methodolies for Developing Countries. Washington, D.C.

NKAONJA, R S W (1981). Rural fuel-wood and poles research project in Malawi: a general account. South African Forestry Journal, Vol 117, pp 19-21.

OKI, J & MAJAHA-JARTBY, J (1983). Botswana Village Energy Survey Report. BRET Project, Gaborone.

POWELL, P I (1982). Calorific yield models : their construction and use with particular relevance to Lesotho. Unpublished MSc thesis, Oxford University.

SCHNEIDER, C (1984). Microstudies in Gazankulu : study of 8 villages in two districts of Gazankulu. Carnegie conference paper no 66, op cit.

SILBERBERG, R B (1981). An Energy Supply and Demand Model for South Africa. Unpublished PhD Thesis, University of Cape Town.

SIMKINS, C E W (1981). The Distribution of the African Population of South Africa. Saldru Working Paper No. 32, University of Cape Town.

SMITH, J H (1983). "Electricity Supply in South Africa - A Strategy for Electric Utilities", pp 42-49 in the proceedings of the conference, South African Energy in perspective, SANCWEC, Pretoria.

SOCIAL AND ECONOMIC PLANNING COUNCIL (1946). The Native Reserves and their Place in the Economy of the Union of South Africa. Government Printer Pretoria.

STEELE, R J G & NCHOLU, T G (1983). Woodlot Marketing Study (North) Final Report. Ministry of Agriculture, Leribe and Buthe Buthe Districts, Lesotho.

VAN VUUREN, N J J, BANKS, C H & STOHR, H P (1978). Shrinkage and density of timbers used in the Republic of South Africa. Department of Forestry Bulletin No. 57.

WATTE & BREYER-BRANDWIJK (1962). Medicinal and poisonous plants of Southern and Eastern Africa. E&S Livingston, Edinburgh.

WHITLOW, J R (1979). The household use of woodland resources in rural areas. Salisbury: Department of Natural Resources.

WICKSTEAD, M (1984). Marketing Study (South). Lesotho Woodlots Study, Ministry of Agriculture, Lesotho.

VILLAGE ENERGY SURVEY

Village : .....
Name of Interviewer : .....
Name of household being interviewed : .....

DOMESTIC ENERGY USE

1. Which of the following do you use for cooking, keeping warm, lighting, and other household activities? State how many.

- ☐ open fire
- ☐ fire in brazier (tin)
- ☐ paraffin primus stove
- ☐ paraffin wick (flame) stove
- ☐ gas stove
- ☐ coal stove
- ☐ metal or mud wood-burning stove
- ☐ wonderbox
- ☐ 3 legged iron pot
- ☐ saucepans
- ☐ kettle
- ☐ tripod stand
- ☐ solar water heater
- ☐ paraffin heater
- ☐ gas heater
- ☐ candles
- ☐ paraffin lamp
- ☐ gas lamp
- ☐ torch
- ☐ flat iron for pressing clothes
- ☐ paraffin fridge
- ☐ gas fridge
- ☐ petrol/diesel generator
- ☐ car battery
- ☐ dry cell batteries
- ☐ solar cells
- ☐ Any other appliances - specify .....

2. Do you usually do the cooking? ..... ☐

3. For how many people do you or your family cook each day? ..... ☐☐

4. Do you or your family cook every day? ..... ☐
   If no, how often do you cook? ..... ☐

5. Yesterday, or the last day you cooked, what foods did you cook, at what time of day, with what kind of stove, with what fuel, and was it indoors or outdoors?

Time of Day	Food Cooked	Type of Stove	Type of Fuel	Indoors or Outdoors
.....				
.....				
.....				
.....				
.....				
.....				
.....				
.....				
.....				

6. Do you usually cook any other kinds of food? ..... ☐
   Specify .....
   .....
   .....

7. Other than for cooking, what do you heat water for? .....
.....
.....

8. Do you heat water for washing? .....
If yes, how much do you heat each day? .....
With what fuel and stove? .....
And at what times of the day? .....

9. Do you heat water for tea or coffee? .....
At what times of the day? .....
With what fuel and stove? .....

10. How many buckets of water does the family use per day? .....
What size are the buckets? (litres or small/medium/large)
.....

11. How often do you brew beer per month?.....
How much do you usually brew? .....

12. How do you keep your houses warm in winter? .....
.....

13. How many houses does your family have? .....
With what kind of roofs (ie grass/thatch or iron)? .....
.....
What kind of roof do you prefer? .....
Why? .....
What kind of materials are the walls made of?.....

14. What do you use for light at night? .....
How long do you usually light your house each night?
.....
How many candles do you use each week? .....

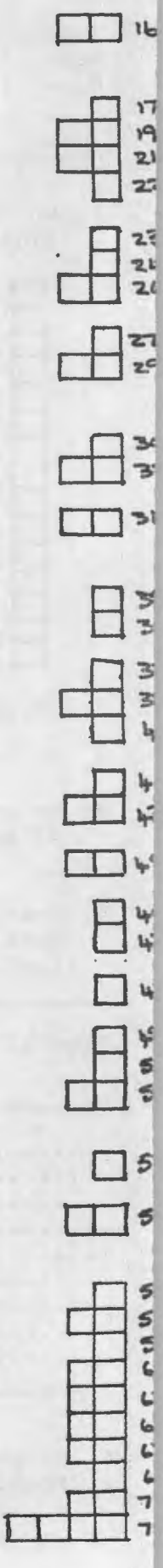
15. How many times a week do you iron clothes? .....
What fuel do you use to heat the iron? .....

16. How many fires do you make each day?.....

17. Do you ever move the fire from outside to indoors .....
When and Why? .....
.....
.....

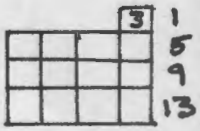
18. If you make a fire outside, do you shield it from the wind?
.....
How do you shield it? .....
.....

19. Do you or your family use firewood? .....
Where do you get it from? .....
Who collects it? .....
How is it collected? .....
How far is it and how long does it take to collect it?
.....
How much is collected each time? .....
How often is wood collected? .....
How much wood is used each week? .....
Do you buy wood? ....., at what price? .....



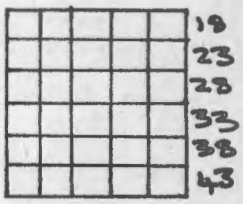
20. Are there any problems with the collection or use of wood, and what would be the best way of overcoming these problems?

Problem	Possible Solutions
.....	.....
.....	.....
.....	.....



21. Which kinds of wood do you prefer, is it easy or difficult to find them, and what do you usually use them for?

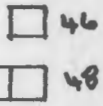
Preferred kinds of wood	Difficult to find (yes/no)	Used for
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....



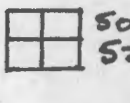
22. Do people collect only dead wood or do they cut growing trees and branches? .....
.....

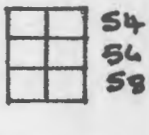
23. Is it more difficult, and do you have to go further to collect firewood now than a few years ago? .....

24. Do you think it is good idea to plant trees?.....
Why? .....
.....

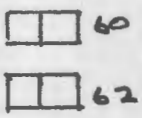


25. How many trees, of what type, have you planted in the past year? .....
.....
If you ever planted trees which did not live, explain what type you planted, in what kind of place, and why you think they died .....
.....
.....
.....

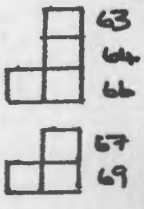




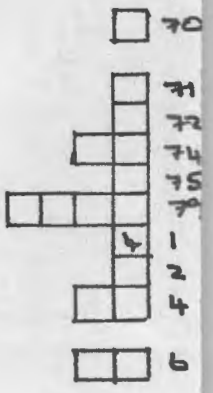
26. Who should plant trees and who should control when they can be cut? .....
.....
.....



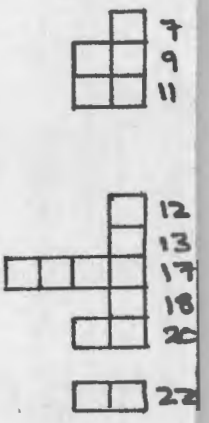
27. Have you ever seen a metal or mud cooking stove which uses firewood? .....
Would you like to use one of these stoves? .....
Why? .....
.....
Would you prefer a mud or a metal stove .....
Why? .....
.....



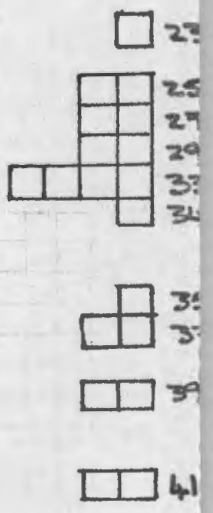
28. Do you use dung for making fires .....
(If no, skip to question 29)
If yes, do you collect it from cattle kraals .....
or from the veld? .....
How much do you use each week? .....
Do you ever have to pay for dung? .....
If yes, what price? .....
Do you prefer to use dung for specific cooking or heating operations? .....explain .....
.....
.....
Are there any problems with burning dung .....
.....
.....



29. Do you use mielie cobs for making fires .....
or mielie stalks ..... or sorghum stalks .....
or bean stalks ..... or any other crop stalks .....
specify .....
(If no, skip to question 30)
At what times of the year do you use these crop residues?
.....
Do you ever have to pay for crop residues? .....
If yes, what price? .....
Do you use these crop residues for any specific cooking or heating operation? ..... explain .....
.....
Are there any problems with burning crop residues? .....
.....
.....



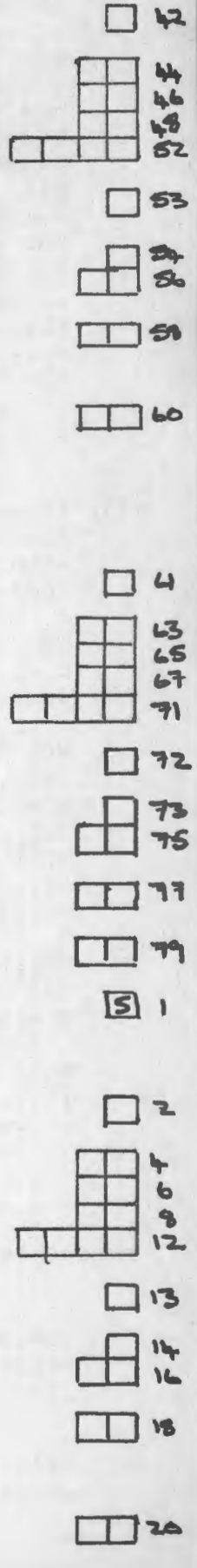
30. Do you use charcoal? .....
(If no, skip to question 31)
If yes, where do you buy it from? .....
How much charcoal did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without charcoal? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there any problems using paraffin? .....
.....
.....



31. Do you use paraffin? .....
(If no, skip to question 32)
If yes, where do you buy it from? .....
How much paraffin did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more paraffin as soon as it is finished? ..
Or do you sometimes do without? .....
Give details:
How often are you without paraffin? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there any problems using paraffin? .....
.....
.....

32. Do you use coal? .....
(If no, skip to question 33)
If yes, where do you get it from? .....
How much did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more coal as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without coal? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
Are there any problems using coal? .....
.....
.....

33. Do you use gas? .....
(If no, skip to question 34)
If yes, where do you get it from .....
How much gas did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more gas as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there problems with using gas? .....
.....
.....



34. Do you use batteries? .....
(If no, skip to question 35)
If yes, what do you use them for? .....
.....
What type do you buy, and how much do they cost? .....
.....
How long do they last? .....
Do you always buy more as soon as they are finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there problems using batteries? .....
.....
.....

35. If you had a choice, which fuel would you prefer to use for cooking? (tick)

wood	charcoal	gas	.....
coal	paraffin	electricity	.....

What is the reason for your choice? .....
.....
.....

36. Which fuel would you prefer to use for heating? (tick)

wood	charcoal	gas	.....
coal	paraffin	electricity	.....

What is the reason for your choice? .....
.....
.....

37. Which fuel would you prefer to use for lighting (tick)

gas	.....	paraffin	.....
electricity	.....	candles	.....

What is the reason for your choice? .....
.....
.....

ENERGY IN AGRICULTURE

38. How many livestock do your family own? cattle ....

horses/mules	donkeys	sheep	goats .....
pigs	chickens	other	

39. Have you ever used dung as a fertiliser for the growing of crops? .....

40. How many fields ..... or garden plots ..... do you have?

41. What do you use to plough your fields?
Do you hire a tractor? .....
Or how many cattle do you use? .....
What do you use to harrow? .....
And to plant? .....
And to weed? .....
And to harvest? .....

42. How many days each year are spent ploughing your fields? ....
.....
And harrowing? .....
And planting? .....
And weeding? .....
And harvesting? .....

43. For transport or carrying things, do you use:
donkeys ..... , horses ..... , cattle .....
a cart ..... , sleigh .....

44. Where do you take your mielies, wheat or sorghum to be ground? .....
.....

45. How many bags of mielies do you grind per year? .....
how many bags sorghum? ..... and wheat .....

46. Do you ever exchange your mielies for ground flour at the shop? .....

47. Do you ever grind small quantities by hand? .....
Descibe what you use for grinding .....
.....

48. Where do you get your water? .....
Who fetches water in your family? .....
How often is water fetched? .....
How far do people walk to fetch water? .....
How long does it take each time? .....

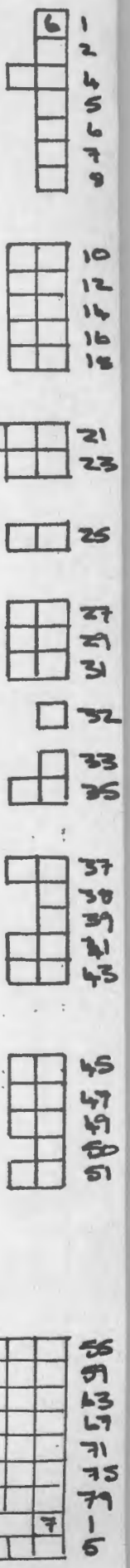
GENERAL

49. How many children ..... women ..... and men .....
are there in your household ?

50. Is any one working away from home? ..... Give details
.....
.....

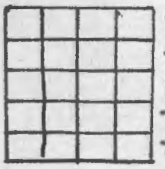
51. How much money does your household earn?

Source	Per month	Per year
Money sent by away workers	.....	
	.....	
	.....	
Sale of crops	.....	
Pensions	.....	
Disability grants	.....	
Other (specify)	.....	
	.....	



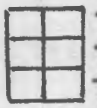
52. List the most important needs and problems of your household? Rank these according to importance. What do you think should be done to solve these needs and problems?

Need or problem	Possible solution
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....



53. What work that women usually do is the most difficult or tiring?
(1).....
(2).....
(3).....

54. What work that men usually do is the most difficult or tiring?
(1).....
(2).....
(3).....



55. What things do you think would make this community or village be a better place?
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

56. ANY COMMENTS OR OBSERVATIONS

VILLAGE ENERGY SURVEY

NOTES FOR ENUMERATORS

Q 1 Note down the number of each appliance used by the household. Note details of the appliance: eg. record whether a gas stove has one, two or more cooking rings, or whether it has an oven; or if a generator is used, what size, and whether it uses petrol or diesel, etc.

Some explanations:

(i) an open fire is one that is not made in a wood or coal burning stove or brazier (chimu);

(ii) a wonderbox is a box, usually made of cardboard, with some form of insulation in which a hot pot is placed for the food to carry on cooking;

(iii) a tripod stand is a frame with 3 legs on which a cooking pot is placed and underneath which a fire is made;

(iv) a solar water heater is a device which is placed in the sun to heat water;

(iv) a petrol or diesel generator is an engine which produces electricity;

(v) examples of dry cell batteries are torch batteries or the larger PM10 batteries for radios, etc.

(vi) solar cells are flat panels placed in the sun to produce electricity.

Q 2 If the answer is "no" try to find the person who cooks. If that person is not available, attempt the questionnaire, but be prepared to abandon it and return another time if it does not go well.

Q 5 Make sure that you include all meals cooked in the morning, midday and evening, but do not include tea or coffee making as there is a separate question on this.

Fuel is that which is burnt during cooking: eg. wood, coal, paraffin, gas, etc.

Q 12 ie. are paraffin or gas heaters used or do they sit around the cooking fire to keep warm?

Q 13 If corrugated iron roofs are prefered find out whether this is because of a shortage of thatching grass or because iron roofs are seen to be more "modern".

Q 14 ie. are paraffin or gas lamps, candles or torches used?

Q 15 ie. is the iron heated on a paraffin, gas or coal stove?

Q 19 The amount of wood collected in headloads must be weighed. Ask households to show you how big the headloads usually are and weigh these with your spring balance. Ask them how long the bundle usually lasts to estimate how much wood is used each week.

Q 21 Record the local name of trees that people prefer for firewood. Also write down those trees which people think make bad firewood, stating this clearly on the form.

Q 22 Find out also if there are any local laws or regulations which control firewood collection and whether the chiefs can impose fines for the collection of green wood.

Q 28-34 If people do not use these fuels, skip to the next question. If people use dung or coal it is important to weigh a few tins, or sacks of these fuels. One thing to look out for is that bags may have a weight marked on it, but this may not be the actual weight of the fuel. For example, coal is sometimes delivered in 10Kg potatoe bags. This does not mean 10kg of coal, and some bags should be weighed as a check. Another point is that when people buy paraffin this may be in 750ml or 1 litre bottles or in 10 or 20 litre tins. This should be stated clearly on the forms.

When recording how much money is spent on fuel, make sure that the quantity is also written down: eg. 72c for 6 candles, or R 1-20 for 1 litre of paraffin, or R 5-30 for 40kg of coal, etc.

Q 38 - It may be wise to ask the men in the household these questions.

Q 43 Also write down here whether people own a car or truck.

Q 51 If people are reluctant to answer this question then skip it.

Q 52-54 Try to find out in these questions whether people see firewood, or the cost or availabililty of other fuels as a serious problem or whether there are more serious problems, eg water, or employment, or the need for clinics, etc.

Q 56. Any points not covered by the previous questions should be noted down here.

GENERAL

Whenever you see a women carrying a headload of firewood, ask her if you can weigh the bundle. Write down these measurements on a separate piece of paper.

PERI-URBAN DOMESTIC ENERGY SURVEY

Area : .....
Name of Interviewer : .....
Name of household being interviewed : .....
Address " " " "

---

1. Which of the following do you use for cooking, keeping warm, lighting, and other household activities? Say how many.

- ☐ open fire
- ☐ fire in brazier (tin)
- ☐ paraffin primus stove
- ☐ paraffin wick (flame) stove
- ☐ gas stove
- ☐ coal stove
- ☐ metal or mud wood-burning stove
- ☐ wonderbox
- ☐ 3 legged iron pot
- ☐ saucepans
- ☐ kettle
- ☐ tripod stand
- ☐ solar water heater
- ☐ mains electricity
- ☐ paraffin heater
- ☐ gas heater
- ☐ candles
- ☐ paraffin lamp
- ☐ gas lamp
- ☐ torch
- ☐ flat iron for pressing clothes
- ☐ paraffin fridge
- ☐ gas fridge
- ☐ petrol/diesel generator
- ☐ car battery
- ☐ dry cell batteries
- ☐ solar cells
- ☐ Any other appliances - specify .....

2. Do you usually do the cooking? .....

3. For how many people do you or your family cook each day? .....

4. Do you or your family cook every day? .....
   If no, how often do you cook? .....

5. Yesterday, or the last day you cooked, what foods did you cook, at what time of day, with what kind of stove, with what fuel, and was it indoors or outdoors?

Time of Day	Food Cooked	Type of Stove	Type of Fuel	Indoors or Outdoors
.....				
.....				
.....				
.....				
.....				
.....				
.....				
.....				
.....				

---

6. What other foods do you most often cook?
   .....
   .....
   .....

7. Do you heat water for tea or coffee? .....
   At what times of the day? .....
   With what fuel and stove? .....

8. Do you heat water for washing? .....
   With what fuel and appliance .....
   .....
   And at what times of the day .....

9. Do you heat water for any other purpose? .....
   Give details .....

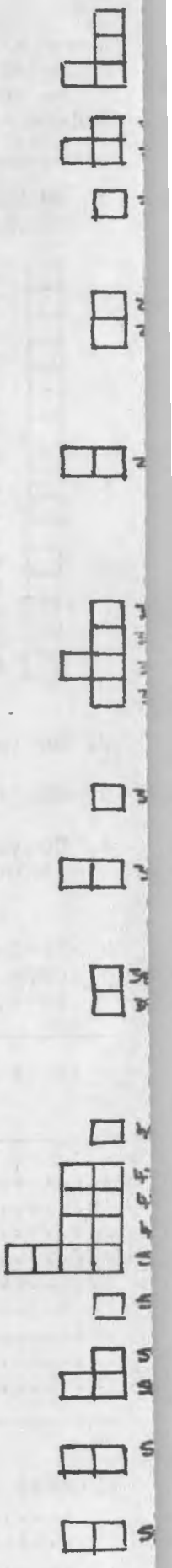
10. How do you keep your house warm in winter? .....
    .....
    .....

11. What kind of roof does your house have (ie. thatch, iron or tiles)? .....
    What kind of roof do you prefer? .....
    Why? .....
    What kind of materials are the walls made of?.....

12. What do you use for light at night? .....
    .....
    How long do you usually light your house each night?
    .....

13. How many times a week do you iron clothes? .....
    What fuel do you use to heat the iron? .....

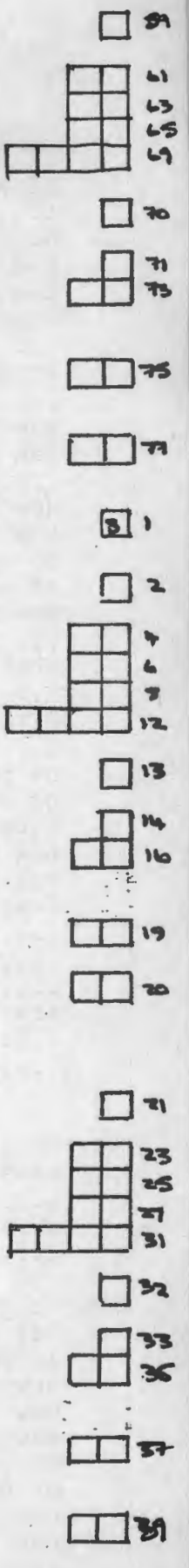
14. Do you use paraffin? .....
    (If no, skip to question 15)
    If yes, where do you buy it from? .....
    How much paraffin did you buy last time? .....
    How long does it last? .....
    How much did you pay for it? .....
    Do you always buy more paraffin as soon as it is finished? ..
    Or do you sometimes do without? .....
    Give details:
    How often are you without paraffin? .....
    For how long at a time? .....
    What do you do during these periods? .....
    .....
    .....
    .....
    Are there any problems using paraffin? .....
    .....
    .....



15. Do you use gas? .....
(If no, skip to question 16)
If yes, where do you get it from .....
How much gas did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more gas as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there problems with using gas? .....
.....
.....

16. Do you use coal? .....
(If no, skip to question 17)
If yes, where do you get it from? .....
How much did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more coal as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without coal? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
Are there any problems using coal? .....
.....
.....

17. Do you use charcoal? .....
(If no, skip to question 18)
If yes, where do you buy it from? .....
How much charcoal did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
Do you always buy more as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without charcoal? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there any problems using charcoal? .....
.....
.....



18. Do you or your family use firewood? .....
(If no, skip to question 19)
If yes, is it all bought? .....
mostly bought? .....
mostly gathered yourself .....
all gathered .....
If you buy firewood, where do you get it from? .....
.....
How much did you buy last time? .....
How long does it last? .....
How much did you pay for it? .....
What kind of firewood do you buy? .....
.....
If you gather your own firewood, where do you collect it?
.....
How is it collected? .....
How far is it and how long does it take to collect it?
.....
How much did you collect last time? .....
How long does it last? .....
Do you have to pay to gather your own firewood? .....
If so, how much? .....
What kind of wood do you collect? .....
.....
What kind of wood do you prefer? .....
.....
Give reasons .....
.....
Do you always get more wood as soon as it is finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there problems in getting or burning wood? .....
.....
.....

19. Do you sometimes burn other things such as cardboard boxes, mielie cobs, etc. ..... Give details .....
.....
.....
.....

20. Do you use candles? .....
(If no, skip to question 21)
If yes, where do you buy them from? .....
How many candles did you buy last time? .....
How long do they last? .....
How much did you pay for them? .....
Do you always buy more as soon as they are finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without candles? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....

Are there any problems using candles? .....
.....
.....

21. Do you use batteries? .....
(If no, skip to question 22)
If yes, do you use car batteries? .....
How many? .....
What do you use them for? .....
.....
How long does it last before you have to recharge it? .....
How do you recharge it? .....
How much does it cost to recharge it? .....
After the battery is flat do you often wait before recharging it? .....
How long do you usually wait? .....
Do you use dry cell batteries? .....
What type do you buy? .....
What do you use them for? .....
How much do they cost? .....
How long do they last? .....
Do you always buy more as soon as they are finished? .....
Or do you sometimes do without? .....
Give details:
How often are you without? .....
For how long at a time? .....
What do you do during these periods? .....
.....
.....
.....
Are there problems using batteries? .....
.....
.....

22. Do you use anything else for heating, lighting or cooking (eg solar water heaters, petrol generators, mains electricity, etc)? .....
(If no, skip to question 23)
If yes, give details.
What do you use? .....
What do you use it for? .....
How much fuel do you use? .....
What does it cost per month? .....

23. If you had a choice, which fuel would you prefer to use for cooking? (tick)

wood	charcoal	gas	
coal	paraffin	electricity	

What is the reason for your choice? .....
.....
.....

24. Which fuel would you prefer to use for heating? (tick)

wood	charcoal	gas	
coal	paraffin	electricity	

What is the reason for your choice? .....
.....
.....

25. Which fuel would you prefer to use for lighting (tick)
gas ..... paraffin .....
electricity ..... candles .....

What is the reason for your choice? .....
.....
.....

26. Do you use any electric appliances such as washing machines, television sets, hi fi sets, drills, etc.....
Give details .....
.....
.....

27. Do you own a car, truck, tractor or any other vehicle? .....
(If no, skip to question 28)
If yes, give details .....
.....
.....
.....
How much petrol or diesel do you use for these vehicles each week? .....
.....
How much do you pay for petrol or diesel for these vehicles each week? .....
.....

GENERAL

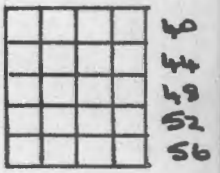
28. How many children ..... women ..... and men .....
are there in your household ?

29. How much money does your household earn?

Source	Per ~~month~~ week	Per ~~year~~ month
Women workers	.....	
	.....	
	.....	
Men workers	.....	
	.....	
	.....	
Weekend workers	.....	
Money sent by	.....	
away workers	.....	
Pensions	.....	
Disability grants	.....	
Other (specify)	.....	
	.....	

30. List the most important needs and problems of your household? Rank these according to importance. What do you think should be done to solve these needs and problems?

Need or problem	Possible solution
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	



32. ANY COMMENTS OR OBSERVATIONS

PERI URBAN ENERGY SURVEY

NOTES FOR ENUMERATORS

Q 1 Note down the number of each appliance used by the household. Note details of the appliance: eg. record whether a gas stove has one, two or more cooking rings, or whether it has an oven; or if a generator is used, what size, and whether it uses petrol or diesel; etc.
Some explanations:
(i) an open fire is one that is not made in a wood or coal burning stove or brazier (tin);
(ii) a wonderbox is a box, usually made of cardboard, with some form of insulation in which a hot pot is placed for the food to carry on cooking;
(iii) a tripod stand is a frame with 3 legs on which a cooking pot is placed and underneath which a fire is made;
(iv) a solar water heater is a device which is placed in the sun to heat water;
(iv) a petrol or diesel generator is an engine which produces electricity;
(v) examples of dry cell batteries are torch batteries or the larger PM1Ø batteries for radios, etc.
(vi) solar cells are flat panels placed in the sun to produce electricity.

Q 2 If the answer is "no" try to find the person who cooks. If that person is not available, attempt the questionnaire, but be prepared to abandon it and return another time if it does not go well.

Q 5 Make sure that you include all meals cooked in the morning, midday and evening, but do not include tea or coffee making as there is a separate question on this.
Fuel is that which is burnt during cooking: eg. wood, coal, paraffin, gas, etc.

Q 9 ie. are paraffin or gas heaters used or do they sit around a fire or stove to keep warm?

Q 11 If corrugated iron roofs are prefered find out whether this is because of a shortage of thatching grass or because iron roofs are seen to be more "modern".

Q 12 ie. are paraffin or gas lamps, candles or torches used?

Q 13 ie. is the iron heated on a paraffin, gas or coal stove?

Q 14 Paraffin is bought either in 75Øml or 1 litre bottles, or in 1Ø or 2Ø litre tins. Ask to see paraffin containers and record the quantities bought accurately.

Q 16-18 If people use coal, charcoal or firewood it is important to weigh sacks or tins of these fuels so that accurate weights may be recorded. One thing to look out for is that bags may have a weight marked on it, but this may not be the actual weight of the fuel. For example, coal is sometimes delivered in 10Kg potatoe bags. This does not mean 10kg of coal, and some bags should be weighed as a check.

When recording how much money is spent on fuel, make sure that the quantity is also written down: eg. 72c for 6 candles, or R 1-20 for 1 litre of paraffin, or R 5-30 for 40kg of coal, etc.

Q 19 Find out whether people use anything else for cooking: eg. do they burn waste paper, or grass, or crop wastes, or dung, etc.

Q 30 Try to find out whether people think that the cost or availabililty of fuels such as paraffin, gas, coal, wood, candles and batteries is a serious problem or whether there are more serious problems, eg water, or employment, or the need for clinics, etc.

Q 32 Any points not covered by the previous questions should be noted down here.

APPENDIX 2

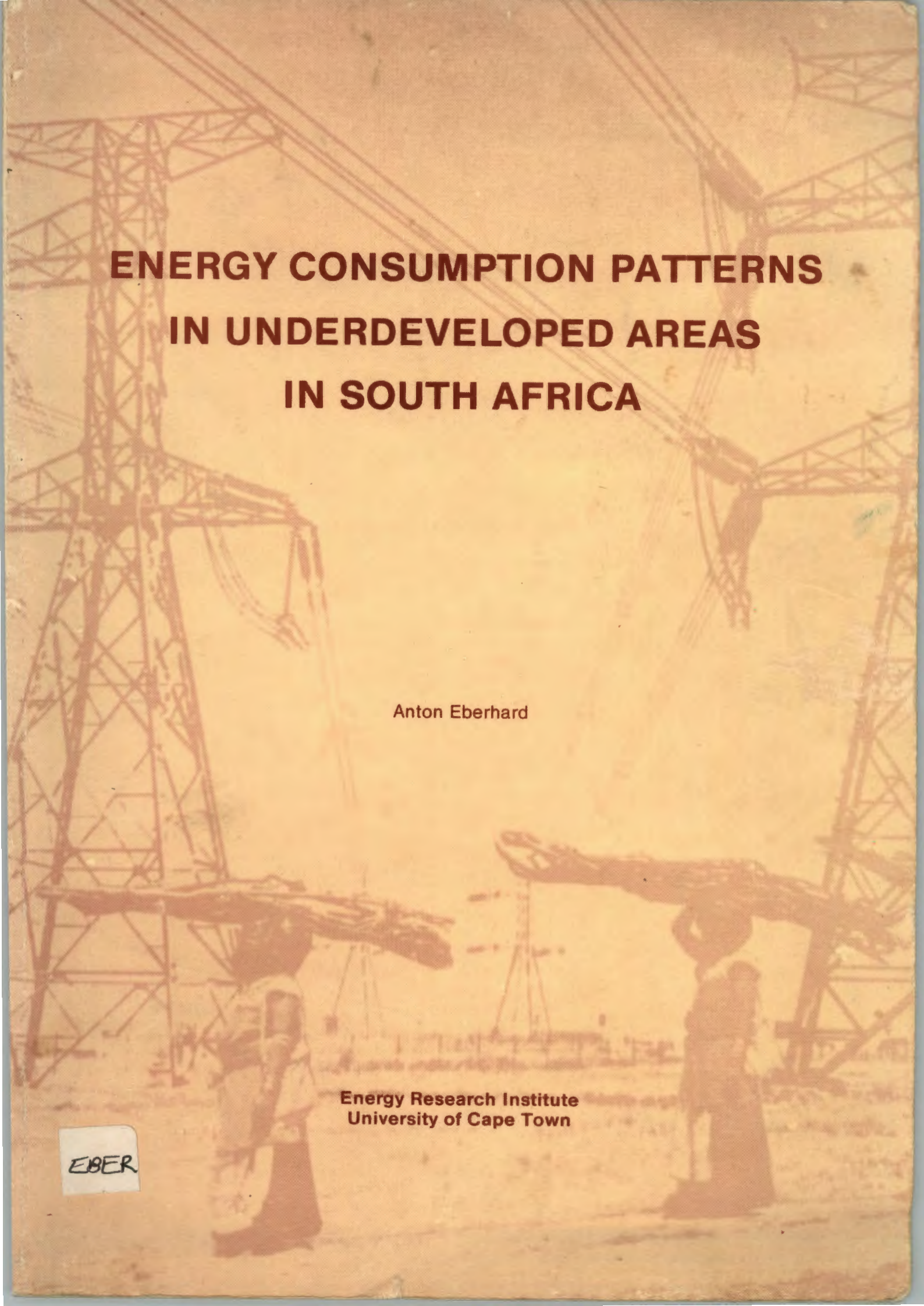
FUEL USAGE (Moller:1985)

	Lighting %	Cooking %	Heating %
Rural:			
Electricity	3	2	2
Wood	2	88	81
Dung	1	32	30
Coal	1	52	51
Candles	94	-	-
Paraffin/petroleum	74	70	48
Gas	4	6	4
White Farm:			
Electricity	10	2	1
Wood	5	93	83
Dung	0	37	31
Coal	0	19	16
Candles	90	-	-
Paraffin/petroleum	67	52	33
Gas	2	2	1
Township:			
Electricity	29	24	19
Wood	2	38	26
Dung	0	2	1
Coal	3	47	38
Candles	77	-	-
Paraffin/petroleum	53	71	52
Gas	8	14	8
Shacks:			
Electricity	1	1	1
Wood	4	30	28
Dung	0	1	1
Coal	0	9	8
Candles	93	-	-
Paraffin/petroleum	70	88	75
Gas	5	7	5

***Multiple responses**

Access to wood (Wood users only)	Rural %	White Farm %	Township %	Shacks %
Bought	45	9	74	18
Collected nearby	45	90	2	62
Collected more than 30 minutes walk away	10	1	24	21
	100	100	100	100
(N)	(297)	(246)	(710)	(39)

Source: Moller, V (1985). Rural blacks' perceptions of basic need fulfilment. Centre for Applied Social Sciences, University of Natal, Durban.



ENERGY CONSUMPTION PATTERNS IN UNDERDEVELOPED AREAS IN SOUTH AFRICA

Anton Eberhard

Energy Research Institute
University of Cape Town