

https://dspace.org/

Rationale for choice of fuel use by poor communities: a study of Ramaphosa Informal Settlement

Doro, Thanduxolo Lawrence

2016

http://hdl.handle.net/10539/22594

Doro, Thanduxolo Lawrence (2016) Rationale for choice of fuel use by poor communities : a study of Ramaphosa Informal Settlement, University of the Witwatersrand, Johannesburg, <http://hdl.handle.net/10539/22594>

Downloaded from a DSpace repository. https://dspace.org/

Rationale for choice of fuel use by poor communities:

A study of Ramaphosa Informal Settlement

By

Thanduxolo Doro

Student number: 1053961

Submission of the Research Report towards fulfilment of the degree

Masters in Health Sociology

In the

Department of Sociology

At the

UNIVERSITY OF WITSWATERSRAND

Principal Supervisor: Prof. David Dickinson

Course Coordinator: Dr. Shireen Ally

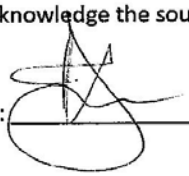
July 20, 2016

DECLARATION

I THANDUXOLO DORO (Student number: 1053961) I am a student registered for MA - HEALTH SOCIOLOGY in the year 2015.

I hereby declare that:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that ALL the work submitted for assessment for the above course is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature:  Date: 18/07/16

ii | Page

ACKNOWLEDGEMENTS

The author wishes to acknowledge a few people without whom both the research and this report would not have been successful:

Dr. Shireen Ally . . . Thank you Shireen for the eye-opening course on advance research methodology and the inspiring manner with which you presented it. Your positive energy, enthusiasm and belief in me kept me going.

Research Respondents . . . Thank you for opening your homes and your hearts to me. Your valuable frank responses helped me to understand your situation better.

Professor David Dickinson (My Supervisor) . . . Thank you Prof. for your guidance, support and patience. Your attention to detail and your insistence on writing this report step-by-step, one section at a time, although I did not like it at the time, turned out to be the best strategy for me to grasp the art of writing.

Tom Jackson . . . Your assistance in editing and proof-reading is greatly appreciated.

Zondi Doro (My wife) . . . Words can never express the gratitude I have for the support you gave me in doing this research and bringing it to finality.

Glory be to the Lord God Almighty for His amazing Grace upon me

ABSTRACT

This study examines use of different energy sources by a poor community of the Ramaphosa Informal Settlement in Gauteng Province, South Africa. The purpose of this study was to investigate the reasons behind continued use of biomass fuel (plant or animal material, wood, charcoal) for cooking and space heating by poor residents. The research questions are: What informs the informal settlement residents' use of certain energy sources for cooking and heating over other types? Where residents possess knowledge of the harmful effects of continued use of an energy source, yet continue to use it, what are the reasons for this? Whose responsibility does it become to collect a chosen energy source, and how is it collected? The consequences of indoor air pollution vary from short-term – eye and throat irritation – to long-term effects – respiratory disease and cancer. Exposure to high levels of some pollutants, such as carbon monoxide, can even result in immediate death.

An exploratory empirical research was performed using mixed qualitative and quantitative methods using data on time-activity patterns collected from eleven households by means of semi-structured interviews, observations, focus group discussions and expert interviews. The results show that the respondents in the researched areas of *Reserve* and *Extension two* in Ramaphosa Informal Settlement use a total of thirteen different energy sources to meet their fuel needs. Although possessing the necessary knowledge on negative effects of indoor air pollution, the respondents lack sufficient resources to make decisions that would help improve their conditions regarding effects of air pollution. In thirty of the fifty respondents women and girls collect fuel and only in the remaining twenty wherein electricity, paraffin and liquid petroleum gas (LPG) are used, do men and boys become responsible for fuel collection. In the absence of electricity, respondents reported preferences for LPG, however, the prohibitive costs of the capital outlay of the latter energy source makes it unaffordable to more than half of the respondents.

The major finding in this report is that whilst some of the respondents think that electricity remains a key barrier to improving their socio-economic development and well-being, twenty of the fifty respondents who exclusively rely on government grants do not think so. Electricity, although an absolute necessity in the researched areas, is not a sufficient condition for avoidance of effects of indoor air pollution for the poor communities. This was demonstrated by the five respondents who have electricity but alternate its use with coal and firewood. The high cost of electricity means that poorer communities will continue to rely on the less expensive bio-mass fuel – risking their lives in the process – even when electricity is available. Respondents reported difficult conditions under which they live which are shaped by a broader sets of unresolved structural aspects in the form of economics, social policies, and politics.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ..... **iii**

ABSTRACT ..... **iv**

TABLE OF CONTENTS ..... **v**

CHAPTER ONE: INTRODUCTION **1**

1.1 INTRODUCTION 1

1.2 RESEARCH PROBLEM 3

1.3 RESEARCH QUESTIONS 4

1.4 RESEARCH METHODOLOGY 4

1.5 DEFINITIONS OF TERMS 5

1.6 CONCLUSION 5

CHAPTER TWO: LITERATURE REVIEW **6**

2.1 INTRODUCTION 6

2.2 HEALTH EFFECTS OF SOLID FUEL USE 6

2.3 POVERTY, GENDER AND INEQUALITY REFLECTED IN FUEL USE 7

2.4 ELECTRICITY ACCESS 9

2.5 CONCLUSION 10

CHAPTER THREE: RESEARCH METHODS **12**

3.1 INTRODUCTION 12

3.2 RESEARCH DESIGN 12

3.3 RESEARCH SETTING 12

3.4 SAMPLING 14

3.5 DATA COLLECTION 15

3.5.1 Interviews 15

3.5.2 Focus group discussions 16

3.5.3 Expert interviews 17

3.5.4 Observations 17

3.6 DATA ANALYSIS 18

3.7 RELIABILITY AND VALIDITY 18
3.8 LIMITATIONS 19
3.9 ETHICAL CONSIDERATIONS 19
3.10 CONCLUSION 20
CHAPTER FOUR: RESULTS AND ANALYSIS 21
4.1 INTRODUCTION 21
4.2 ENERGY USE, TIME AND VALUE OF ENERGY SOURCES 22
4.2.1 Firewood 23
4.2.2 Coal 24
4.2.3 Paraffin 27
4.2.4 Candles 28
4.2.5 Combustible rubbish 29
4.2.6 Other fuel sources 30
4.3 IMPACT OF SOCIO-ECONOMIC AND STRUCTURAL ASPECTS ON ENERGY SOURCE USE 35
4.3.1 Environmental restrictions on energy source use 35
4.3.2 Unemployment and poverty 36
4.3.3 The gendered task of firewood collection 36
4.3.4 Role of the government 37
4.4 RESPONDENTS KNOWLEDGE ABOUT ENERGY SOURCE USE 37
4.4.1 Structure of homes illustrating awareness of negative effects of energy source use 37
4.4.2 Knowledge, behaviour and impact on health 38
4.5 CONCLUSION 39
5. CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS 41
5.1 INTRODUCTION 41
5.2 CONCLUSIONS TO RESEARCH QUESTIONS 42
5.2 RECOMMENDATIONS 44
REFERENCES 45
APPENDICES 49
APPENDIX A: PARTICIPANT INFORMATION SHEET 49

APPENDIX B: INTERVIEW SCHEDULE 51
APPENDIX C: CERTIFICATE OF CONSENT 53
APPENDIX D: CLEARANCE CERTIFICATE 54

TABLE OF FIGURES

Figure 1: (A) Traditional open fire and (B) plancha stove. Images by Nigel Bruce.....07
Figure 2: A traditional home in KZN, South Africa with an open wood fire 08
Figure 3: Young people in the streets of Ramaphosa Informal Settlement.....12
Figure 4: Focus group discussion in Ramaphosa Informal Settlement.....13
Figure 5: Focus Group Discussion in Ramaphosa on November 08, 2015 17
Figure 7: Shangaan stove inside household 26
Figure 8: Imbawula stove in a separate room for cooking 27

LIST OF TABLES

Table 1: Energy sources per family in the eleven interviewed households 22
Table 2: Characteristics of firewood 24
Table 3: Characteristics of coal 25
Table 4: Characteristics of paraffin 28
Table 5: Characteristics of candles 29
Table 6: Characteristics of combustible rubbish 29
Table 7: Characteristics of LPG, Electricity & Petrol 31
Table 8: Characteristics of solar panels, batteries, dry ice & direct sunlight 33

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Public health practitioners and policy makers are strongly encouraged to bear in mind the broader factors that have a bearing on the health of populations. This should be done in order to comprehensively address health and the inequalities therein. Braveman, P. A., Cubbin, C., Egerter, S., Williams, D. R., & Pamuk, E. (2010). This research looks at the reasons for continued use of solid fuel by poor communities despite the known health effects (see section 2.2 on page 6 below) of indoor air pollution.

For purposes of this report we define indoor air pollution as the contamination of natural air. The sources of indoor air pollution include smoke from tobacco and biomass fuel such as firewood, coal, paraffin and others. These types of biomass fuel are commonly used in poor communities in South Africa for cooking and space heating. Indoor air pollution in poor communities arises largely from dependence on flammable, but incomplete combustion of, fuels like wood and coal. Indoor air pollution has serious impacts on multiple issues concerning health, the environment, and socio-economic development, and has disproportionate impacts on women's lives.

Indoor air pollution caused by the use of firewood for cooking is one of the most severe environmental challenges afflicting poor households in developing countries (Nigel B, Perez-Padilla R, & Albalak R. 2000: 1078). The use of firewood for cooking is correlated with high accident rates, and necessitates household members (mostly women – given our patriarchal society) to fetch firewood from far distances, and further risking their health during meal preparation.

Day to day living conditions, beginning from early infancy to adulthood, physical and social environments, working conditions and general health care have important influence on the health of all people, especially the poor. Failure to identify and integrate these socio-economic factors in endeavors to improving people's lives undermine all development programmes. Marmot, M., Friel, S., Bell, R., Houweling, T. A., Taylor, S., & Commission on Social Determinants of Health. (2008).The frequenting of health clinics and hospitals by residents of informal settlements, as voiced by respondents and validated by the local clinic nurse, can be a major hindrance to health and economic development. It maintains and extends poverty as limited resources are stretched both by individuals and government in efforts to restore health of individuals and communities. These are resources which could otherwise have been directed towards other areas of need. The occurrence of informal settlement air pollution and its health effects could be related to inequality in South African society in regard to economic, social,

racial and class issues. All these factors are related to poverty and deprivation. This in turn, is related to the rampant spread of informal settlement, especially in Gauteng. “The causal factors to the spread of informal settlement in South Africa are poverty and urbanization” (Blaikie, P., Cannon, T., Davis, I., & Wisner, B. 2014: 330). Blaikie et al (2014) further contend that urbanization is an escape route by the rural poor in pursuit of better opportunities.

Ramaphosa Informal Settlement is but one community in Gauteng whose majority of residents come from different rural Provinces. A study on rationale for continued use of bio-mass fuel, despite its known health effects, by poor communities was conducted in Ramaphosa Informal Settlement. In essence, what is investigated is how the social conditions of life in informal settlements may determine the choice of fuels used by residents and how this may impact on health outcomes. Such a ‘social-determinants of behaviour’ requires an investigating of the different and competing pressures on informal settlement residents that shape the choices they make. This document constitute an account of the purpose, process and results of the research. This research report is a five chapter document made up of 60 pages including appendices and references. The following structure was charted in order to address the objectives of the study:

Chapter 1, Introduction: The first chapter introduces the subject matter, explaining the motivation of the study, the objectives and methods used to carry out the study and the problem statement.

Chapter 2, Literature review: This chapter consists of an analysis of explored literature: newspapers, published and unpublished thesis, academic books and news bulletins. This chapter outlines the design followed in collecting data providing an overall structure for the procedure that the researcher followed, the data collected and analyzed. The design of this chapter explains how information was gathered for analysis, which instrument were used, how the instruments were administered, and how the information was organized and analyzed. This study generally comprises qualitative research.

Chapter 3, Research methods: This chapter analyzed primary data that was collected through interviews and observation to come up with the study findings. The chapter was interpreted by the researcher based on the information provided and observations of the researcher.

Chapter 4, Results and analysis: This chapter comprises the analysis, presentation and interpretation of the findings resulting from this study. The analysis and interpretation of data is carried out in three phases. The first phase deals with the number and features of the different fuel sources. The second part delves into the impact of socio-economic and structural aspects affecting fuel choice and use. The third part explains respondents’ knowledge of effects

of certain fuel use and the behaviors and practices they adopt to try and mitigate health effects of these fuels.

Chapter 5, Conclusion and recommendations: This chapter concludes the study by summarizing the findings of the study based on analyzed data, objectives and study orientation; the summary assisted the researcher to come up with recommendations of the study.

1.2 RESEARCH PROBLEM

This study explores the reasons for choices of energy sources used in cooking and heating by residents of Ramaphosa informal settlement in Gauteng's Ekurhuleni region, South Africa, and their understanding of the health implications of these choices. This study also documents the reasons that push poor households into using energy sources, such as flammable fuels and hastily connected electricity cables that compromise their health through indoor air pollution and accidents.

When burned indoors in open fires or basic appliances, the incomplete combustion of solid biomass fuels release high concentrations of toxic pollutants such as particulate matter (PM), carbon monoxide (CO), oxides of nitrogen, Sulphur dioxide (SO_2) and volatile organic compounds into the living environment (Barnes, B., Mathee, A., Thomas, E., & Bruce, N. 2009). A high household reliance on solid biomass fuels has been associated with a number of negative health outcomes. "Evidence is strong for presence of COPD (Chronic Obstructive Pulmonary Disease) and ALRI (Acute lower respiratory infections) in children under 5" (Padmavathi, 2012: 11). The high incidence and mortality of childhood ALRI, together with the fact that it predominantly affects young children, means that this condition makes up by far the greatest proportion of the burden of disease attributable to indoor air pollution (Von Schirnding, (2002: 9).

The community that forms the site for the study is in Ekurhuleni, which is one of the six districts and metropolitan municipalities forming the local governments of Gauteng Province in South Africa. The study focuses on the Ramaphosa informal settlement free standing shack-dwellers (see definition of terms below), in the two sections called Reserve and Extension Two within Ramaphosa. The absence of a local electricity generation supply sub-station in the area forces some residents to illegally connect electricity from street poles whilst the majority use firewood, coal and paraffin for cooking and space heating. This exposes the latter group to indoor air pollution.

The purpose of this study therefore was to document the choices of energy sources used in poor households in South Africa and exploring the reasons for these choices. This study also sought to examine the residents' beliefs and perceptions on the implications of use of these

energy sources and their understandings of whether, and how, the energy sources they use impact on their health.

This study is intended to measure my competence of research skills and will help me attain a Master's Degree in Health Sociology. It may also contribute to resolving current controversies around illegal electricity connections.

1.3 RESEARCH QUESTIONS

To answer the research problem, the following research questions are formulated:

1. What informs the informal settlement residents' use of certain energy sources for cooking and heating over other types?
2. Where residents possess knowledge of the harmful effects of continued use of an energy source, yet continue to use it, what are the reasons for this?
3. Whose responsibility does it become to collect a chosen energy source, and how is it collected?

1.4 RESEARCH METHODOLOGY

A chosen research methodology is determined by a variety of several factors – for example, whether the "researcher believes that there is some sort of external 'truth' out there that needs discovering, or whether the task of research is to explore and unpick people's multiple perspectives in natural, field settings" Gray, (2013: 29). This research report is a result of an exploratory research design employing a combination of qualitative and quantitative research methods to investigate the research questions. The qualitative component of the research entailed exploratory gathering of information using focus group discussions, interviews and observations. Since qualitative research seeks to capture up-and-coming concepts and because its coverage is not overly rigid, the possibility for original or creative thoughts or suggestions to surface is high. It also allows ideas to be generated through, and then placed in, the 'real' context from which they arise. Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2013).

Specific questions were asked related to personal details, energy source use, size and division of home, cooking habits and time-activity patterns. Notes of personal observations with pictures were taken with permission of the respondents, providing valuable data. Interviews were guided by a semi-structured questionnaire designed to gather both qualitative data (Appendix B). All interviews and focus group discussions were conducted in a mixture of Zulu and Sotho languages. Pictures and notes that were taken assisted with recalling what was observed and said. Questionnaires specific to interviewing expert personnel were developed. Standard questionnaires for interviewing households and focused group discussions were used

to collect data. Observations, pictures and tape-recorders were also used. Using these multiple methods in collecting data led to valid, reliable responses formed of diverse views.

1.5 DEFINITIONS OF TERMS

*Biomass fuel (BMF)***:** is "any material derived from plants or animals which are deliberately burnt by humans. BMF refers to burned plant or animal material; wood, charcoal, dung and crop residues that account for more than one-half of domestic energy in most developing countries and for as much as 95% in lower income countries" (Smith 2004:19).

Fuel inefficiency: relates to the failure of the combustion process to burn the whole fuel and transform it into useful energy, thus releasing small dangerous particles into the living spaces. This is an inherent quality of biomass fuel use in household settings.

Energy ladder: This is a concept used to describe the way in which households will move to more sophisticated fuels as their economic status improves. A range of the types of energy sources sorted from the least efficiently combustible to the most efficient is known as the 'energy ladder' (Barnes, B., Mathee, A., Thomas, E., & Bruce, N. 2009). Solid biomass fuels such as cow dung; crop residues and wood form the lower ranks, followed by coal, charcoal and paraffin. 'Modern fuels' such as liquid petroleum gas (LPG), natural gas and electricity occupy the higher steps of the ladder (Barnes et al 2009: 10).

Poverty: "the lack of, or the inability to achieve, a socially acceptable standard of living", (Bellù, L. G., & Liberati, P. 2005: 23).

Free-standing shacks: Free standing shacks are the shacks whose owners have been allocated a site, with or without basic services, HSRC (2011).

1.6 CONCLUSION

This chapter focused on the major purposes of an introductory section which are: Firstly, to give a clear description of what the study is about and the reasons for this study were given in the form of problem statement. Secondly, this chapter stated what methodology is to be followed in gathering, storing and interpreting data and research questions. Lastly, a brief overview of the whole report was given and to make it easier to follow the report definitions of terms' section forms part of this chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

The literature review covers the areas of patterns of energy source use in the context of developing countries and poor households, the behavioural triggers of shifts from one energy source to another, the reasons for continued use of energy sources with negative health effects. The interactions between demographic factors, such as poverty, gender and inequality and their effects on energy use, including electricity access and related issues, are reported in this section. With the help of the literature on the aforementioned, I was then able to investigate the different factors, within a small informal settlements that has the characteristics (overcrowding and type of housing) of a poor community, which practically shape the choices of fuel. The research in Ramaphosa Informal Settlement was about digging the 'truth' that exist within that environment about how the respondents' socio-economic factors shape, and are shaped by, the use of solid fuel. The literature review supports the empirical research by outlining areas of similarity and contrasts between the reviewed literature and the research findings in Ramaphosa.

2.2 HEALTH EFFECTS OF SOLID FUEL USE

Indoor air pollution due to the indoor burning of polluting fuels has been linked with Acute Lower Respiratory (ALR) infections amongst children less than five years old. There is evidence suggesting that ALR infections are found in children between two and four years old living in households using polluting energy sources compared to households using electricity. In South Africa, indoor air pollution is responsible for the deaths of up to 1 400 children annually (Barnes et al, 2009). For various reasons, young children are more predisposed to ALR infections through indoor air pollution exposure. One of the reasons put forward by Moya, J., Bearer, C. F., & Etzel, R. A. (2004: 6) is the fact that children's lungs are not yet fully developed resulting in greater penetrability of pollutants. Smith, K. R., Samet, J. M., Romieu, I., & Bruce, N. (2000) further state that children's immune systems are not fully developed thereby limiting the body's defense against infection. According to Moya et al (2004:7) one other reason children are more susceptible to indoor air pollution is that they have higher inhalation rates and thus breathe in more (polluted) air under normal breathing conditions compared to adults. Additionally, from an exposure perspective, children tend to follow their caregivers' around, for example through carriage on their caregivers' backs as seen in *Figure 1 Pictures A and B* below, and therefore are exposed to the heating and cooking activities of their caregivers. The greatest contribution to this burden results from childhood acute lower respiratory infections. Fullerton, D. G., Bruce, N., & Gordon, S. B. (2008: 845) state that indoor air pollution from biomass fuel

disproportionately affects women and children and is the cause of significant global mortality and morbidity. This is a neglected area of global disease that affects a large proportion of the world's population.

2.3 POVERTY, GENDER AND INEQUALITY REFLECTED IN FUEL USE

Poverty-related diseases can be broadly grouped and considered to be a result of social class, physical environment and health services factors. Education (particularly maternal education), family income and employment status are, according to social class theory, important factors for inclusion in characteristics of the physical environment just like the availability of water, the sort and delivery of sewage facilities, solid waste disposal and a "number of factors relating to housing, including the extent of crowding and the quality and type of houses" (Yach, D., Mathews, C., & Buch, E. 1990). Access to health services (both curative and preventive) and attitudes to services are also determinants of poverty-related diseases. If poverty-related diseases are to be reduced, all these components need to receive attention.

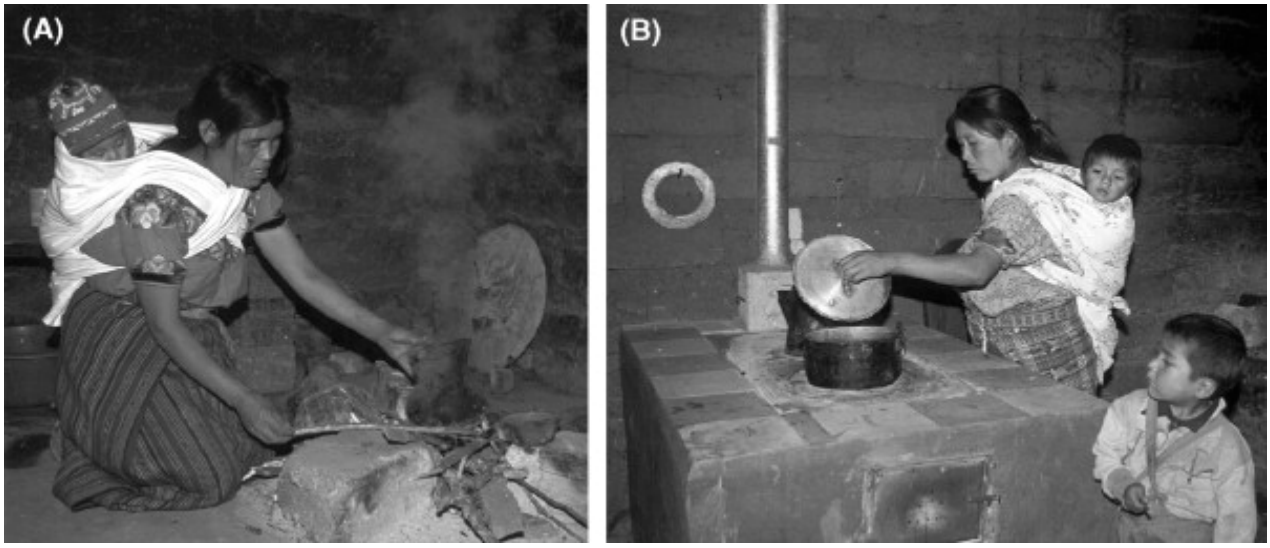


Figure 1: (A) Traditional open fire and (B) plancha stove. Images by Nigel Bruce from his work of indoor air pollution in Guatemala

According to Fullerton, et al (2008) the choice of energy source for a particular use depends not only on the availability thereof, but also on the prices of the energy sources and other alternatives, the appliances to be used and the efficiency of the energy source itself, as seen in Pictures A and B above. In South Africa "the main factor behind the usage of a particular energy source in a household is the household income" (Barnes, B., Mathee, A., Thomas, E., & Bruce, N. 2009: 11). Another factor which significantly influences energy source choice, according to Nigel B, Perez-Padilla R, & Albalak R. (2000: 1078) is the location of the household. It would

therefore make sense for residents of free standing informal settlements to be using an energy source that is cheaper and can be conveniently collected than those residents who rent back-yard spaces as Nigel et al (2010) contends that the latter may have to obey rules of the landlord which could include use of electricity for lighting but disallowing appliances like stoves, kettles and others due to their high consumption of electricity. Also, where an energy source is in abundance and at a low price – like near the coal mines - households will tend not to switch from it to another energy source. Another study in Ghana concluded that "poverty, lack of education, and a lack of awareness were the major factors affecting choice of cooking fuel, place of cooking, and level of respiratory health" (Nigel et al, 2010: 1085).

According to Wilkinson, P., Smith, K. R., Davies, M., Adair, H., Armstrong, B. G., Barrett, M., & Chalabi, Z. (2009) the richest populations use up to 20 times more energy per person than those from the poorest countries and enjoy many benefits but few adverse effects. In contrast, the 2.4 billion people globally who continue to depend on biomass fuels (coal, wood, animal dung etc.) become victims of adverse health effects, not only from indoor air pollution, but also because of the "opportunity cost of time spent collecting fuel, and the lack of access to all services in education, health care, and household resources that modern energy provides" (Wilkinson et al 2009: 82).

Brew-Hammond (2010) argues that access to modern energy services is bound up with fundamental questions around equity, including gender, and that governments should ensure that all segments of the population have access to modern energy services. He further states that it should be acknowledged that there are no one-size-fits-all solutions to this challenge, even in one country; communities are different and face different challenges. "Addressing policy concerns depends on how much effort government officials are prepared to put into identifying and fine-tuning appropriate policy instruments for specific situations" (Brew-Hammond 2010: 2300)

The amount of time that women and children spend in proximity to fires, as seen in *Figure 2* below, is the crucial determinant of the health impact of indoor air pollution (Perez-Padilla, 2010: 1083). From the literature we can deduce that the construction of social relations in the majority of households is such that the responsibility for availing fuel, making fire and preparing food is that of women.

The slow pace of development in many countries, particularly in Africa, suggests that biomass fuels will continue to be used by the poor for the foreseeable future; resulting in perpetuation of poverty, marginalization of women and compromised health for millions of people. According to Statistics South Africa, (2003) over 63% of households in informal settlements in the 'Vaal Triangle' areas of Sasolburg, Vereeniging and Vanderbijlpark are reliant on coal for their daily energy needs. The 'Vaal Triangle' is about 100km from Ramaphosa – the area of this

research. Pollution from coal is a huge problem particularly for women and children's health outcomes, causing health problems such as lung cancer and child mortality (Bruce, N., Perez-Padilla, R., & Albalak, R. 2000. Ezzati, M. 2005. World Health Organization 2009).



Figure 2
A traditional home in KZN, South Africa with an open wood fire. Image taken from Perez-Padilla (2010)

Whilst the literature acknowledges that some affluent homes with electricity would still have heaters and stoves that use solid fuel, this is by choice. The poor have no such luxury; "poorer households use multiple fuels to fulfil their domestic energy needs based largely, although not exclusively, on their ability to afford those fuels" (Barnes et al, 2009:6). Even those with electricity, there are times when they do not have money to buy electricity and can only afford solid fuel like coal or paraffin. According to Schlag and Zuzarte (2008) social, economic and technological barriers all prevent the linear progression towards clean cooking fuels represented by the energy ladder (see definitions of terms).

2.4 ELECTRICITY ACCESS

A study of patterns of energy source use in "households following electrification in a traditionally wood-burning area of South Africa showed that, while there was a shift to the use of electricity, the more polluting energy sources continued to be used, particularly for cooking

and heating" Louw, K., Conradie, B., Howells, M., & Dekenah, M. (2008). The main reasons for not using electricity more, according to Louw et al (2008) were its high cost and the cost of electrical appliances, although other factors, such as seasonal energy requirements (in winter coal is preferred as space heating using electricity is expensive) and cultural beliefs (sometimes men would say they want a meal that is cooked on a firewood), are also important in driving energy source choices.

Some of the households of Ramaphosa informal settlement are using electricity. Ekurhuleni Metropolitan Municipality reports that 100 Units of free basic electricity are provided to all Tariff A residential customers, which amounts to approximately 280 000 users with access to free basic electricity including ESKOM Supply Areas. For residents to get electricity they have to pay a certain amount to be piped and connected to the electricity grid. Some of the challenges faced by the broader Ramaphosa community include: theft of underground cable and equipment; broken and vandalised meter boxes; power outages (excluding load shedding); Illegal connections; network faults due to old cables and contractors damaging cables; transformer failure due to lightning, age and network faults (EMM Profile Report, 2012).

Important for this study was to learn how much these households pay for electricity in comparison to other types of energy sources, and more importantly it was useful to learn how electricity is used alternatively with other energy sources; what determines this interchange and what implications do they have. It is well established that in some informal settlements electricity is stolen; "Electricity theft can be in the form of fraud (meter tampering), stealing (illegal connections), billing irregularities, and unpaid bills" (Smith, 2004: 2069). According to the Ekurhuleni Profile Report (2012: 64) both Eskom and municipalities reportedly lose money due to electricity and cable theft. Such losses in turn affect the quality of electricity supplied, increase load on the electricity-generating stations, and affect tariffs imposed on those who pay for electricity use.

2.5 CONCLUSION

The literature reviewed was categorized into the following thematic areas: Health effects of solid fuel use and the challenges of managing health. Poverty, gender and inequality reflected in fuel collection and use. Access to electricity and the problems related to that. Each of these thematic areas pointed to the disproportionate nature of vulnerability of women and children under five years to the hazardous effects of solid fuel use. During meal preparation, women are the ones most exposed to air pollutants. Their children who are under five years, because they have not started school yet, are also exposed to these pollutants as they are either next to, or at the back of, their mother.

The reviewed literature is in agreement that the use of biomass fuel for cooking and heating is a cause of, and results in poverty, illness, perpetuation of gender and class inequality. The prevailing socio-economic inequality in South Africa burdens women disproportionately and condemns them to sustained poverty as a result of patriarchy and cultural stereotypes.

Within the reviewed literature is a report of Ekurhuleni Municipality which outlines how the indigent are meant to benefit from services of the Municipality. However, due to the nature of the researched informal settlement with the absence of bulk infrastructure, the researched area is excluded from such benefits.

Although there is currently a strong body of evidence supporting the relationship between social determinants and various health outcomes, it is critical to continue bringing attention to the impact of indoor air pollution as an identified Social Determinant of (ill) Health and to employ methods that will stimulate sustainable action in addressing economic and social disparities as these are important considerations for health and health equity.

CHAPTER THREE: RESEARCH METHODS

3.1 INTRODUCTION

In this chapter the research methodology used in the study is described. The geographical area where the study was conducted, the study design and the population and sample are described. The instruments used to collect the data, including methods implemented to maintain validity and reliability of the instruments, are described.

3.2 RESEARCH DESIGN

This research is an exploratory research design employing use of qualitative research methods to investigate the research questions. This qualitative method of research that was followed entailed exploratory gathering of information using focus group discussions, interviews and observations. The study was carried out in Ramaphosa informal settlement in the Ekurhuleni region of Gauteng Province - South Africa. The approach to this study allowed for the voices, views, opinions and stories of participants to be heard and was facilitated through a range of qualitative interview processes, one-on-one interviews with families and others in focused group discussions. (Gray, 2013: 31, Ritchie et al 2013).

3.3 RESEARCH SETTING

The community that forms the site for the study is in Ekurhuleni, which is one of the six districts and metropolitan municipalities forming the local governments of Gauteng Province in South Africa. The study focuses on the Ramaphosa informal settlement (free standing shack-dwellers), in the areas called Reserve and Extension Two within Ramaphosa - named after the current Deputy President of South Africa, Cyril Ramaphosa, when he was still the Secretary General of the Congress of South African Trade Unions (COSATU).

Ramaphosa informal settlement is part of the Municipal Ward 42, which is made up of four areas divided into Graceland (formal houses), the Reconstruction and Development Programme (RDP) section, Sunward Park (suburban) and Ellispark (subserviced shacks). Ramaphosa is an electrified informal settlement located in Germiston, in Ekurhuleni and had 3,043 informal households in 2011 according to Census 2011 (Stats SA 2011). However Reserve and Extension Two, which were the focus of my research, are not electrified as these areas settled there in the past ten years.



Image taken from the Internet. The link is provided in Page 45 of the Reference list.

Ramaphosa is a very densely populated area containing various ethnic groups and Nationalities. Its residents came from long established neighbouring communities like Reiger Park, Vosloorus, Daveyton and others. Other residents come from the Limpopo, Eastern Cape and Kwa-Zulu Natal Provinces. Residents have chosen this area because it is closer to both Germiston and Boksburg industrial towns which they can access in search of job opportunities. There is also a prominent presence of foreign nationals from countries like Malawi, Mozambique and Zimbabwe.



Figure 3
Young people in the streets of Ramaphosa Informal Settlement. Picture taken by the author on the 10 October 2015

Like other South African townships, the main feature of Ramaphosa is a significant presence of young people and women in the streets on a daily basis, signifying high unemployment (as seen in *figure 3* above. Most of the residents of the *Reserve and Extension Two* areas which are part of Ramaphosa informal settlement have settled in poorly built shacks and in an area that is without formal electricity and proper sanitation infrastructure.

3.4 SAMPLING

In sampling I used a mixture of techniques to draw participants: purposive, snowballing and quota. Firstly, for interviews I sought ten households and half of whom would be using solid fuel like wood, coal or paraffin. The first sign of identifying such a home is a chimney. Having gone just to the first house I was then led to the next by the previous respondent. By the time I finished interviews I already had an idea of a few people who would not only be part of the focus group discussions but were to help vouch for others to participate. In this way I was using a snowballing technique to identify study participants. Thus my sample continued to build up and became larger as the study continued. Additionally, because I needed more women than men not only for purposes of variation but also for the main reason of affording women more space as they are much more affected. In this way one could say I also partially used a quota technique.

Only thirty five respondents, given the time factor, were targeted to participate in the study in order to gather a variety of experiences and practices. However, this number rose to fifty due to interest of residents to participate in the study. For instance, the plan was to have eight participants in each focus group discussion but instead there were twelve in each. I interacted with a total of fifty individuals by the end of the study. I also conducted expert interviews with community leaders (committee) and a nurse of the local health clinic. The limitation of my sampling lay in the haphazard and unplanned nature of the informal settlement which made strict adherence to the sampling procedure difficult, forcing me to exercise flexibility in locating and accommodating participants for the research.

My data sources for this study included interviewing of residents and experts. Data was collected from eleven households by means of semi-structured interviews and observations. Another set of data was collected through focus group discussions. In both interviews and focus group discussions specific questions were asked related to personal details, energy source use, size and division of home, cooking habits and time-activity patterns. Notes of personal observations with pictures were taken with permission of the respondents, providing valuable data.

3.5 DATA COLLECTION

Having secured access from the community leaders to conduct my research, data was then collected through a combination of techniques that included semi-structured interviews, focus group discussions that were guided by an interview schedule, observations and expert interviews. The sample characteristics included men and women who have their own household, have need for and use fuel, and were willing to participate.



Figure 4: Focus Group Discussions in Ramaphosa Informal Settlement (Picture taken by author 15/10/2015)

3.5.1 Interviews

Interviews were guided by a semi-structured questionnaire designed to gather both qualitative and quantitative data (Appendix B). The semi-structured questionnaire followed an open framework which allowed for focused, conversational, two-way communication. I preferred this technique because I knew beforehand that I had questions that were sensitive and would require some rapport to be established first for me to tackle them. Questions relating to the health of individuals can be sensitive to handle and I could therefore not write them in the questionnaire but I would raise them as the respondents warmed up to me. This tool was very helpful in that I received more than just answers to questions I had and in that process I was learning. But I also felt I was receiving more information than I needed as there was a tendency for respondents to divert from the specific information that relate to indoor air pollution. This needed skills to sensitively redirect the conversation back on track – my track, something which I continuously did not feel good about. But my skills improved with each interview.

All interviews and focus group discussions were conducted in a mixture of Zulu and Sotho languages. Pictures and notes that were taken assisted with recalling what was observed and said. Eleven households were visited for interviewing and observation. In a household there were, in ten of the eleven cases, more than one person. Interviews were guided by use of a semi-structured questionnaire (Appendix B).

During the households interviews I interviewed two men, three women, and six (heterosexual) couples in six days skipping a day in between. Except for only one man's and one woman's household, the rest were in the presence of children some of whom are adults themselves. In the households only two families had both the man and woman working. The rest it was either one person working or nobody working and the family relying on government grants. All interviews were done and finished before focus group discussions could begin. The analysis of the data from the interviews helped me to shape the interview schedule and sampling for focus group discussions.

3.5.2 Focus group discussions

My primary reason for also using focus group discussion was because I needed to know more about the respondents' perceptions, opinions, beliefs, and attitudes with regard to fuel choice and use. The focus group discussions proved worthwhile especially in sensitive areas like discussing unemployment in a family where the man is unemployed but the woman is working. This particular technique brought a lively conversation which made light of situations that were otherwise awkward during interviews.

Three groups of twelve individuals participated in each focus group discussion respectively. I convened these focus group discussions at around midday during week-ends when most residents were at home. The first group was made up of women only who have free standing shacks who use wood, paraffin and coal during winter. The second group was composed of women only who switch between wood or coal and electricity that is illegally connected. The last group was a mixture of men and women staying in free standing shacks using a single or combination of energy sources.

In the focused group discussions I spent two hours with each of three groups of between, as shown in Figure 1 below. One of the reasons a focused group discussion was successful for this study is that air pollution is not a very personal and sensitive issue to talk about in a group. The key reason for conducting focus group discussions was for me to understand what the community of Ramaphosa thinks about indoor air pollution.

3.5.3 Expert interviews

Interviews were conducted with community leaders of the Ramaphosa community and the nurse of the local clinic who all proved knowledgeable on some of the effects of energy sources. Bogner (2009: 47) asserts "Expert interviews are about a person's special knowledge and experiences which result from the actions, responsibilities, obligations of the specific functional status within an organization." I therefore considered the community leaders as experts in that they are the ones who receive reports (See Section 4.3 below) about effects indoor air pollution and expected to act on these. This committee also manages daily events within this community. The nurse is also an expert not only in medical assistance but also in knowing the determinants of illness that prompt repeated medical attention of the community members.

The limitation of these expert interviews is in my failed attempts to interview the ward councilor. This could not take place as he kept on requesting a postponement of our meeting up until writing of this report.



Figure 5: Focus Group Discussion in Ramaphosa Informal Settlement
(Picture taken by author: 08/11/ 2015)

3.5.4 Observations

I spent some time over weekends with five of the eleven interview and three of the focus group respondents (one from each group) to observe processes of use of energy sources. I learnt how decisions to use which particular energy source are arrived at, and whose responsibility it is to

make energy sources available in the home. It was important for me to note how the respondents' health is maintained or compromised by a chosen energy source. Most importantly, I observed and noted frequency and length of exposure to indoor air pollution with regards to who gets more exposed, why and how. This is elaborated on in the Results Section.

My observation was not a stand-alone technique but was also linked to the interviews, focus group discussions and expert interviews. Observations gave me undetectable tactics of checking for nonverbal expression of feelings, determine who interacts with whom, grasp how participants communicate with each other, and check for how much time is spent on various activities. For instance, it was through observations that I realized that crime was used to push for installation of Apollo Street lights so as to illegally connect from these street lights. How a focus group discussion would be very animated when discussing crime was inconsistent with the somber mood I had observed in one interview in discussing the same thing. The more I dug, the truth came out. Observations helped me validate some of the data earlier collected and gave me a holistic understanding of reasons for fuel use. Without observations as an added and encompassed technique within interviews and focus group discussions, I would not have been able to guide myself in managing all those interactions and relations.

3.6 DATA ANALYSIS

The method of analysis used is a combination of thematic analysis, whereby I intently observed the flow of information and patterns of interaction during the focus group discussions and content analysis as I had recorded and transcribed one of the proceedings of focus group discussions, others refused tape recording but I took notes which proved helpful. Through this I established themes that emerged and which can contribute towards aligning government policies and/or interventions with community needs.

3.7 RELIABILITY AND VALIDITY

Standard questionnaires for interviewing households and focused group discussions were used to collect data. Observations, pictures and tape-recorders were also used. I believe that using these multiple methods in collecting data led to valid, reliable responses formed of diverse views.

Because single data collection method would be insufficient to provide adequate and accurate research results, I used multi methods for purposes of cross-checking for consistencies and contradictions. This triangulation of data collection helped me to improve validity and reliability because data was from a number of vantage points. Additionally, because indoor air pollution

and its effects are so entangled with other issues, triangulation crystalized it as a separate though related issue and increased my understanding of indoor air pollution reality in its full complexity.

It was through triangulation that I was able to bring different data sources together and provide a summary of what the results were and identified common themes in various sets of data in order to generate the triangulated results.

3.8 LIMITATIONS

It is recognized that the sample size represents a very small percentage of the total number of households in Ramaphosa however, financial constraints and time factors have been the major limitations. Women formed the majority of research participants, which may be seen as a limitation of gender viewpoints, however this is justified by the fact that women are at the centre of the use of energy sources and are the ones most exposed to air pollution whilst they prepare meals for their families. Therefore it was crucial that women were at the centre of this study because it is women, this study demonstrates, who are central in both energy source collection and meal preparation. The other issue that might affect the findings is that not all respondents disclosed having illegally connected electricity for fear of reprisal. I overcame the cultural belief that women do not express themselves fully in the presence of men by having two focused group discussions that are composed of women only. That I was a man did not bother them as I am not from their local area. The other limitation was that I could not find an official from the Ekurhuleni Municipality to be interviewed as an expert because I could not be able to follow the excessive bureaucracy within the limited time I had.

3.9 ETHICAL CONSIDERATIONS

Having received ethical clearance from the University Human Research Ethics Committee (Appendix D), this study was conducted in an ethical way and did not infringe on human rights and dignity of respondents. My primary responsibility in collecting this data was to make sure that I do not harm respondents in any way – whether physically, emotionally, psychologically or otherwise.

The first thing I did to ensure informed consent was that in recruiting respondents I gave each one a Participant Information Sheet (PIS) which outlined who I am, the purpose of the study, methods that I was to use (Appendix A). Secondly, I ensured that I obtain a verbal informed consent before I began interviewing them.

I adhered to the basic ethical principles of voluntary participation and confidentiality by not forcing or coercing anybody to participate in this study. I also communicated to respondents

beforehand that confidentiality of information might not necessarily be guaranteed as some things were going to be said in open discussions. However, recorded information, pictures and transcripts are kept safe. For interviews and observations, households were only visited after permission had been granted by community leaders. This report will be submitted to the Wits University and will be available in the Wits library.

3.10 CONCLUSION

In this research eleven questionnaires were administered by the researcher to collect the data randomly from eleven households. The questionnaires had both closed and open-ended questions. Following that, using an interview schedule, three focus group discussions were also conducted on different days. Interviews, Focus group discussions, expert interviews and observations were the primary tools used to gather data.

Permission was obtained from the Committee that serves as gatekeepers of both sections i.e., Reserve and Extension Two. Verbal consent was obtained from the respondents themselves. Anonymity, self-determination and confidentiality were ensured during administration of the questionnaires and report writing.

This chapter described the research methodology, including the population, sample, data collection instruments as well as strategies used to ensure the ethical standards, reliability and validity of the study.

CHAPTER FOUR: RESULTS AND ANALYSIS

4.1 INTRODUCTION

Indoor air pollution in the researched area arises from a dependence on combustible fuels without enough channeling of smoke outside the house by means of either chimneys or windows. This chapter covers the time and financial value of the energy sources commonly used by respondents which are firewood, coal, paraffin, candles and combustible rubbish. It also delves into the other energy sources that are not commonly used though preferred e.g., electricity and liquid petroleum gas. The chapter further outlines the prohibitive costs of capital outlay of the most efficient energy sources: electricity and LPG. All energy source discussions are accompanied by corresponding tables detailing the features of each energy source.

The second part of this chapter lifts out a few important socio-economic and structural aspects impacting on the choice of fuel use. These include environmental restrictions, unemployment, poverty, gender, family stability and health linked to fuel use. The chapter ends with a section outlining practices of the respondents that demonstrate knowledge of the risks and benefits of the different energy sources they use and/or not use.

The overall results of the research include the following: The respondents were found to be using a total of thirteen different energy sources. However, only five were commonly used: firewood, coal, paraffin, candles and combustible rubbish. There are compelling reasons for continued use of these fuels and are clearly outlined under each fuel discussion below accompanied by tables illustrating characteristics of each fuel.

The two known least polluting energy sources, electricity and liquid petroleum gas, have been found to be used by very few of the respondents. Only five respondents reported to be using electricity and five were seen to be using liquid petroleum gas. Costs associated with (illegal) electricity connection and the capital outlay cost of liquid petroleum gas hinder respondents' access to these two fuels.

Table 1: Energy sources per family in the eleven interviewed households

# of Families	Cooking	Lighting	Space Heating
3	Wood, (paraffin as back-up)	Paraffin, (candles as back-up)	Wood
2	LPG, Wood, (paraffin as back-up)	Paraffin, (candles as back-up)	Wood,
2	Electricity (paraffin as back-up)	Electricity (candles as back-up)	Coal
2	Combustible rubbish	Paraffin (candles as back-up)	Combustible rubbish
1	LPG,	Paraffin	Coal
1	Electricity (paraffin as back-up)	Electricity (candles as back-up)	Electricity Coal
Total: 11			

4.2 ENERGY USE, TIME AND VALUE OF ENERGY SOURCES

With specific focus on major fuel needs, e.g. for cooking and space heating, households interviewed and focus group discussions reported using combinations of at least two different energy sources during the period of investigation and at least three during the winter season (usually with the addition of coal). Three households reported using electricity and paraffin and/or coal. Again these three households use paraffin in addition to electricity during summer or use coal in addition to electricity during winter. Only two other households reported using four types of energy sources. These are petrol for a generator, LPG for cooking, firewood for cooking outside and paraffin for lighting. The rest were all using wood and paraffin. Firewood and paraffin are the most commonly used energy sources (See *Figure 8* below).

Comparing firewood with paraffin found that influencing paraffin preference is employment, having school-going children and time-saving as it is easier to access and quicker to light in

order to prepare a meal or boil water. It takes respondents only a maximum of twenty minutes to collect paraffin. Within two hours a family of four people will have collected paraffin, bathed, eaten and be ready to depart for work and school, compared to use of firewood which can take up to four hours. Tables 1 to 7 provide more details on time range in collection of the different fuels, their costs and risks or benefits of their use.

According to the respondents the most efficient fuel, after electricity, that they aspire to use is LPG. They defined efficiency as easy collection, its safety in both storing and in the rarity of leakage of gas, thorough combustion of fuel leaving no breathing discomfort as is the case with other fuels like coal, wood and paraffin. Major reasons provided for preferring this type of energy source is its ease of use, speed and efficiency in both cooking and saving time.

This type of fuel was observed to be used by established or stable families. Established families are those that have one or both parents who are working and have two or more school-going children and are settled in the area evidenced by their investment in safety and security of their home. In preparing to go to school and work, the use of LPG seems to serve the requirements of saving time best.

According to the respondents who use LPG, the cost of a 9kg gas cylinder is R700, and a two plate gas stove costs about R250. Cash availability in a home using LPG is important as well as refilling the cylinder costs from R240 to R300 per 9kg cylinder. One respondent reported refilling a 14kg gas cylinder once a month at R300. The other respondent reported refilling a 9kg gas cylinder twice a month at R240 each time, making it R480 per month. Yet another respondent reported using a 4,5kg gas cylinder and refilling it every week for R130 making it R520 per month. The total once off capital cost required for use of LPG ranges between R1500 and R2000. These are costs that hinder use of LPG by poorer families, although LPG is understood by them to be the best fuel after electricity. The variance in gas used is caused by the size of the family and whether the LPG is the only source of energy source or used alternatively with other energy sources. A visit to the *Checkers Hyper Store* in Boksburg where most respondents reported purchasing LPG revealed that the prices of the above items correspond to what the respondents reported.

4.2.1 Firewood

Firewood is the most commonly used fuel in the research areas. *Table 2* below on characteristics of firewood gives reasons for the preference of wood. Chief amongst the reasons for the use of firewood is its availability as a free energy source. Other fuels are also used but due to the fact that the respondents cannot afford the costs of these other fuels, they use firewood. Making things easier for the residents is that the Ekurhuleni municipality drops firewood in an open space adjacent to the community for their use.

Table 2: Characteristics of firewood

Energy source type	Energy source use	Energy source cost	Time range in energy source collection	Factors influencing its use	Benefits and risks associated with use each energy source
Fire-wood	Cooking, heating bathing and dish-washing water, boiling water for tea/coffee and ironing clothes.	Free	From one hour to a maximum of four hours.	Poverty, unemployment, free availability of wood – supplied by the Municipality. Option to buy wood at R20 a sack within the community.	Storing too much of the firewood in the yard attracts rats. Much time spent on collecting and sorting wood

Thirty of the fifty respondents (interviews and FGD's) in the researched area view their collection of firewood as the most important activity contributing to the survival of households. Women respondents rearrange times for other chores like child rearing and food parcel collection from a local church around fuel collection. Twenty of the fifty respondents, being those who rely exclusively on Government child support grants for cash income, use firewood as their primary energy source. Influencing much use of firewood is financial constraints. Collection of firewood is a time-consuming task, yet is critical. "We cannot do without the collection of firewood. I need to sterilize my child's feeding bottle so the water must be boiled" Interviewee who is a mother of three children. Without firewood collection there would not be an adequate supply of fuel for cooking, space heating and boiling water the results of which would be devastating as infants' water must be sterilized and elderly people's bathing water warmed. Therefore all other required household tasks for this thirty of the fifty respondents have to be organized around the task of firewood collection.

4.2.2 Coal

Twenty of the fifty respondents who participated in focus group discussions and some of whom were interviewed earlier reported using mainly coal in winter for warming their homes and cooking, especially evening and weekend meals, boiling water for tea/coffee, heating water to wash dishes, and ironing clothes. Influencing the common use of coal in winter are the harsh

winter days and nights, regular income, the availability of coal in close proximity (the furthest household is about one kilometre from where coal is sold) and the double use of coal for space heating and cooking at the same time. Respondents said that, compared to wood, coal fire lasts longer. And compared to electricity (for those who use electricity), coal and its appliances (*Imbawula* and *Shangaan* stoves as depicted in *Figures 7 and 8*) are much cheaper. All respondents reported satisfaction with using coal for warming their homes, saying *"Imbawula efficiently warms the house"* commented one respondent. However, "at R15 per five litre bucket or R60 per twenty litre bucket, this is too much for me. I cannot afford to do that for a long time" Said one FGD Participant.

Table 3: Characteristics of coal

Energy source type	**Energy source use**	**Energy source cost**	**Time range in energy source collection**	**Factors influencing its use**	**Benefits and risks associated with use each energy source**
Coal	Mostly used in winter for warming the home and cooking especially evening and weekend meals, boiling water for tea/coffee, heating water to wash dishes, and ironing clothes.	Buckets: 5l costs R15 20l costs R60	Takes up to 30 minutes, using wheel barrow for 20 litres.	Harsh winter weather, having a regular income, its double use of space heating and cooking at the same time, easy availability.	All respondents reported satisfaction with using coal for warming their homes, saying *"Imbawula efficiently warms the house".* However, at R15 per 5 litres bucket or R60 per 20 litres bucket, respondents said this is too expensive for them; hence they sometimes burn wood on it as well.

The cost of R15 and R60 a five litre and 20 litre bucket respectively is too much for twenty respondents who are not working and some of whom are dependent on Government child support grants. This 40% of respondents is thus excluded by socio-economic conditions from using coal. Since they neither can afford to buy the *Shangaan* stoves, they improvise and cook on the *Imbawula* using any other suitable fuel except coal.

To collect coal it takes up to thirty minutes. The respondents reported that they use a wheelbarrow or a sack for collecting coal which is sold in buckets. Respondents reported that a twenty litre bucket lasts between three and five days depending on the size of the family. For instance, in a family of three – husband, wife and a child – the twenty litre bucket lasts four days whilst in a family of five the same twenty litre bucket of coal lasts only three days.

Respondents who stay in one room shacks store their coal just behind the entry door whilst the established families store their coal in a separate room. Coal fire is prepared twice a day, i.e., in the mornings and evenings. Five of the eleven interviewed respondents were observed using their stoves. All five stoves were not efficiently channeling the smoke through the chimney. Evidence of this was a smoky room and soot on the surfaces of these homes. The other three homes belong to established families who avoid this situation by having big windows that create sufficient ventilation inside.



Figure 7: *Shangaan stove* inside a respondent's household in Ramaphosa. Picture taken by author, 10/11/2015



Figure 8: *Imbawula* (brazier) in a separate room for cooking in one respondent's household in Ramaphosa. Picture taken by author, 10/ 10/ 2015

4.2.3 Paraffin

Paraffin oil is a flammable liquid hydrocarbon burned as fuel. It is most commonly used for heating, lighting, and cooking (see *Table 4*). All respondents reported using paraffin for one need or another. Fifteen of the fifty respondents reported using paraffin for cooking, boiling water for tea/coffee and ironing clothes and lighting their homes. Twenty of the fifty respondents reported using paraffin only for lighting because they find it safer, and better than candles for lighting. Paraffin is used by those who mainly use electricity (Five of the fifty respondents) as a back-up in the event of load shedding or electricity disconnection. Working parents with school-going children prefer paraffin for the efficiency of its use, easy access, and its cheap capital outlay requiring purchase of only a pressure stove of R120 or a camping stove of R550 and the fuel. Paraffin has a moderately cheaper capital outlay especially when compared to LPG which requires up to R2000 once off capital outlay and monthly refill of up to R500. The need to quickly prepare for work and school in the mornings also influences the choice of paraffin as one interviewee put it "I do not have time to prepare fire in the morning so I bought a primus stove and paraffin because it is quick"

Paraffin is available within the community for sale. A two litre container costs R22 (see *Table 4* below) and fifteen of the fifty respondents who mainly use paraffin for cooking report spending R400 per month on twenty litres of paraffin. Due to the high costs of paraffin relative to the freely available firewood, all respondents are against using paraffin for heating their living

spaces. Also bathing and dish washing water is reportedly heated only during winter and only for elderly people and young children.

Table 4: Characteristics of paraffin

Energy source type	Energy source use	Energy source cost	Time range in energy source collection	Factors influencing its use	Benefits and risks associated with use each energy source
Paraffin	Cooking, heating bathing and dish washing water, boiling water for tea/coffee and ironing clothes.	R22 per 2litre Respondents reported spending between R50 and R400pm.	Twenty minutes maximum	Working parents, school-going children, efficiency of its use, easy access, cheap capital outlay, the need to be clean and eat.	Easy to cook with and comparatively safer than candles for lighting. Slight but consistent headaches, coughs, itching eyes, chest pains, throat irritations, sinus resulting in frequent trips to the health clinic.

In all eleven visited homes paraffin is stored in a plastic container that has a lid which can be easily opened by a child. It is within easy reach of anyone including children as it is on the floor either behind the door or under the table upon which is a stove, pots and other utensils are. This has significant health and safety implications due to the toxic nature of the paraffin.

4.2.4 Candles

All respondents reported having and using candles for emergencies like late night arrivals or a child waking up at night (see *Table 5* below for factors influencing use of candles and the benefits or risks thereof). General use of candles is discouraged by the community as one home was burnt down a few months before this study, killing the owner.

Table 5: Characteristics of candles

Energy source type	Energy source use	Energy source cost	Time range in energy source collection	Factors influencing its use	Benefits and risks associated with use each energy source
Candles	For lighting and for religious rituals.	R30 Pack of 6	Within 30 minutes	Emergency situations like late night arrival or a child waking up at night, religious beliefs.	Easy to use for lighting and blow out as soon as one is done with the emergency. A neighbor died in his shack in a fire that was ignited by a candle.

Eight of the eleven respondents who were visited at their homes were observed to be using candles for other religious purposes as I spotted red and green candles as well as the common white ones. In their homes these candles are used as part of a shrine.

4.2.5 Combustible rubbish

Table 6: Characteristics of combustible rubbish

Energy source type	Energy source use	Energy source cost	Time range in energy source collection	Factors influencing its use	Benefits and risks associated with use each energy source
Combustible rubbish	Cooking, heating bathing and dish washing water, boiling water for tea/coffee	N/A	Four hours and up to a whole day.	Poverty and unemployment	No costs involved but the risk of inhaling plastic smoke could be costlier with time when health is compromised.

Twenty of the fifty respondents reported that on the occasions when the Municipality did not come to drop firewood, they would go around the veld collecting anything that they can make fire with. They find planks, small tree branches, twigs, maize cobs and even plastic. With these items they meet their basic fuel needs. *Table 6* above illustrate the health risks that respondents take in order to survive.

4.2.6 Other fuel sources

- **Liquid Petroleum Gas (LPG):** Five of the fifty respondents reported, and were observed, using LPG. Their common reasons for using this type of energy source are its ease of use, speed and efficiency in both cooking and saving time. In preparing to go to school and work, the use of LPG seems to serve the requirements of saving time best, compared to paraffin, coal and firewood. Features of LPG as an energy source are illustrated in *Table 7* below.

- **Electricity:** Five of the fifty respondents disclosed that they were using electricity. It must be noted that the actual number of electricity users may be higher as respondents may fear recrimination from disclosing their illegal use of electricity. The Extension Two and Reserve areas which were the focus of my research do not have a formal/legal electricity supply. Four of the five respondents illegally connected from street lights whilst one of the five respondents using electricity connected it from another house across the street.

  The one electricity user connects electricity from a neighbor across the street for R200 per month. She paid an initial fee of R300 to the electrician who helped her with installing plugs around her shack. The cables run below a tarred road from across the street. The road construction workers who were building a new road in the area cooperated with her when she requested them to let the cables run underground. She runs a nursery of about ten infants and toddlers receiving between R400 and R600 per child per month depending on the age of the child. Without electricity she would struggle to run her business which requires a refrigerator and consistent preparation of meals for the children. She also runs a business of cell phone charging at R5 per cell phone.

  The other four respondents who disclosed using electricity have connected from a light not far from their homes. All four respondents or their spouses are working and have a regular income which helped them to afford not only to pay the electrician who helps them to connect the electricity, but also to buy the necessary and expensive electricity

appliances. The electrician charges an initial fee of R500 and a R200 per month rental/service charge which he comes to collect every month-end (see *Table 7)*. This electricity has enough capacity for them to connect a two plate stove, a refrigerator, television, radio and lights. Except on the rare occasion (once in a year or two) that Eskom / Municipality sends their electricians to disconnect and cut off cables from the light and during load shedding, these four respondents never run out of electricity. On such occasions they then revert to wood and or paraffin for cooking and heating water, paraffin for lighting and car batteries for radio and television.

- **Petrol:** Three of the fifty respondents said they use petrol for their generators only to watch their televisions. Two of the three respondents buy five litres of petrol each month, spending about R65. The third respondent is running a tavern. He buys 20 litres of petrol, totaling R260 per month. The latter respondent uses the generator for a sound system, television and a refrigerator that stocks liquor. See *Table 7* below for features of using petrol. Two of the three petrol-user respondents are men and are responsible for collecting this type of fuel. They bring it home from work on the last day of the month. The tavern owner has a car which he uses to collect fuel – both petrol and the LPG that he also uses. All three respondents store the fuel in a separate room for safety. The downside of the generator according to all three respondents is the noise it creates and its attraction of criminal elements.

Table 7: Characteristics of LPG, Electricity & Petrol

Energy source type	Energy source use	Energy source cost	Time range in energy source collection	Factors influencing its use	Benefits and risks associated with use each energy source
Liquid Petroleum Gas (LPG)	Cooking, heating bathing and dish washing water, boiling water for tea/coffee, and ironing clothes.	Cylinders: 4,5 kg = R130 9kg = R270 14kg = R350	Delivered within 24hours of placing an order.	Working parents, school-going children, efficiency of its use, emitting fewer pollutants, having infants or ailing person (asthma).	It is easy to store, efficient to use and neater. Even though it is cleaner than wood or coal as far as its by products are concerned, leakage of gas has serious consequences as

					methane Inhalation is more toxic than carbon dioxide.
Electricity	Cooking, warming bath water, boiling water for tea/coffee, and ironing clothes.	R500 initial connection and R200pm	Immediately	Its efficiency, regular income, accessible (nearby) 'Apollo' light available expertise to 'connect' to an 'Apollo' light', having the electric appliances	The three respondents who managed to 'connect' electricity report an easy life (e.g. bulk-buying of meat, veggies and fruit). However, maintaining the expert is too costly.
Petrol	For watching TV through running a generator,	R12,70 per litre and spend about R300pm	Up to three hours using public transport.	Upward mobility, established families, need to keep abreast of news and entertainment	Generator is very expensive, noisy and attracts criminals otherwise without electricity or car battery this is the only other means through which a television can be watched.

- **Solar panels:** Two respondents said they charge their phones using solar panels that are specifically made to charge cell phones. These solar panels use energy from the sun to power their phones as they do not have electricity. Respondents mentioned that it cost them about R600 to buy these and it has been more than a year since they acquired them. They also help out their neighbors by charging their cell phone batteries in return for other favors. These two respondents said they do not run a business of cell phone charging because most of the time they are at work. See *Table 8* below for characteristics of Solar panels.

- **Acid batteries:** These are used for powering radios and televisions. Influencing use of the batteries is the need to communicate with far off relatives and friends, electricity cuts, load shedding and poverty.

- **Alkaline batteries:** Six of the fifty respondents use alkaline batteries to connect their radios and television sets. Four of the six use car batteries whilst the remaining two use the alkaline batteries. Influencing use of the batteries is electricity cuts, load shedding and being unemployed (See *Table 8* below*)*.

- **Dry Ice:** Two of the fifty respondents, one of whom is a shebeen owner, reported using dry ice. Dry ice is the solid form of carbon dioxide, a colorless, odorless, non-flammable gas that is slightly acidic. It is a white solid substance available in standard sized blocks. Its temperature is -78.5°C (See *Table 8* below*).* Dry ice can be used to keep food and other materials cold or frozen. The shebeen owner respondent said that he places dry ice on the bottom of a wheelie and covers it with cardboard and plastic or other material as insulation. As dry ice freezes items in direct contact with it, foods that may be damaged by freezing are placed as far from the dry ice as possible. The surface of dry ice is reportedly very cold to the point of burning the skin in manner similar to frostbite.

- **Direct Sunlight:** As a cost-saving exercise in summer bathing, laundry and dish washing water is placed outside in the sun as a way of warming it. Whilst in winter people warm themselves up by sitting or doing their chores like laundry in the sun.

Table 8: Characteristics of solar panels, batteries, dry ice & direct sunlight

Energy source type	**Energy source use**	**Energy source cost**	**Time range in energy source collection**	**Factors influencing its use**	**Benefits and risks associated with use each energy source**
Solar panels	For charging mobile phones (business or private)	Ones used in researched area range between R200 and R600	One to three hours. These are bought along with groceries.	Non-available electricity, income generation, need to charge mobile phones	Solar battery chargers use energy from the sun to power devices, there is no need to be near an electrical socket to use one. The downside is that they cannot be used at night or when the

					weather is particularly bad.
Alkaline batteries	These are used to power things like remote controls, flashlights and hearing aids. More advanced batteries, such as lithium batteries, are used in providing power to laptops.	Alkaline lead batteries range from R20 to R200 depending on their use.	Up to three hours, using public transport.	Need to communicate with far off relatives and friends	Influencing use of the batteries is electricity cuts, load shedding and poverty.
Lead acid batteries	They are used for playing radios and televisions.	Car batteries range from R600 to R1200 depending on size	Up to three hours, using public transport.	They are used for playing radios and televisions.	Car batteries are very heavy to carry around and can attract criminals.
Dry ice	Used to keep perishable foods, drinks and other materials cold or frozen, also stores medication like antibiotics	1kg costs R30	Up to three hours, using public transport.	Regular income, need to store medication, big family, non-availability of electricity, need to buy some perishables in bulks, regular income	Efficient only to the extent that instructions on its use are followed. Great way of improvising for those without refrigerators. But, can spoil foods and crack glasses or bottles if these are

					put directly on dry ice.
Direct Sunlight	Direct sunlight is used to warm cold water in order to bathe the young children and older people and older people.	There are savings on costs that would have, otherwise, been used in other energy sources.	It takes three to four hours to warm the water on a very hot day?	Poverty and unemployment.	One benefit is that the sunlight is not paid for and therefore cuts costs.

4.3 IMPACT OF SOCIO-ECONOMIC AND STRUCTURAL ASPECTS ON ENERGY SOURCE USE

During the research, respondents' accounts indicated that the use of some energy sources were restricted by a number of financial and social constraints that are linked to their socio-economic position. This section identifies key socio-economic and structural aspects that limit respondents' ability to invest in appropriate energy sources that help meet the major energy needs whilst not compromising their health.

4.3.1 Environmental restrictions on energy source use

There are two reasons why people who could afford LPG do not purchase it. Firstly, in both interviews and focus group discussions respondents reported that crime is very prevalent in the researched areas. This crime comes in the form of burglary accompanied by assaults. The five respondents who use LPG were observed to have fortified security measures in their homes. They have fences with lockable gates, burglar bars on doors and windows and all have someone at home at any given time. Paraffin-using respondents who could easily transition into using LPG because of their secure employment are hesitant to do so as they perceive use of LPG and buying appliances as a sign of a richer home thus attracting criminals. One respondent who uses paraffin alluded to having bought an electric stove, refrigerator, washing machine, kettle and other appliances, but whilst waiting for electricity to be installed is keeping them elsewhere because of crime. She mentioned that when they have electricity she will then enhance security of her household. The other reason that some people do not use LPG although they can afford it, as provided by four respondents, is that they use their shacks only as sleeping spaces and are

not concerned about developing it into a 'home'. These respondents' families (wives and children) are situated in the rural areas.

4.3.2 Unemployment and poverty

The biggest limitation towards investing in efficient fuel for twenty of the fifty respondents is lack of finance. These are respondents who are in the lowest level of the socio-economic stratum. They have lower levels of education and their main occupation is pulling trolleys with some picking steel whilst others pick plastic containers for recycling. They mainly use firewood and combustible rubbish for cooking. Ten of the twenty unemployed respondents report relying on government support that they say is not enough to cover all their basic needs. Restricting them from connecting electricity illegally is the prohibitive cost of initial connection and the cost of maintaining the electrician who must be contacted every time the municipality and Eskom disconnects illegal connections from the street light. When it comes to LPG use, these respondents are also restricted by the high capital outlay costs that accompany LPG use (see *Table 6*).

4.3.3 The gendered task of firewood collection

Whilst working men are happy to collect or bring home energy resources that are paid for, such as LPG or paraffin, the collection of firewood from the veld was expressly delegated to women and girls. What discourages men from collecting the freely available firewood? Working men said that they are already contributing by bringing in an income to the family. Unemployed men said they would rather use their time to look for a paying job. "We agreed with my wife that I must go to look for a job every day, and looking for a job has become a job because every day I walk to town leaving my wife at home to collect wood and whatever" Said one FGD male participant.

Other reasons for men not to be collecting firewood seemed to be in order to cover the shame of unemployment. For instance, male respondents said that it is stigmatizing to be among women collecting firewood and degrading to be seen as not being able to pay for the preferred but unaffordable fuels like LPG or paraffin. Women, including the few that are working, do household tasks that are regularly necessary, like cooking, shopping, child care, washing, cleaning, changing diapers and collecting firewood. These are tasks that often cannot be put off until a more fitting time. Their work tends to take place indoors, and women normally plan and solicit other female family members' help to do household tasks. Women as a group perform 70-80% of all household labor.

Women in the researched areas have clearly taken up leadership positions not only in ensuring the stability of their respective homes but by also forming themselves into committees that bring issues they are confronted with to the attention of the authorities. It is women who collect firewood and food parcels thereby making a major contribution to sustaining their respective homes. It is also women in this researched area who started a crèche ten years ago. Furthermore, the women negotiated the time of arrival and distribution of food parcels and are reported to be in constant touch with the Ward Councilor representing their community.

4.3.4 Role of the government

Focus group discussions got heated when discussing the role of government in respondents' lives. Whilst some praised the government (municipality) for providing them with firewood every second day, other respondents lambasted the government for not having provided them with electricity in the twenty years since democracy began. Other structural aspects adding burdens to respondents that do not necessarily appear to be related to energy sources include non-availability of a health clinic and schools or transport for kids to school. Respondents argued that the money they use for travel for these services could be channeled to more efficient energy sources like LPG along with safety and security measures for their homes. It is unfortunate that the researcher could not meet with the Councilor who was continuously unavailable until the time of writing this report.

4.4 RESPONDENTS KNOWLEDGE ABOUT ENERGY SOURCE USE

How some of the homes are built give an indication of the awareness of negative effects of indoor air pollution. The behaviour of the respondents in making, using and dowsing fires shows that they know the dangers associated with indoor air pollution. However, the illnesses that both mothers and children acquire expose the inadequacies of the mitigating measures taken by respondents to control indoor air pollution. For instance, whilst other homes are built such that there is sufficient ventilation in the house, for the other homes the opposite is true as in some homes a thick soot lying on surfaces was observed. However, this is not due to lack of knowledge of safe practices but is due to financial constraints. For twenty of the fifty respondents nothing matters more than daily survival.

4.4.1 Structure of homes illustrating awareness of negative effects of energy source use

Five of the eleven interviewed respondents have built a separate room for cooking and storing fuel. These homes also have stoves in a separate room designated for cooking with chimneys for emitting much of the smoke and windows for ventilation. However, six of the eleven

interviewed respondents and fourteen of the focus group respondents said they cannot afford to build extra rooms. These are the twenty respondents who reported negative health effects (see below).

Absence of electricity remains a key barrier to improving socio-economic development and well-being of residents of the researched area, according to respondents in all three focus group discussions. It disproportionately affects them when comparing their lives to those of neighboring Ramaphosa areas where there is formal electricity supply. The delay of the municipality in bringing electricity to this community has discouraged some of the residents (ten of the fifty respondents) from establishing themselves as nuclear families. Rather, these respondents have chosen to let their children stay with their grandparents in the rural areas or townships from which the parents come. The effect of this is unresponsiveness in endeavors of community building. This is not an ideal situation in any community as it leads to other social ills like teenage pregnancy, drugs or alcohol abuse and crime.

Proximity to open fire due to compactness of space in the shacks was one major factor observed by the researcher. This translates into a lengthy exposure to pollutants by the whole family including children. These are the same twenty respondents who reported health effects (see below).

4.4.2 Knowledge, behaviour and impact on health

The five respondents with separate rooms said that a method to reduce the effects of indoor air pollution is to buy firewood that is already chopped into appropriate sizes. Such wood fits inside the stoves and the stove door can be closed and therefore sealed; allowing the smoke to be emitted out only through the chimney. They reported that they also clean their chimneys just before and after winter seasons to make sure that there are no blockages and all smoke is channeled out. Although this is costly and time consuming for most of the respondents, it is one major way of lessening indoor air pollution. Respondents who use *imbawula* stoves (*Figure 8*) said that they initiate the fire outside and only bring it inside the house when the coal is red-hot. They also said they make a point of taking it outside and dowsing it just before going to bed. By bringing it inside when it is less smoky they are minimizing indoor air pollution, taking it out afterwards is meant to avoid inhaling toxic fumes whilst sleeping. The purpose of dowsing is to avoid shack fires.

There are consequences to certain choices of energy source use. Five of the twenty respondents who only use firewood and paraffin complain of slight but consistent headaches, coughs, itching eyes, chest pains, throat irritation, and sinus problems; resulting in frequent trips to the health clinic. The same respondents said that at the clinic they are always given inadequate treatments like cough mixtures or pain killers and are often discouraged from using

paraffin because of the respiratory illnesses it causes and its dangers. However, respondents who use paraffin have their rational reasons for doing so. Working parents with school-going children prefer paraffin for the efficiency of its use, easy access, and cheap capital outlay. Two of the respondents in focus group discussions reported that their children drank paraffin as toddlers at one point. The victims were admitted in hospital for a lengthy period. Respondents said that they make a point of not leaving appliances unattended while in operation and not leaving children, especially infants and toddlers, unattended. These respondents emphasize this point because they cannot afford less polluting fuels like LPG.

Twenty of the fifty respondents reported that on cold days they start the fire inside the house as firewood is quick to burn and produce flame compared to coal. It is the open flame of the firewood that they need and use for both cooking and space-heating. They are completely unaware of the dangers of inefficiently burnt firewood (stating that it is coal smoke that is dangerous) although they admit to seeing potentially dangerous sparks emitted from the fire. A nurse working at the Ramaphosa Health Clinic corroborated the above information by saying that the residents of *Reserve* and *Extension Two* frequent the clinic during winter because of pulmonary infections that are largely due to preparing fires inside their homes.

More than half of the respondents reported having one or more income generating skill. Skills mentioned include baking, sewing, weaving, and welding. Due to absence of electricity, this group of individuals cannot use these skills. Whilst others acquired new skills that help them to survive. Three respondents reported doing tree felling, two respondents are spaza shop owners, and one respondent runs a crèche and cell-phone charging business. These are the five respondents who have illegally connected electricity taking advantage of the fact that many residents do not have electricity.

4.5 CONCLUSION

This chapter reports on the research findings in the *Reserve* and *Extension Two* Sections of Ramaphosa Informal Settlement. Out of a total of thirteen energy sources that were found to be used in this area only five can be considered as primary: firewood, coal, paraffin, candles and combustible rubbish. Most health related issues reported to be experienced by the respondents in this chapter can largely be attributed to these five energy sources, except the candles. The rest are reported under other energy sources because they were found to be used by few and far in between. These are: electricity, petrol, dry ice, solar panels, LPG, alkaline batteries, acid batteries and direct sunlight.

Also reported in this chapter is the impact of socio-economic and structural factors on choices of fuels. These were found to be unemployment, environmental restrictions, government role, gendered task of fuel collection and the respondents' knowledge about the health risks

associated with use of solid fuel. This was to be observed in the structures of the respondents' homes and learnt from their narration of their life experience in deciding about and using fuel.

5. CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The purpose of this chapter is to summarize the research report and to make recommendations for areas requiring further research. The first section of the chapter will discuss the socio-economic conditions of respondents in as far as these facilitate and/or constrain livelihood in the researched communities and the methodology used to accomplish the analysis. A summary of the major results will be described in relation to the different questions.

The difficult social and economic circumstances in the researched area and their bearing on respondents' lives determine their risk of illness. These difficult circumstances are in turn shaped by a broader set of unresolved structural aspects in the form of economics, social policies, and politics. High unemployment levels, slow pace of service delivery demonstrated by non-availability of bulk electricity in the researched area and gender inequality are some of the issues pointing to structural inequalities.

The research discovered how socio-economic conditions constrain the respondents' choice of energy source. There is a relationship found between willingness to invest in the establishment of a home and age and/or size of the family. The more established and older the children, the more willing the parents are to invest in more efficient and safe energy sources and related family safety. More importantly, being established as a home or family is determined by family members' secure employment. Secure employment is also determined by possession of a certain level of education or skill.

Even if electricity is available in this community, there will be many amongst the respondents who cannot afford electricity especially the buying of electric appliances. Even if they register as indigent, the free 100 units that are given by the Government would not be sufficient for cooking, space-heating, ironing and others. But, it would help them with lighting and that would reduce crime and increase children's pass rate at school. The economic conditions of the respondents will continue to dictate the use of electricity alongside the other inefficiently combustible fuels like coal, wood, paraffin and others.

Whilst some of the respondents think that electricity remains a key barrier to improving their socio-economic development and well-being, twenty of the fifty respondents who exclusively rely on Government grants do not think so.

5.2 CONCLUSIONS TO RESEARCH QUESTIONS

1. What informs the informal settlement residents' use of certain energy sources for cooking and heating over other types?

This study found a number of reasons for energy source choices made by respondents. Firstly, the use of clean-burning liquid petroleum gas (LPG) is hindered for poorer families by the prohibitive capital outlay costs, although LPG is understood by them to be the best fuel after electricity. Secondly, illegal electricity connections are prohibitively expensive due to the high cost of initial connection and the cost of maintaining the connection. Another factor driving energy source use is the perception that the use of energy sources like LPG and the buying of gas or electrical appliances is a sign of a richer home thus attracting criminals. This was reported by paraffin-using respondents who admitted that they can afford LPG.

According to literature the choice of energy source for a particular use depends not only on the availability thereof, but also on the prices of the energy sources and other alternatives, the appliances to be used and the efficiency of the energy source itself. In the study in Ramaphosa this assertion was demonstrated with the addition that also crime, season and cultural beliefs do influence the choice of energy source use.

Firewood is the most commonly used fuel in the research areas with more than half the respondents reporting using it. The factors influencing paraffin use are having the money to buy it, its time saving benefit and cheap capital outlay. The total capital cost required for use of LPG hinder the use of LPG by poorer families, although LPG is understood by them to be the best fuel after electricity.

What is clear from this study is that even if electricity is available in this community there will be many amongst the respondents who will not be able to afford electricity and/or its appliances.

2. Where residents possess knowledge of the harmful effects of continued use of an energy source, yet continue to use it, what are the reasons for this?

Indoor air pollution in the researched area arises precisely from dependence on combustible fuels without proper infrastructure for emitting smoke or means for sufficient ventilation. The respondents, to some extent, demonstrated knowledge of the negative effects of indoor air pollution. This is demonstrated by five of the eleven homes visited who, because there are employed members, were able to afford a separate room for cooking and stoves with chimneys that are cleaned periodically. However, financial constraints for twenty of the fifty respondents result in a different situation as they are not able to build a solid shack nor to furnish it with

stoves that have chimneys, resorting instead to using *imbawula* stoves for both cooking and space heating.

The reviewed literature indicates that the use of biomass fuel for cooking and heating is a cause of, and results in poverty, illness, perpetuation of gender and class inequality. This has been substantiated in the study on energy source use in Ramaphosa. However, whilst the literature suggests lack of awareness as one of the major contributing factors to choices of energy sources, the study in Ramaphosa demonstrates that the respondents know the effects of the energy source they are using but are forced by circumstances to continue using them. In the study of Ramaphosa three respondents with established families (both parents employed and yard maximally used by building a separate room for cooking) greatly reduce indoor air pollution by professionally installing stoves with chimneys that are cleaned periodically to effectively channel all smoke outside. These respondents' homes were also observed to be having big windows that create sufficient ventilation inside.

As far as the study in Ramaphosa demonstrated, economic barriers are the main cause for respondents to continue using biomass fuel. In the study in Ramaphosa, respondents' assertions that their children are mostly sick in winter were validated by a nurse working the health clinic which is about 5km away. The clinic nurse reported that the residents of the researched area are constantly advised not to have open fires inside their homes.

The consequences to certain choices of fuel use like firewood and coal have been reported. Respondents reported about the ill-health of their children during cold season. This assertion was validated by the nurse of the local health clinic. Good quality of air is an essential determinant of healthy life and people's well-being. Harmful particles released in the process of converting fuel into needed energy for cooking and warming spaces cause an array of health complications for respondents in the researched area, particularly for women and children under five years of age who are often at home exposed to burning fuel, as reported by both the respondents and the expert interviewee.

3. Whose responsibility does it become to collect a chosen energy source, and how is it collected?

The 2.4 billion people who continue to depend on biomass fuels (coal, wood, animal dung etc.) become victims of adverse health effects, not only from indoor air pollution, but also because of the "opportunity cost of time spent collecting fuel, and the lack of access to all services in education, health care, and household resources that modern energy provides" (Wilkinson et al, 2007). This has been corroborated by the study in Ramaphosa as the respondents reported that it takes them up to four hours to collect firewood that would last two to three days.

The other finding in the study was that the task of firewood collection along with meal preparation is the sole responsibility of women. Whilst men who are working are happy to take on the added responsibility of collecting paid-for fuel, it was clearly demonstrated that in both the families that have employed men and those families where men are not employed that the burden of firewood collection falls squarely on women, as meal preparation is women's responsibility. Women in this area recognize that firewood collection is not only a crucial source of fuel but a means of maintaining their families.

In the study of Ramaphosa, for each family to collect three days' worth of firewood there must be more than one family member at the task of collecting the wood. This is often the mothers and daughters. Thirty of the fifty respondents who said they mainly use firewood for cooking reported that the responsibility of hewing of firewood lies with women. The underplaying of women's contribution to creating and maintaining a home points to linkages between feminization ('women belong to the kitchen') of their capabilities and continued poverty.

5.2 RECOMMENDATIONS

More detailed research is needed on how availability of bulk electricity will not be a sufficient condition to ending in-door air pollution in poorer communities. Pro-poor policies that can relieve the poor whose health is constantly compromised by use of inefficiently combustible fuel are needed. Such policies need also to be redistributive so as to benefit the poor. Government has an obligation to protect the citizens including the poor. There are various areas of Government and the economy that, if handled well, can contribute to fairness in health. Even though health might not necessarily be the main focus addressed by Government, through for instance economic development, decent housing, women empowerment, education or employment creation, these have direct and strong correlations to health.

REFERENCES

Barnes, B., Mathee, A., Thomas, E., & Bruce, N. (2009). Household energy, indoor air pollution and child respiratory health in South Africa. *Journal of Energy in Southern Africa*, *20*(1), 4-13.

Bellù, L. G., & Liberati, P. (2005). *Impacts of policies on poverty: The definition of poverty* (No. 44644). University Library of Munich, Germany.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (2014). *At risk: natural hazards, people's vulnerability and disasters*. Routledge.

BOGNER, A. (2009). The Theory-Generating Expert Interview: Epistemological Interest, Forms of Knowledge, Interaction. IN BOGNER, A., LITTIG, B. & MENZ, W. (Eds.) Interviewing experts.

Bond, P. (2000). Cities of gold, townships of coal: essays on South Africa's new urban crisis. Africa World Press.

Braveman, P. A., Cubbin, C., Egerter, S., Williams, D. R., & Pamuk, E. (2010). Socioeconomic disparities in health in the United States: what the patterns tell us. *American Journal of Public Health*, *100*(S1), S186-S196.

Bruce, N., Perez-Padilla, R., & Albalak, R. (2000). Indoor air pollution in developing countries: a major environmental and public health challenge. *Bulletin of the World Health Organization*, *78*(9), 1078-1092.

Brew-Hammond, A. (2010). Energy access in Africa: Challenges ahead. *Energy Policy*, *38*(5), 2291-2301.

Cecelski, E., & Unit, A. A. E. (2000). Enabling equitable access to rural electrification: current thinking and major activities in energy, poverty and gender. *World Development Report*, *1*, 2-3.

Duflo E, Greenstone M & Hanna Rema. (2008**).** Indoor air pollution, health and economic well-being », *S.A.P.I.EN.S* [Online], 1.1 | 2008, Online since 26 November 2008, connection on 14 March 2015. URL: http://sapiens.revues.org/130

Ezzati, M., & Kammen, D. M. (2002). The health impacts of exposure to indoor air pollution from solid fuels in developing countries: knowledge, gaps, and data needs. *Environmental health perspectives*, *110*(11), 1057.

Fullerton, D. G., Bruce, N., & Gordon, S. B. (2008). Indoor air pollution from biomass fuel smoke is a major health concern in the developing world. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *102*(9), 843-851.

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M. C., Shyamsundar, P. ... & Noble, I. (2013). Policy: Sustainable development goals for people and planet. *Nature*, *495*(7441), 305-307.

https://www.google.co.za/search?q=Profile+of+Ramaphosa+informal+settlement&sa=N&biw=1600&bih=754&tbm=isch&tbo=u&source=univ&ved=0ahUKEwi67P3IzKfNAhVF1xoKHU3ACfI4FBDsCQg4#imgrc=JfskvfYgO23NCM%3A Image of aerial view of Ramaphosa Informal Settlement.

Kaygusuz, K. (2011). Energy services and energy poverty for sustainable rural development. *Renewable and Sustainable Energy Reviews*, *15*(2), 936-947.

Klassen, S. (2000). Measuring poverty and deprivation in South Africa. *Review of income and wealth*, *46*(1), 33-58.

Louw, K., Conradie, B., Howells, M., & Dekenah, M. (2008). Determinants of electricity demand for newly electrified low-income African households. *Energy Policy*, *36*(8), 2812-2818.

Marmot, M., Friel, S., Bell, R., Houweling, T. A., Taylor, S., & Commission on Social Determinants of Health. (2008). Closing the gap in a generation: health equity through action on the social determinants of health. *The Lancet*, *372*(9650), 1661-1669.

Masera, O. R., Saatkamp, B. D., & Kammen, D. M. (2000). From linear fuel switching to multiple cooking strategies: a critique and alternative to the energy ladder model. *World development*, *28*(12), 2083-2103.

Moya, J., Bearer, C. F., & Etzel, R. A. (2004). Children's behavior and physiology and how it affects exposure to environmental contaminants. *Pediatrics*, *113*(Supplement 3), 996-1006.

Nigel B, Perez-Padilla R, & Albalak R. (2000) "Indoor air pollution in developing countries: a major environmental and public health challenge." *Bulletin of the World Health Organization* 78.9 (2000): 1078-1092.

Padmavathi, R. (2012). Indoor air pollution due to combustion of biomass fuel and respiratory illness in south Indian population.

Perez-Padilla, R., Schilmann, A., & Riojas-Rodriguez, H. (2010). Respiratory health effects of indoor air pollution [Review article]. *The International Journal of Tuberculosis and Lung Disease*, *14*(9), 1079-1086.

Pope, D. P., Mishra, V., Thompson, L., Siddiqui, A. R., Rehfuess, E. A., Weber, M., & Bruce, N. G. (2010). Risk of low birth weight and stillbirth associated with indoor air pollution from solid fuel use in developing countries. *Epidemiologic reviews*, mxq005.

Ratcliff, D. (15). Methods of data analysis in qualitative research. Website–qualitative research. Ratcliffs. Net/15methods. Pdf (accessed 12/20/2008) (= Ratcliff 2008a).

Rehfuess, E., Mehta, S., & Prüss-Üstün, A. (2006). Assessing household solid fuel use: multiple implications for the Millennium Development Goals. *Environmental health perspectives*, 373-378.

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (Eds.). (2013). *Qualitative research practice: A guide for social science students and researchers*. Sage.

Ruiters, G. (2009). Free basic electricity in South Africa: A strategy for helping or containing the poor. *Electric capitalism: Recolonizing Africa on the power grid*, 248.Schlag, N., & Zuzarte, F. (2008). Market barriers to clean cooking fuels in sub-Saharan Africa: a review of literature. *Stockholm Environment Institute, Stockholm*.

Smith, K. R., Samet, J. M., Romieu, I., & Bruce, N. (2000). Indoor air pollution in developing countries and acute lower respiratory infections in children. *Thorax*, *55*(6), 518-532.

Smith, K. R. (2000). National burden of disease in India from indoor air pollution. *Proceedings of the National Academy of Sciences*, *97*(24), 13286-13293.

Smith, T. B. (2004). Electricity theft: a comparative analysis. *Energy Policy*, *32*(18), 2067-2076.

Spengler, J. D., & Chen, Q. (2000). Indoor air quality factors in designing a healthy building. *Annual Review of Energy and the Environment*, *25*(1), 567-600.

Van der Kroon, B., Brouwer, R., & van Beukering, P. J. (2013). The energy ladder: Theoretical myth or empirical truth? Results from a meta-analysis. *Renewable and Sustainable Energy Reviews*, *20*, 504-513.

Von Schirnding, Y. (2002). Addressing the Impact of Household Energy and Indoor Air Pollution on the Health of Poor: Implications for Policy Action and Intervention Measures. Geneva, Switzerland: World Health Organization.

Wilkinson, P., Smith, K. R., Davies, M., Adair, H., Armstrong, B. G., Barrett, M., & Chalabi, Z. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: household energy. *The Lancet*, *374*(9705), 1917-1929.

World Health Organization. (2009). *Global health risks: mortality and burden of disease attributable to selected major risks*. World Health Organization.

Yach, D., Mathews, C., & Buch, E. (1990). Urbanization and health: methodological difficulties in undertaking epidemiological research in developing countries. *Social science & medicine*, *31*(4), 507-514.

APPENDICES

APPENDIX A: PARTICIPANT INFORMATION SHEET

Introduction

Good morning/afternoon Mama and/ Baba. My name is Thanduxolo Doro, a post-graduate student at Wits University. I am doing research on reasoning behind choices of energy fuel use by your households in your community. I am going to give you some information about this research and request you to be part of this research. There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain.

Purpose

The purpose of this study is for me to ask and understand your views and experiences of using the types of energy fuels that you are using. The other purpose of this study is for me to pass my M.A degree in Health Sociology. I humbly invite you to participate in this research. I am grateful for your time and will do my best to fit into your schedule.

Method and Duration

This research will take the form of an interview at your home. I would like to interview you in your home so that you can show me how use fuel to light, cook, heat etc.

Participant selection

You have been selected to participate in this research because, firstly you are over 25 years old and you live in informal settlement part of Ramaphosa. I have acquired permission from the community leaders to approach people in the community and seek their permission. That is how I came to approach you.

Voluntary Participation

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. You are free not to participate.

Benefits

I will not provide anything that may be of any benefit to you for your participation. I am, however, willing to compensate airtime used to recruit other participants only to a maximum of R50, 00 (Fifty Rands only) and offer some refreshments during our focused group discussions.

Confidentiality and Anonymity

I will keep all the information I collect from this research project confidential. I will put all information about you away and no-one else will be able to see it. I will put a number on any information about you instead of your name. I will use pseudo-names should there be information that clearly points to you in the findings.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so and refusing to participate will not negatively affect you in any way. Should you feel uncomfortable with certain questions, please feel free to say 'I prefer not to answer that'. At any point you may stop participating.

Research results

The results of this research will be available on world-wide web (internet) through Wits by June 2016. If you desire, I can come back to give you a summary of the research findings. Should you be interested, I am willing to acknowledge your participation in this research by listing your names in the final report.

Who to Contact

Should you need any more information, you may contact me (Thanduxolo Doro) at 072 596 3267 or my supervisor and lecturer at Wits Professor David Dickinson. His number is 011 717 4438

Thank you very much

APPENDIX B: INTERVIEW SCHEDULE

I. Opening

- **(Greeting and introduction)** Good day Ma'am or Baba, my name is Thanduxolo Doro a post graduate student at Wits doing health sociology, Mr. . . . , the chairperson of Ramaphosa committee thought it would be a good idea to interview you, amongst other, so that I can gain some understanding of energy fuel use in Ramaphosa.
- (**Purpose**) I would like to ask you some questions about your experiences in using whatever energy fuel you use for cooking and heating your home.
- (**Motivation**) I invite you to voluntary participate in this interview as your experiences might help benefit future generations who may live in areas such as yours.
- (**Time Line)** The interview should take about 45 minutes. Are you available to respond to some questions at this time? Or, should I maybe come back later or on another day?

Background information

So, to begin, can you tell me about your background?

Who are you? Where are you from originally? How many people do you stay with in the household? Are your kids at school? Which grades and how far are the schools? How do they commute? Income sources? How long have you been staying at this place? Why did you choose to stay this place? Do you have appliances like refrigerator, stove, microwave, iron, kettle, TV set, radio, mobile phone, hair dryer, heater, washing machine, etc.?

(**Transition to the topic:** Rationale behind choice of energy fuel use.

1. Which type of energy fuel do you use for?

Lights, cooking food, heating the home when it is cold, warming food, ironing your clothes, making tea/coffee, charging your mobile phone, putting TV or radio on?

2. How was the decision to choose this type of energy fuel arrived at (tell me for each type and each use as listed above?
3. How far is the energy fuel collection point for each energy type and use (roughly what distance do you have to walk or do take a taxi?
4. If you don't mind, can we do some calculations now? Tell me the unit cost of . . . ? (depending on what is used in a particular home, I will probe)
5. Would you say there are some dangers associated with use of certain fuels? How did you discover that?

6. What kind of risks are there in collecting, using and storing your energy fuel?
7. For how long would you say you stay in close proximity to open fire (if using solid fuel or paraffin)?
8. What are the benefits of using this energy fuel that you are currently using as compared to others that you would wish to use?
9. What limits you from using those others that you mentioned?
10. What would be an ideal type of energy fuel for each use that you have?
11. What is the general view of your family on this or that type of energy fuel?
12. What is the general view of the community on this or that type of energy fuel?

(**Winding down:** Well, it has been a pleasure finding out more about your experiences of using this energy fuel. Let me briefly summarize the information that I have recorded during our interview.)

Did I miss anything of importance to you?

Closing

I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know at this stage?

I should have all the information I need. Would it be alright to call you at home if I have any more questions? Thanks again. I look forward to listening to the recording of our conversation. Should you need to ask something related to this research, please call me on 072 596 3267?

Thank you very much.

APPENDIX C: CERTIFICATE OF CONSENT

I agree to participate in discussions and interviews about the energy fuel that we use to cook or heat our home(s). I also agree to have myself and/or my home photographed and my words tape-recorded. I have been clearly informed that there is no compensation for participating in this research. I have also been told that I can stop participating at any point and will not be judged for that.

Name of Student: Thanduxolo Doro

Name of institution: Wits University

Name of Research Proposal: Rationale behind choices of energy fuel by poor communities: A study of Ramaphosa Informal Settlement.

_____

I …… have had the opportunity to ask questions about this research and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this study.

Signature of Participant _____ Date _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Signature of Researcher /person taking the consent

_____Date_____

A copy of this Informed Consent Form has been provided to the participants:

APPENDIX D: CLEARANCE CERTIFICATE

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Doro

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H15/09/06**
PROJECT TITLE	Rationale behind choice of energy fuel by poor communities: A study of Ramaphosa informal settlement
INVESTIGATOR(S)	Mr T Doro
SCHOOL/DEPARTMENT	Sociology/
DATE CONSIDERED	18 September 2015
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	12 October 2018

DATE 13 October 2015 **CHAIRPERSON** J. Knight
(Professor J Knight)

cc: Supervisor : Professor D Dickinson

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

Signature

9 , 11 , 2015
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES