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Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Methods Approach

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A thesis submitted in fulfillment of the requirements for the Degree of ***Doctor of Philosophy (Ph.D.)*** in School of Business and Finance, Faculty of Economics and Management Sciences, University of the Western Cape

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ABSTRACT

South Africa was considered to have attained universal access to modern energy, this meant that the number of households that have access to energy had successfully increased from 30% in 1994 to 87% in 2012. However, the situation in Nigeria is such that electricity generating figures are very poor and they cannot meet half of the demand of Nigerian households, and the majority of the states have challenges in accessing sufficient fossil fuels. However, recent trends in domestic energy consumption for both countries are becoming biased in favor of fuel-wood energy especially among low-income households, "descending the energy ladder". Despite this downward movement in the energy ladder, fuel-wood energy is still politically neglected and deprived of the same attention given to commercial forms of energy namely, kerosene, gas, LPG, and electricity, this is due to negative perceptions associated with it, such as, how the need of fuel-wood energy is considered as the major cause of deforestation

Based on the above, a comparative study was conducted between South Africa and Nigeria to empirically asses and analyze domestic fuel-wood energy consumption. The objectives of the study were to analyze and compare the dynamics of fuel-wood energy consumption and estimate the impact of socioeconomic and demographic variables on the level of domestic fuel-wood energy consumption. Moreover, the study was focused on estimating and comparing the contribution of fuel-wood business to trader's livelihood and finally determine factors affecting fuel-wood energy sector funding in Nigeria (case study). A quantitative cross-sectional survey design involving a structured questionnaire was employed, where 1199 questionnaires were received from fuel-wood consumers and 200 questionnaires from fuel-wood traders, given the response rate of 85% for fuel-wood consumers and 95% for fuel-wood traders in Western Cape Province.

In Katsina State, 992 questionnaires were received from fuel-wood consumers and 209 questionnaires from fuel-wood traders given the response rate of 78% for fuel-wood consumers and 93% for fuel-wood traders respectively. Frequency tables were used to compare the dynamics of fuel-wood energy consumption between South Africa and Nigeria. Moreover, the Chi-Square test and the logit regression were used to compare the impact of socioeconomic and demographic variables on domestic fuel-wood energy consumption. Furthermore, the frequency of using fuel-wood, reasons for using fuel-wood as a major energy source and reason for the combination of fuel-wood with other energy types (fuel stacking) were used to capture the dynamics of fuel-wood energy consumption. While, consumer gender, age, marital status, household size, the structure of the house, monthly income and employment status were used as independent variables that determine higher or lower levels of fuel-wood energy consumption (dependent variable) among households.

In addition to this, frequency tables were used to compare the contribution of fuel-wood business to trader's livelihood as per income, food security, health security, and children's education. Finally, to determine factors affecting the fuel-wood energy sector funding in Nigeria, a qualitative survey design involving a Focus Group Discussion (FGD) was used. Ten (10) groups comprising of ten (10) participants in each group were formed, making 100 participants (fuel-wood traders). Data analysis was carried out by identifying three themes namely, lack of access to finance, lack of available information on financial products and lack of government support. The findings revealed that consumption of fuel-wood as energy is high in Nigeria compared to what is obtained in South Africa, and the frequency at which households consume fuel-wood in Nigeria is higher than the frequency at which South African households consume fuel-wood as energy. In addition to this, the study found that South African households still consume fuel-wood despite the availability of modern energy. The study also noted that educational level, gender, monthly income, the structure of the house and employment status have a negative significant relationship with fuel-wood consumption in the two countries. While, household size, marital status, and age have a positive significant relationship with fuel-wood consumption.

The study revealed a strong connection between household economy and fuel-wood consumption in both countries. Furthermore, the results showed that weekly profit from the fuel-wood business is used to provide food and health care for South African fuel-wood traders. Nigeria traders, on the other hand, used their weekly profit to provide food, health care and education for their children. Finally, the findings in the case study area revealed that there has not been any funding for the fuel-wood energy sector in Nigeria. Lack of access to finance, lack of available information on financial products and lack of government support are the major funding constraints for the fuel-wood energy sector. The findings of the study have important implications for energy planning and small business development.

Keywords: domestic, fuel-wood energy, consumption, dynamics, socioeconomic variables, livelihood, funding, South Africa, Nigeria

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DEDICATION

Dedicated to my late father, Babangida Muazu and my late mother, Halima Muhammad. Rest in Peace.

Table of Contents

List of Tables

List of Figures

Acronyms

ANC	African National Congress
BOI	Bank of Industry
DISCO	Distribution Company
DOE	Department of Energy
ECN	Energy Commission of Nigeria
ESCON	Electricity Company
FBE	Free Basic Electricity
FOS	Federal Office of Statistics
GDP	Gross Domestic Project
GENCOS	Generation Company
HEPM	Household Economic Portfolio Model
HH	Household
HHK	Household Kerosene
HSRC	Human Science Resource Council
IEA	International Energy Agency
INEP	National Integrated Electrification Programme
ITF	Industrial Training Fund
LPG	Liquefied Petroleum Gas
NALDA	National Land Development Authority
NBS	National Bureau of Statistics
NDB	National Data Bank
NEDEP	National Enterprises Development Agency
NGR	National Electricity Regulatory
NNPC	Nigeria National Petrol Corporation
NPC	National Population Commission)
NREEP	National Renewable Energy and Energy Efficiency Policy
PASASA	Paraffin Safety Association of South Africa
SADC	Southern African Development Community
SAP	Structural Adjustment Programme
SMEDAN	Small and Medium Enterprise Development Agency
SSA	Sub-Saharan Africa
TCN	Transmission Company of Nigeria

CHAPTER ONE: INTRODUCTION

1.1 Background/stylized facts

In Sub-Saharan African countries wood-based biomass is known to be the dominant source of energy where about 81% of households rely on it for energy more than in any other region in the world (World Bank, 2011:1). Fuel-wood is the most competitive and attractive energy source amongst other forms of biomass renewable energy sources, and many households depend on it for certain reasons. Firstly, fuelwood is the most available energy in its source and it is easily accessible to households at depots, sheds or markets and at a lower price depending on the quantity they want. Secondly, wood as an energy source does not contribute to global warming; the amount of carbon dioxide absorbed by a tree during growth is roughly equal to the amount produced by burning of wood (Massachusetts sustainable bio-energy initiative, 2008). Finally, the wood energy sector generates more jobs than other sectors like gas, kerosene, and electricity (Geoffrey, 2010:14, Couture et. al. 2012:1).

Globally, 2.7 billion people use wood-based biomass as domestic energy for cooking and heating (Jolie et al..2014:1). Out of this figure, 93 percent of households in rural areas and 58 percent in urban zones rely on wood-based biomass. Although the number is decreasing in Asian countries, there will still be 1.75 billion people depending on wood-based biomass for domestic energy by 2030 (Jolie et al. 2014:1). Therefore wood-based biomass accounts for a substantial amount of domestic energy for Africa, Asia and Latin America 89%, 81%, and 66%, respectively. The share in Bangladesh, Cambodia, Nepal, and Pakistan goes up to 98% (IEA, 2010 and 2006). Countries such as Burundi, Central African Republic (C.A.R.), Chad, Liberia, Rwanda, Gambia and Sierra Leone due to lack access to modern energy, over 95% of the population use wood-based biomass as their domestic energy with the rural population relying entirely on wood-based biomass energy for cooking (UNDP, 2009). The use of wood-based biomass as the main energy source is reported in Kenya (68%), Eritrea (95%), Ethiopia (94), while the consumption in Zambia and Uganda stands at 70% and 92%, respectively (World Bank, 2011:2).

Extant literature on domestic energy use shows that the popularity of fuel-wood as domestic energy is increasing in Nigeria. In the year 2013, fuel-wood consumption escalated to about 72%, consisting of 86% rural households and 42% urban households from 60% in 2003 (NPC and ICT international, 2014, Abdullahi et.al, 2017:369). The huge growing number of people that consumes fuel-wood in Nigeria led Cline-Cole and Maconachie (2015:10) to argue that, "it is true today as it was three decades ago when "the role of fuel-wood (was) so predominant that any realistic energy analysis was essentially a fuel-wood analysis". Similarly, despite the rapid improvement in electricity access in South Africa, many households dependent on fuel-wood as their energy source. According to Wessels (2012:1), 67% of South African households use fuel-wood exclusively. A survey conducted on energy-related behavior and perceptions in South Africa by the Department of Energy and Human Science Research Council (2012:26) reported that the majority of the provinces still relied on fuel-wood for domestic activities, it is the second most common main energy source for cooking. Also, the ProBec (2008) report on Biomass energy consumption for South Africa showed approximately 40% of total energy in South Africa is fuel-wood, and the consumption is concentrated among poor households in rural areas and those living in un-electrified informal settlements in the urban areas. These findings corroborated the study of Matsika et al (2013) in Sub-Saharan African showing over 70% of the rural areas depending on fuel-wood for domestic energy. More importantly, key development indices have indicated that the accelerated rate of urbanization, economic development, the rate of population growth and the relative price of energy will have a positive relationship with fuel-wood consumption. It is projected that the consumption of energy from wood-based biomass will increase in Sub-Saharan Africa in relative terms over the next thirty years as the rate of demographic growth will outstrip the accessibility of modern energy (IEA, 2009). Urbanization increase will also increase the demand of fuel-wood because African population has exceeded one billion in 2009, out of this 395 million live in the urban areas, it is expected that the urban

population will increase to about 780 million by 2030 (UN Habitat, 2010). The strong hike in the prices of modern energy will give household little incentives to switch away from wood (World Bank, 2011). However, despite the high level of fuel-wood consumption exhibited by Nigerian and South African households, the social and economic significance of fuel-wood has been neglected, undermining the development and efficiency of the sector given less attention compared to conventional forms of energy namely electricity, LPG, paraffin/kerosene and coal. The fuel-wood energy sector is politically neglected and viewed entirely negatively. Jolie et al (2014:1) argue that issues regarding the fuel-wood energy sector are often addressed in relative isolation, especially on projects and policies. Even though many belief that even though fuel-wood energy is neglected and isolated, it will remain the energy option for many households for cooking and heating in Africa and other parts of the world (Abdullahi et al.,2017, Cline-Cole and Maconachie, 2015, Specht et.al, 2015 Naibbi, 2013, Ekanade & Orimoogunje, 2012, Asifat, 2012). It is on the strength of the significance of fuel-wood to the households in South Africa and Nigeria and the rest of the world, a consensus was made by environmentalists that the level of demand for fuel-wood will be environmentally unsustainable. For example, a report by the Food and Agricultural Organization (2010:101) indicated that fuel-wood consumption led to the removal of the world's wood from the forest and other wooded land areas by about 50% translating into 3,359 million cubic meters in 2005. In Nigeria, Naibbi (2013:6) explained Nigeria's total area of 923,687 km^2 is annually losing 3500km to desertification as a result of fuel-wood consumption. Also, Abdullahi et.al (2017:349) reported that the huge growing number of people relying on fuel-wood for energy will deplete the 15 million hectares of forest and woodland resources within the next fifteen years. In South Africa, a study conducted in the Lowveld of the savanna in the Northeastern parts by Wessels et al (2012) revealed the possibility of exhausting the biomass of the areas in fifteen years if fuel-wood consumption persists. Other parts of the region are also experiencing a significant reduction in their forest areas because of fuel-wood consumption. For this reason, the issue of fuel-wood is supposed to take both local and environmental dimensions and be at the front burner in Africa's development effort. To address these challenges, measures were taken such as the promulgation of laws and policies to mitigate the perceived effects, in most cases without giving an option to the households (Nwofe, 2013, Geoffrey, 2010). However, scholars like Dovie et al. (2002), Banks et al. (1996), Higgins et al. (1999) and Wessel et al. (2013) raised concerns on this approach, that failing to develop new approach and interventions that promotes other ways of providing affordable renewable energy options and resource management will make the long-awaited fuel-wood crisis a reality with a negative ecological and socioeconomic effects. These concerns are also contained in the Brundtland Commission's report (1987) on sustainable development that advocated for a linkage between ensuring human wellbeing on one hand and living within the limit of nature on the other hand. This means that welfare concerns of the people have to be incorporated in policies that have to do with environmental protection, considering that household's choice to consume fuel-wood as energy is an economic choice that contributes to their welfare. Jolien et al. (2014:1) support the view and suggested that policymakers and practitioners should develop an approach that will better their understanding of the fuel-wood energy sector and in a way that it contributes to reducing the removal of forest and enhance the living condition of the people of the communities involved. A similar suggestion was also made by Geoffrey (2010:85) on the need to streamline the fuel-wood energy sector to improve its structure and proper management that will enhance its economic potentials and promote the development of the rural economy.

Conversely, most researches in South Africa and Nigeria largely focused on negative environmental effects of fuel-wood consumption (Cline Cole et al, 1987, Gbadegesin and Olorunfemi, 2011, Nwofe, 2013, Naibbi, 2013, Cline Cole and Maconachie, 2015, Oluwagbenga, 2015, Musa et al. 2017, Abdullahi et.al, 2017, William and Shackleton 2002, Shackleton, 2006, Madubansi and Shackleton, 2007, ProBec, 2009, HRSC and DoE, 2012, Wessels et al. 2013) instead of looking on how fuel-wood energy sector could be developed into a market-oriented industry that could achieve household energy supply, sustainable resource management, energy security, low carbon growth, employment and poverty reduction. Achieving this will promote economic development and poverty reduction in both South Africa

and Nigeria. Many kinds of research in this area have fallen short of identifying the role of informal businesses like fuel-wood businesses in the supply chain and production and their overall impact on the livelihood of households in urban and rural areas of South Africa and Nigeria. It is a fact that the informal sector in the developing countries has been playing an enormous role in the areas of job creation, economic growth and poverty reduction. With more and more people moving from rural to urban areas due to lack of unemployment, there is the need to explore more business opportunities and find a way of enhancing their growth. Therefore, this study is set to explore these opportunities by contributing to the understanding that, since fuel-wood will continue to become one of the major alternative energy for households in South Africa and Nigeria in the nearest future, there is the need to develop a sustainable and profitable fuel-wood energy sector. The following three key issues are essential towards achieving this target, firstly, understanding the dynamics and socioeconomic variables of fuel-wood energy consumption, secondly, understanding the contribution of fuel-wood business to the livelihood of the household traders and finally, understanding the funding of the fuel-wood energy sector.

1.1.1 Fuel-wood energy Consumption and Environment

This study is of the view that fuelwood consumption is no longer recognized as the principal cause of deforestation. Many studies have shown that the forest ecosystem has a regeneration potential that can easily offset the quantities of wood extracted. As a result, not causing the forest stock to decline permanently as generally portrayed. Therefore, removal of fuel-wood for energy is not the likely reason for deforestation beyond what clearance for agriculture, commercial and residential development and other permanent land-use can cause (Dewees, 1989; ESMAP, 2001; Arnold et al., 2005). For example, Nigeria's National Land Development Authority (NALDA), a project introduced by the military government to increase crop production and create more land for farmers led to the clearance of more than 28,000 hectares in just one year (1992 to 1993). This action has contributed a lot to reducing vegetation in the area causing deforestation (Odihi, 2005). This may then question the arguments put forward by many studies to justify fuel-wood consumption as a major driver of deforestation in the country. Scholars think that the issue of deforestation has been politicized. Forsyth (2003: 33-36) and Adams (2009: 242-243) argued that it is difficult to ascertain the definition of deforestation and establish reliable data on the rate of forest loss. Understanding the local dynamics of forest cover change and economic, environmental and social processes at work was encouraged (Naibbi. 2013). Besides, knowledge of deforestation causes and underlying factors on forest removal is needed to reduce the generalization (Eckholm et al.1984) states that there is a need to seek for local-specific knowledge of the underlying cause of deforestation. On the issue of greenhouse gas emission, the Massachusetts Sustainable Bio-energy Initiative (2008) argues that, if land that produces wood is allowed the opportunity and time to become forested, the emission of net green gas produced as a result of burning wood is roughly equal to the amount a tree can absorb during the growth and less than the amount emitted by fossil fuel burning. for as long as the land producing the wood is allowed the opportunity to grow and become forested, the net greenhouse gas emissions of wood-burning systems are much less than those generated by the burning of fossil fuels. Fuel-wood contains less amount of heavy metals and sulfur when compared to oil and coal. Thus, sustainable fuel-wood supply practice that is environmentally friendly could be possible.

1.2 Research Problem/ Rationale of the Study

Results from studies on Nigeria's fuel-wood situation suggests that households are reverting to the use of fuel-wood. For example, a study which investigates consumption patterns of fuelwood among households in Kano, Northern Nigeria over at least two decades by Maconachie et al. (2009) made an interesting revelation that most families are reverting to fuel-wood for domestic activities despite the experience of using other modern cooking fuels in the fast. The reason given was that high prices of kerosene and other domestic petroleum products made fuelwood an attractive substitute for the households in the area. Naibbi and Hearley (2013) linked this phenomenon to inequality in the spatial patterns of fossil fuel

supply in the country. Similarly, in South Africa, the study of Matsika et al. (2013) on fuel-wood consumption strategy of the households in villages of Athol and Welverdiend located in the Bushbuckridge Municipality of Mpumalanga Province, showed an interesting scenario where 68% of the rural households that have electricity still use fuel-wood as primary source of energy to meet their day to day household needs, even as the wood becomes more expensive. Their reason for clinging to fuel-wood is primarily cost-saving for using electricity. This strategy will allow households to invest in other economic activities that will generate other incomes to satisfy other necessities such as food, children's schooling and clothing instead of spending on electricity. Additionally, Madubansi and Shackleton (2003) found that the mean household fuel-wood energy consumption rate over eleven years had not changed. The reason given was that the increase in the price of fuel-wood was well below that of other fuels. Even households that have financial means to afford electricity are using fuel-wood and their money is kept as a safety net because fuel-wood remains low-cost energy.

From all indications, fuel-wood consumption in South Africa and Nigeria is becoming inescapable like in many of the developing countries. However, many scholars have the belief that fuel-wood consumption is the major cause of deforestation (Mortimore & Adams, 2001 & Odihi, 2003, Wessels et al (2012) Naibbi, 2013). However, the modeling of the Sahelian vegetation in Sub-Saharan Africa (including South Africa and Nigeria) by Anyambaa and Tucker (2005:596-614) and Olsson et al. (2005:556-566) had brought a new dimension to the causality between fuel-wood consumption and deforestation. The studies showed that the vegetation in the region is increasing instead of decreasing. Naibbi (2013) also conducted a study in the Yobe State, Northern Nigeria between the two periods (1987 and 2005). His results partially corroborated the findings of Anyamba and Tucker (2005) and that of Olsson et al. (2005). Even though the study concluded that there was a drastic reduction in vegetation in most of the periods but contended that the causes of the reduction of vegetation are apparently difficult to be explained by any single either anthropogenic or physical factor. More studies are pointing to the fact that local fuel-wood collection could not be the main cause of deforestation and rarely the primary source of forest removal, clearance of forest for road construction, housing, agricultural, overgrazing, and overpopulation are contributing factor other than only fuel-wood (Dewees, 1989; ESMAP, 2001, Mahiri and Howorth, 2001; Ali and Benjaminsen, 2004, Arnold et al., 2005, Bensel 2008 and World Bank, 2011). It is imperative to mention that, the studies of Anyambaa & Tucker, 2005, Olsson et al. (2005), Mahiri and Howorth (2001); Ali and Benjaminsen (2004), Arnold et al., Bensel (2008), World Bank, (2011) and Naibbi (2013) did not in any way change the negative perception attributed to fuel-wood consumption as the major cause of deforestation in the Sub-Saharan African countries, thus frustrating the development of fuel-wood energy sector. For example, Petrie and Macqueen, (2013:1) reported biomass to have the largest renewable energy source in South Africa, mostly in form of fuel-wood for cooking and heating that can be used for both household and industrial energy. Also, the 2003 White Paper on Renewable Energy in South Africa identifies biomass as an important source of low- carbon renewable energy. However, to date the biomass energy sector is not well developed in South Africa due to the concerns that increasing fuel-wood use and other biomass might threaten water availability, biodiversity and domestic health, and questions South Africa's carbon-neutrality. A similar situation is found in Nigeria, for instance, the Nigerian Renewable Energy and Energy Efficiency Policy (2015:12) recognizes fuel-wood biomass as an alternative energy resource that can be harnessed. Also, the Federal Ministry of Environment (2001) is convinced that biomass technology needs urgent improvement to enhance the efficiency of fuel-wood production and use thereby substitute modern energy usage. But Nigeria's fuelwood energy planning and policy hinges only on the reduction of fuel-wood production instead of increasing or diversifying supplies to meet the demand of households in a sustainable manner (Cline-Cole and Maconachie,2015:22).

From the above, it can be seen that examining domestic fuel-wood energy consumption will give us valuable insight into the dynamics of household energy consumption in both countries. In developing countries like South Africa and Nigeria, studying domestic fuel-wood energy consumption is necessary

since fuel-wood account for a large share of household energy source, and household fuel-wood consumption is a very important indicator in the level of economic and business activities as well as poverty and standard of living of a country. The recent trends of domestic energy consumption in the countries are showing many households are reverting while others are still using fuel-wood as an energy source despite the presence of modern energy. Therefore, understanding the level of domestic fuel-wood energy consumption will shed light on energy policies and programs as they provide an estimate of how fuel-wood energy consumption will be affected by socioeconomic variables and government policies.

We have to know that an average South African household spends 14% of total monthly income on energy needs, and the international benchmark is this is 10% for energy poverty. Meaning that many South African households have fallen in the category of energy poverty. According to a study, energy poverty has been established on close to half of the South African households because 74% that are in the poorest quintile are energy poor. Even high-income households, 13% of rich quintiles are energy poor because of the burden of high electricity prices (HSRC and DoE, (2012:1). The situation in Nigeria is even more extreme, despite Nigeria is the energy giant in Africa and oil-rich country. The majority of the poor households earn less than 2 dollars per day and 0.4 dollars is spent on energy every day This translates into approximately 20-40% of the income earned by the households being spent on energy alone (Olisa and Nria-Dappa, 2009). Not only that, 40 percent of the population of the country do not have electricity supply due to poor energy infrastructure, while the supply of fossil fuels is so unreliable coupled with high cost. The over-dependence on fuelwood in Nigeria is simply due to product easiness, availability and affordability if compared with modern forms of energy (Maconachie et al., 2009, Naibbi and Healey, 2013). The ongoing dependency on fuel-wood as energy by South African and Nigerian households requires careful attention. Fuel-wood can be a viable renewable energy option that can supplement more difficult modern forms of energy if sustainably harvested. However, it can also lead to deforestation and energy poverty for lower-income households if unsustainably exploited.

Given the above issues, it is imperative to further investigate and analyze fuel-wood energy consumption in South Africa and Nigeria. In developing countries, economic development had hitherto been mainly been defined with the pursuit and sustenance of balanced economic growth. Since the new millennium, the essence of development has shifted beyond minimalist economic definitions, to include balanced incorporation of social welfare focusing on the core areas like environmental sustainability and social development (Tika, 2018:1). World Bank (2011:1) underscores this within a complex arrays of investigations at different scales and draw a renewed understanding on the need to develop a wood-based biomass sector being 81% of the Sub-Saharan African households consume it for domestic energy exceeding any other region in the world, and the sector is playing a complementary in employment generation for the poor segments of the society that are unemployed in the formal sector. Furthermore, Nosiru et al. (2013:1) argue that forest resources (fuel-wood inclusive) are extremely important more especially for rural livelihood providing food, medicine, shelter, fuel, and cash. However, the statistics on the contribution of forest products to livelihood are extremely poor.

1.3 Hypotheses

To meet the research objectives and research questions raised in this study, hypotheses need to be formulated and tested. The study developed three hypotheses to make a comparative analysis of domestic fuel-wood energy consumption between South Africa and Nigeria and recommend how the fuel-wood energy sector can be developed into a market-oriented sector in future energy policies of South Africa and Nigeria. The hypotheses are:

(H_1): There is [no] significant difference between South Africa and Nigeria on the influence of socioeconomic and demographic factors namely (Gender, Monthly income, education level, age,

employment status, household size, marital status and structure of the house) on domestic fuel-wood energy consumption.

(H_2): There is [no] significant difference between South Africa and Nigeria on the contribution of fuel-wood business on trader's livelihood as per income, food security, health security, and children education.

(H_3): There are [no] significant factors affecting fuel-wood funding in Nigeria

1.4 Research questions

Against this background, the enormous social and economic significance of fuel-wood is huge but fuel-wood as popular household energy has been sidelined unlike commercial energy (kerosene, LPG and electricity). This plethora of challenges necessitates the need for an investigation into fuel-wood energy consumption in South Africa and Nigeria considering that the two countries have high relevance in Africa and the globe, and there has been no attempt to compare fuel-wood consumption between them. Therefore, the present study wants to answer the following questions;

1. What is the impact of socioeconomic and demographic variables on domestic fuel-wood energy consumption in South Africa and Nigeria?
2. Does the fuel-wood business improve the lives of fuel-wood traders in South Africa and Nigeria?
3. What factors affect fuel-wood energy sector funding?

1.5 Objectives

The objective of the study was to make a comparative analysis of domestic fuel-wood energy consumption between South Africa and Nigeria. The study will empirically examine the dynamics and impact of socioeconomic and demographic variables on the level of fuel-wood energy consumption, the contribution of fuel-wood energy business to trader's livelihood and funding of the fuel-wood energy sector in the province of Western Cape in South Africa and Katsina State in Nigeria. To achieve the overall aim of the study, the following secondary objectives are set:

1(a). To analyze and compare the dynamics of domestic fuel-wood energy consumption in South Africa and Nigeria.

(b). To estimate the impact of socioeconomic and demographic variables on the level of domestic fuel-wood energy consumption in South Africa and Nigeria.

2. To analyze the contribution of fuel-wood business on traders' livelihood in South Africa and Nigeria as per income, food security, health security, and children's education.

3. To determine the factors affecting fuel-wood energy sector funding from perspectives of stakeholders (a case study of Nigeria).

1.6 Significance of the study

Firstly, research shows that world oil my likely run out in the nearest future, and the cost of generating electricity in the developing countries is becoming very high. A viable renewable energy system is needed that is less and less dependent on modern energy. Wood energy is seen as a perfect substitute (couture et. al, 2012:20). Hence, this research is needed to provide information that can help both the private and public sectors to develop a realistic energy master plan that will promote business development within the economy thereby attracting investment. This research will assist the investors and policymakers to understand the level and significance of fuel-wood energy so that they can strategically invest to address various household energy challenges, thereby increasing economic growth. It is worthy

to mention that increasing economic development in Africa is automatically increasing the demand for energy, and consumers can use energy portfolios to satisfy their growing energy needs. Even though modern energy is needed to satisfy the additional energy requirement of the households of these emerging economies, many people in both South Africa and Nigeria will continue to use fuel-wood energy for other needs like cooking and heating.

Secondly, it is noted that the concerns of the policymakers overconsumption of fuel-wood arise from the perceived impact of harvesting and the use of fuel-wood on the natural environment such as deforestation, loss of biodiversity and loss of environmental amenities and services. Considering the importance of fuel-wood energy in the rural and urban areas of South Africa and Nigeria, policies aimed at reducing fuel-wood supply will have a serious impact on the livelihood of people, most especially the rural population. The decrease in fuel-wood supply may mean less pressure on the forest in the short term. However, if those people along the fuel-wood value chain find that they cannot sell wood for profit they may turn to other sources of income such as agriculture, for which land previously used for forestry may be acquired. The consequent loss of income from selling fuel-wood could also increase the number of people moving from rural areas towards the towns causing rural-urban migration. Studying the contribution of fuel-wood business on the livelihood of traders using micro-level data will provide insights that inform policymakers on how they can intervene and resolve the problem.

Thirdly, United Nations assessments suggest that the average percentage composition of GDP by the informal sector in the developing countries ought to be 41% and for countries in transition, 38 % (Henshaw, 2017:1). Studying the fuel-wood energy sector that has a high level of informality will unpack its various components to better understand how the sector works and why people are specifically involved rather than other areas of the informal economy. This expansive approach unveils and provides deeper insights into the various components and multifaceted characteristics of the informal fuel-wood energy sector so that governments will find a way of enhancing it.

Finally, comparative studies on domestic fuel-wood energy consumption in emerging economies are few. Therefore, comparing the results will provide more information on the determinant factors for fuel-wood consumption in emerging economies. The results in the studies will reveal the differences in the drivers of fuel-wood consumption in each economy. Thereby, indicating the policy direction that needs to be taking into consideration in energy planning in each economy. It should be noted that the author does not know of any study that was conducted on a comparative study in the area of domestic fuel-wood energy in South Africa and Nigeria.

1.7 Structure of the study

The preceding section provides the background/stylized facts on fuel-wood energy consumption in South Africa and Nigeria, followed by issues surrounding fuel-wood consumption and environment. The remaining sections presented the research problem/ rationale of the study, hypotheses, research questions, objectives and significance of the study.

Chapter Two reviews the literature relevant to the study. The review covers issues that dealt with the socio-economic development of South Africa and Nigeria and fuel-wood energy consumption, analysis of modern energy and domestic energy consumption patterns and fuel-wood value chain.

Chapter Three looks at socioeconomic and demographic variables of fuel-wood energy consumption. The chapter unpacked the significance of fuel-wood business to livelihood development using Household Economic portfolio Model (HEPM). It further presents the constraints to the growth of the fuel-wood energy sector.

Chapter Four conducts a theoretical and conceptual review to explain energy consumption in the developing countries and fuel-wood energy consumption in particular. Modern and traditional energy as well as Energy Ladder and Energy Stacking Models that were often used to explain domestic fuel choices

in developing countries which at the same time adequately described domestic fuel-wood energy consumption in South Africa and Nigeria were discussed. Theories of the informal sector, as well as activities of informal sector for both South Africa and Nigeria, were also presented in this chapter.

Chapter Five presents a discussion of the research design and methods, the justification for using a mixed-methods approach in data collection and the method of data analysis.

Chapter Six compares domestic fuel-wood energy consumption between South Africa and Nigeria using data obtained from the field.

Chapter Seven draws a summary of the key findings, conclusions and major recommendations based on findings presented in the analysis chapter. The chapter also discussed limitations and proposes areas for further research.

CHAPTER TWO: FUEL-WOOD ENERGY CONSUMPTION AND VALUE CHAIN

This chapter reviews the socio-economic development of South Africa and Nigeria and fuel-wood energy consumption. This was followed by an analysis of forms of modern energy available to South African and Nigerian households, and domestic energy consumption patterns. The chapter also highlighted the fuel-wood value chain through the exploration of different pathways by which stakeholders in the fuel-wood energy sector produced, processed and sold fuel-wood to the final consumers.

2.1 Economy and fuel-wood consumption in South Africa and Nigeria

Household energy use and economic development are interrelated. Many studies have indicated that energy consumption is co-integrated with economic growth (Onwofe, 2013:7, Baban Yara and Saleh, 2010). This study finds it relevant to understand the peculiarities and differences in the economic situation of the two countries in question as they relate to the subject matter, fuel-wood energy consumption.

The economic situation prevailing in South Africa is a significant variable in current energy consumption and the expected future trend. The political transition experienced in South Africa in 1994 is a significant milestone that will continue to shape the social, economic and political landscape of South Africa, especially with ANC driving the policy agenda. South African economy is still a dual economy with the highest and striking inequality rates in the world, perpetuating. Only 3% of the total expenditure is being consumed by 20% of the poorest population in the country, while 65% of the expenditure is used for the wealthiest 20% (World Bank, 2016). The rate of poverty has barely changed in 2016 from 16.6% since 2011 to just marginally to 15.9% (World Bank, 2016:1). However, the level of poverty fell from 33.8% in 1996 to 16.9% by 2008. This is an indication that some progress was made in addressing the issue of absolute poverty in the past decade primarily through extensive social safety net programs but slow employment growth negatively affects household consumption leading to reduced consumption of the households.

Nigeria is the most populated country in Africa with an estimated population of over 172 million people (NPC, 2015), a GDP of $568.5 billion and a per capita income of $1,430 (World Bank, 2015). Strong export of crude oil, but still the country remains among the poorest countries in the world. The level of poverty in Nigeria is very high that in 2013 about 112 million people or 70% of the population were living below the poverty line (Anyebe, 2015:13). The prevalence of poverty rate in Nigeria is very high, it has attained endemic proportions and it is becoming worrisome. However, there was a drop-in poverty rate between 1999 and 2007 to 56.1% due to serious measures taken by Obasanjo administration against corruption, robust agricultural policies and increased foreign direct investment (Inibehe & Ibrahim, 2014:6). However, these achievements could not be sustained by the incoming administrations especially after the taking over of the opposition government. Given the aforementioned statistics, it is no longer debatable that poverty is equally high in Nigeria.

The relationship between poverty and fuel-wood consumption is quite clear in South Africa and Nigeria. For instance, the notable studies of Human Science Research Council HSRC and DoE (2012:1-118) and ProBec (2008:1-66) have reported poverty among the poorest sectors of the South African population makes proportion of the households unable to meet the basic needs, the consumption of cheaper fuel-wood is common among the poor and low-income households. In the case of Nigeria, the Nigerian National Bureau of Statistics, in their attempt to understand Nigeria's fuel-wood consumption patterns, undertook an analysis of poverty levels and fuel-wood consumed by region. North-east and North-west regions where the level of poverty is highest consumes more fuel-wood than the rest of the regions (95.9% and 95.3%). The Southwest and South-east regions that are economically better up consumes less fuel-wood (54.9% and 78.0%). This statistic expounds a strong relationship between poverty and the use of fuel-wood in Nigeria (Zaku et. al, 2013:87) as shown in table 1 below;

Table 1.1: Poverty rate and percentage of wood as fuel source in Nigeria

Region	Poverty Rate (%)	Percent of Wood as Fuel Source
North-east	72.2	95.9
North-west	71.2	95.3
North-central	67.2	86.4
South-west	43.0	54.9
South-east	26.7	78.0
South-south	35.1	72.7

Source: Zaku et al, (2013:87).

On the significance of fuel prices on household fuel consumption that have been explained in many energy literature. Most studies point market prices for fuel-wood, kerosene, electricity, coal, charcoal, and LPG as a major determinant of household energy consumption (Heltberg 2005, Gupta and Kohlin (2006), Akputa et al (2011), Zhang and Koji (2012), Muller and Yan (2016). Empirical evidence had shown a negative own-price effect on the quantity of fuel consumed and the probability of choosing the fuel. Adam (2010:9) observed that electricity costs in South Africa have the potential effect of pushing poor households to either change their behavior through energy savings or switch back to unsafe and insufficient fuels such as fuel-wood or paraffin. Millions of South African households that have a connection to the national grid are not able to pay for electricity because electricity tariffs have tripled in real term since 2005.

Although the South government had introduced the idea of Free Basic Electricity (FBE) as a policy in 2003 and allocated 50kWh on monthly basis for free to assist the poor to meet their basic need for lighting and media plus a limited amount for water heating and cooking. Evidence emerging showed not all indigent households receive the FBE subsidy due to implementation failure at the municipal level (South African Local Government Association 2012). About 3.3 million poor households earning less than R4150 a month that are connected to electricity but are not benefiting from the FBE program (Franks and Prasad, 2014:1). Many believed that fuelwood consumption does not decline with the availability of electricity, but electricity use was shifted to lightening while fuel-wood becomes the energy use for cooking and boiling that requires a high thermal application. Apart from the expensive nature of electricity in South Africa in fulfilling the range of daily energy chores that is required, the prices of the electrical appliances are sometimes beyond the reach of many homes that operated on low- and unpredictable-income levels.

There is a big difference between South Africa and Nigeria in the price impact on energy. The high energy price in Nigeria is mostly a result of the decline in the oil price causing hardship on Nigerian households. To address the imbalance created by low oil prices, the government has been consistent in introducing some measures like structural Adjustment Program (SAP), import control and subsidy withdrawal. The withdrawal of petroleum products subsidy could be the reason for the price increase in petroleum products. The increase has put households at risk of using energy for their daily needs. Most of the domestic energy has become unaffordable, especially for low-income households across the country. These changes in the household imply that the majority of them shifted to fuel-wood that is cheaper and available. Abd, Razack at el. (2012:18) in their study on North Central Nigeria reports some increase in the prices of LPG and kerosene where the cost of LPG increased to50 naira in 1998 from 0.40 naira in 1991. Again, the distribution challenges had given undue advantage to the kerosene hoarders, making it between N115-N125 per liter or even above these prices in 2001. Similarly, the price of 12.5kg cylinder of LPG rose to 3900 in 2012 from 200 naira in 1991, meaning that the price has skyrocketed within ten years. Electricity tariff has also been continuously on the increase without even being noticed by the

consumers. Therefore, over 73% of the Nigerian households were affected by the increase in the cost of modern energy, and this predicament necessitated many households to abandon modern energy and shift to fuel-wood. The proportion of consumers using fuel-wood for domestic activities have increased tremendously. It is expected that the households shift from modern fuels to fuel-wood will record high as the government from 2016 after the total withdrawal of subsidies. The cost of kerosene has risen to N180 per liter while at the black market a liter can reach as high as N300. No wonder IEA (2014:443).

2.2 Modern energy access in South Africa and Nigeria

Generally, limited access to modern energy has been reported to have increased the level of fuel-wood consumption in African countries. For instance, Oluwagbenga et al. (2015:57) have attributed an increase of fuel-wood consumption in Nigeria to unstable electricity and petroleum products supply. While Aitken (2007:24) reported extensive use of fuel-wood across households that are not connected to electricity in the rural areas of South Africa. Therefore, a review of modern energy access is needed to have a clear understanding of issues surrounding fuel-wood energy consumption for both South Africa and Nigeria.

2.2.1 Electricity.

Before 1994, the minority white population were the beneficiaries of government energy infrastructure investment for the residential sector to the detriment of the majority of blacks (HSRC& DoE, 2012:1). The success story of South African electricity generation is hinged on the power sector reforms which has greatly assisted many households to have access to electricity since 1994. The power policy was shifted towards making provision of electricity to the disadvantaged blacks as the cornerstone of the development policy of South Africa under the slogan "Access to electricity for all". The policy made it in such a way that grid electricity to become for all including people in the remote areas of the country. In 1998, the energy white paper was released to provide a framework and guidelines to the government to achieve the goal of universal household access to electricity putting more priority on the poor households at the same time alleviating negative environmental impact. The white paper contains the following;

a) Tackling the challenges facing poor man's energy requirements
b) Provision of low-cost but high-quality energy to industrial, mining and other sectors as a way of enhancing the economy.
c) Providing ways of achieving resource management and environmental sustainability.
d) Providing level playing ground that will attract foreign energy investments.

Also, the government of South Africa in 1995 established a regulator known as National Electricity Regulator (NER) to succeed Electricity Control Board that was established in 1987 under Act No. 41 to regulate the electricity supply industry in the country. NER will exercise its power through national jurisdiction by licensing of generators, transmitters, and distributors across the country. NER's role is to ensure customer's electricity requirements are met and the electricity supply industry is regulated. Initially, the NER task was the development of a financial model that will lead to electricity connection to many households for the National Electrification Programme.

As South Africa is recording successes in electricity accessibility, Nigerian is battling with electricity shortages. Electricity shortages have become one of the setbacks facing the nation. Electricity supply has been erratic and epileptic in the country to the extent that it has taken a new political dimension as captured by Richard Dowden (2011) as cited in Cline-Cole and Maconachie, (2015:8) in the following exchange:

During the election in April (2011), I was talking to a woman in Kaduna standing in the queue waiting to vote. I asked her "What are you voting for?" she replied "Power". "What - political power?" I said. "No" she replied, "Electricity".

The above discussion exposed the deteriorating state of electricity in Nigeria. To date, only 40% of Nigerians have access to electricity (NREEP, 2015). Studies have shown the electricity-generating figures of Nigeria is very poor that it cannot meet half of the demand of Nigeria (Sambo, 2008:33, Naibbi and Healey, 2013:161, Nwachukwu et al., 2014:7). According to Oyedepo (2012:13), the electricity generation in Nigeria cannot be compared with what is obtained in other African countries particularly Southern Africa Development Community (SADC) countries such as Botswana and South Africa. Serious move for the rehabilitation of Nigeria's existing power infrastructure started in 1999 during the administration of President Obasanjo. National Integrated Power Project (NIPP) was initiated in 2004 with the quest to boost electricity supply through the gas-powered station that was launched. The National Electric Power Policy (NEPP) developed in 2001 and culminated in the Electricity Power Sector Reform Act. 2005 and finally led to the formation of the Nigerian Electricity Regulatory Commission (NERC) provided the statutory basis for the privatization of the power sector leading to setting up Power Holding Company of Nigeria (PHCN). It also led to the unbundling PHCN into 18 successor companies that formed six generating companies (GENCOS) and eleven distribution companies (DISCOS) and establishment of the Transmission Company of Nigeria (TCN). The economic rationale of this policy was to establish an electricity market that has long term effects in Nigeria through efficient services by multiple operators under a competitive environment. However, the success of electrification in Nigeria can be challenging (Adeniji and Osisiogu, 2014). Despite the vision of Electricity Power Sector Reform of generating 40000MW of electricity by 20:20 but as of 2016 Nigeria generates less than 6000MW due to insufficient supply of gas to thermal plants and funding constraints.

Unlike Nigeria, South African access to electricity is overwhelming due to government commitment in the energy sector, thereby making households electricity access an important government in their policy agenda. In achieving this, the government-initiated national electrification program since 2001 under Energy Department named Integrated National Electricity Programme (INEP) to give low-income households electricity. To achieve this, ESCOM (South African Electricity Company) targeted 1.75 million households at 300,000 households per year. The project intended to raise the level of South African national electricity access to about 66% by 2001 (rural 46% and urban 80%) (NER, 2002). Also, the programme targeted all schools and clinics as well as formerly disadvantaged communities. The outcome of the above policy was overwhelming, as it dramatically increased household electricity access to 87% in 2012 from 36% in 1994 (5.7 million households), (DoE, 2012). Even though ESCOM is in a deep financial crisis that can undermine these achievements. South African households are beginning to experience load shedding like their Nigerian counterpart.

Despite ESCOM's deep financial mess, still, the company is better than the GenCos, TCN, and DisCos operating in Nigeria. These are companies that are responsible for the generation, transmission and distribution of electricity to urban and rural areas of Nigeria. However, they could only generate 4000MW or 6000MW daily from the estimated 8039MW of installed capacity. According to (Olise and Dappa, 2009:3 and Odularu and Okwokwo, 2009:) that out of the meager megawatts that are generated, the electricity remain of poor quality and supply is always erratic. As a result, many people have to depend on their power generators to meet their demands. As Opara (2013) reported in the Punch Newspaper 31/1/2013 edition that both residential and about 90% of industrial customers have installed their generators bearing the cost. United Nations Industrial Development Organization in 2009 confirmed that notable international companies and organizations have been on a generator for 365 days for the whole 24 hours of the day. Recently, Ohiare (2018:17) reported in Daily Trust Newspaper that Nigeria spends an estimated 5trillion Naira ($14billion) annually for importing, fueling and maintaining generators. However, President Muhammad Buhari's 2018 New Year address, stated his government's determination in addressing the lingering electricity problem facing the country. He highlighted some of his achievements in office in the area of electricity supply;

1. Repair of Afam power station which added 110MW in 2017 and another 240MW will be added in 2018 through private partnership.
2. Katsina's power project is being tested and about to produce 10MW.
3. Zungeru 700MW hydroelectric power project is due for completion in 2019.
4. 40MW Kashimbilla hydro plant and 215 Kaduna Gas/LPG diesel power plants will be completed in 2018.
5. Mambilla hydroelectricity power project has taken off which will generate 3050MW and to be completed by 2023.

2.2.2 Liquid Paraffin/ Kerosene

Paraffin, also known as kerosene, is one of the widely used conventional energy for lower-income households in South Africa. Its popularity can be due to its comparative affordability, availability, convenience, versatility, and ease of purchase, transport, and use (Paulsen et al, 2010:2). According to Statistics South Africa (2007), approximately, 14.8% of households living in South African consume paraffin as energy for cooking, representing approximately 1.8 million households. Moreover, the study of PASASA by Paulsen et al. (2010:21-22) showed significant levels of paraffin consumption among households. According to them, paraffin and electricity were the popular energy types among South African households, while fuel-wood; gas, coal, and candle were less widely used. This study corroborated the data provided by Statistics South Africa (2007) that showed paraffin is used for cooking (85%), lighting (41%) and heating (32%). The reason for the wide usage of paraffin by South African households despite the widespread electrification is that electricity alone is unlikely to satisfy the household energy needs especially with continuous ESCOM crisis (insufficient generating capacity, aging infrastructure, reliance on coal high emission levels, financial challenges and hike in tariff structure, etc).

However, a recent study by Franks (2014:82) in Cape Town has presented a different scenario on paraffin use among households in South Africa. The findings showed that Integrated National Electrification Program (INEP) has successfully displaced paraffin as the main fuel for lighting and cooking for many poor urban households in Cape Town city, as it can be seen in the decline of kerosene expenditure between 2005/06 and 2010/2011. The study however clarified that in winter, households consume paraffin and fuel-wood for space heating. Consumption of paraffin in South Africa is decreasing due to the successful implementation of the Integrated National Electrification Program. Other reasons for the decline in paraffin usage include the Free Basic Electricity Programme (FBE) for the poor households and the escalating cost of kerosene as well as limited availability and suitable appliances (Statistics SA, 2007). As reported by Trura (2009:3) that the reduction in the consumption of paraffin by the households experienced in 2008 was due to the price of paraffin has escalated. The price of paraffin is driven by a violent spike on the prices of oil making it difficult for consumers that do not have the disposable income to cope, many of them have no option than to cut back their supplies.

In Nigerian, paraffin (popularly known as kerosene or HHK) is used for lightening in the rural areas, while for cooking and boiling in the urban areas (Olise & Nria-Dappa, 2009:3). In 2016, NBS showed the declining household disposable income had lowered down the amount of kerosene being used in Nigeria from 25.7% to 195.8 million liters in the third quarter, against 263.5 million recorded in 2015. The high cost of kerosene in the market in the form of a constant increase in price by successive governments by way of de-regulation and hoarding by wholesalers makes kerosene a difficult fuel in Nigeria. Abd'razaq et al (2012:20) showed price increase on kerosene has made households drastically reduce kerosene consumption. Between the period of 2004 and 2008, kerosene price per liter jumped from N 24 to N 50 naira and by 2009 and 2012, it has skyrocketed to N150 and N200. De-regulation and malpractice of kerosene middlemen have been the challenges of kerosene in Nigeria. The same period witnessed an unprecedented consumption of fuel-wood in the region from 10% in 2000 to 45% in 2008 and 65% in 2012.

Former Minister of Petroleum Resources Mrs. Diezani Allison-Madueke has explained the challenges facing kerosene supply in Nigeria at the senate chamber during her confirmation as minister of Petroleum Resources. According to testimony that Nigeria has sufficient kerosene but marketers are the ones that hoard the product because Nigeria's type of kerosene has the same quality as aviation fuel. Marketers will buy at a cheaper rate and sell to the aviation industry at a higher rate. This malpractice in the sector creates an artificial scarcity of the product, making it very expensive.

The difference between South Africa and Nigeria in terms of kerosene consumption is that South Africa is only confronted with high prices of kerosene while Nigeria is faced with both high prices and shortages in supply as a result of hoarding by the middlemen. Furthermore, South African households are less dependent on kerosene – it is not their primary source of energy. Conversely, the higher-income households in urban and rural areas of Nigeria use kerosene as one of their main energy sources.

2.2.3 Liquefied Petroleum Gas (LPG)

Liquefies petroleum gas is a clean and efficient energy source used by households with superior burning characteristics, is popularly referred to as cooking gas is not widely used energy for South African households. According to Franks (2014:84), gas is not a likely substitute for even electricity by poor households. Despite this, in KwaZulu-Natal and Eastern Cape provinces, a study conducted by Aitken (2007:23) has indicated some degree of LPG usage, approximately 50% of the households use gas for domestic activities.

Nigeria produces LPG in a large quantity as it occupies the sixth position in LPG production in the world, and coming second in the African continent. The gas reserve is estimated at 170million cubic meter feet, making it the tenth-largest gas reserve in the world. As Nigeria is occupying the sixth position in LPG production in the world, it is the lowest country in Africa in terms of LPG consumption. The per capita consumption of LPG in Nigeria is far below South Africa even though about 1.5 million metric tonnes per annum potential exist in the country. For a country of over 170 million that is supposed to be consuming at least one million metric tonnes of LPG yearly, Nigeria's per capita consumption of LPG is far below South Africa. Consumption of cooking gas in Nigeria in 2013 stood at 0.5 kg per capital as against 5.5 kg per capita in South Africa. Based on national consumption estimates of 2013, Nigeria consumes 30% or 250,000 tonnes of LPG. This is low when compared to the production or output of 850,000 tonnes of LPG earmarked for domestic utilization in 2013 (LPG consumption survey, 2013). According to Sambo (2008:34), 80% of the gas consumed in Nigeria is for electricity generation but the household sector consumes very negligible quantity. In 2015, some remarkable improvement in LPG consumption has been recorded to about 1.8kg per capital (NNPC, 2015). Even at that, Vice President of Nigeria Yemi Osinbajo as reported in Vanguard Newspaper of 30th November 2015, lamenting the high fuel-wood and kerosene consumption witnessed in Nigeria is the result of low LPG usage of LPG.

The poor and disappointing consumption of LPG in Nigeria may also not be connected to the price of the product which is beyond the reach of the average Nigerian. Another issue is that most of the appliances use in LPG, for example, gas cookers, adaptors/regulators, cylinders and horses are all imported products and are priced highly above the reach of many households. Additionally, most Nigerian families are not fully aware of LPG, even if they are aware, they associate the use of LPG to status thereby giving it an elitist connotation. For both South Africa and Nigeria many households refrain from using LPG due to safety considerations, hence fuel-wood and other energies become a better source of energy.

2.3 Domestic energy Consumption Patterns in South Africa and Nigeria

South African households have shown consistency in energy consumption behavior over the last twenty years. The majority of the households, especially the lower-income households relies on multiple sources of energy to meet up with their day to day energy needs (HSRC and DoE, 2012:19). There is a considerable difference in the ways electrified households consume energy to meet their basic energy needs from those households that are not connected to electricity (non-electrified). In the last decade,

there has been an increase in South African household's electricity uptake for lighting and cooking (Stats SA, 2011). Therefore, households connected to electricity utilize electricity for either lighting, cooking or heating. Even though, fuel-wood, candles, paraffin, and gas are being relied upon by some households (HSRC and DoE, 2012:19).

The uptake of multiple sources of energy by South African households could be due to many reasons. One of these reasons is that electricity is not only too expensive to meet the daily energy needs of households but the price of electricity appliances is too high for many low-income households. Another reason is the real cost of electricity that is heating the lower-income households. As a result, many of them have to rely on multiple sources where they use the different types of energy either intermittently or simultaneously. South African households are using multiple energy sources because of the opportunity costs associated with electricity, it is the reason other forms of energy like fuel-wood, paraffin, and candles that do not decline even when electricity becomes available. Most often due to the cost of electricity, many households are avoiding electricity in activities that are high energy consumption in nature. No doubt electricity has driven South African households up the energy ladder, meaning that from biomass consumption to electricity, but in most of the rural areas, electricity has played a very little impact in displacing fuel-wood due to affordability reasons (Madubansi and Shackleton, 2006:11, ProBEC, 2008:31)
Information on table 3.1 below, adapted from HSRC and DoE (2012) depicts how formal and informal households in South Africa utilize multiple energy sources with electricity being the dominate while rural areas and farms use more of fuel-wood for their domestic activities.

Table 2.1: Household energy use pattern by geographical location and province in South Africa.

	Electricity	Candles	Paraffin	Firewood	Gas	Coal	Drycellbatteries	Solar system	Generator	Car batteries	Base N
South Africa	88	47	37	32	19	7	3	3	1	0	3000
Geographic location											
Urban formal	98	30	25	11	22	5	4	4	2	0	1885
Urban informal	70	51	62	17	12	12	4	2	2	0	243
Rural, trad. auth. areas	79	77	50	74	15	7	2	2	1	0	626
Farms	70	66	45	58	17	13	2	5	3	0	246
Province											
Western Cape	99	24	26	14	19	0	2	1	0	0	393
Eastern Cape	78	48	72	48	16	5	2	3	2	0	337
Northern Cape	98	52	16	37	25	4	3	4	2	1	157
Free State	96	35	66	19	26	6	7	11	5	1	224
KwaZulu-Natal	80	57	37	37	26	9	3	3	1	0	579
North-West	85	77	42	51	18	6	6	5	1	0	218
Gauteng	89	30	28	8	19	7	5	3	2	0	590
Mpumalanga	89	70	23	45	12	26	1	3	1	0	232
Limpopo	91	75	20	70	6	1	2	1	0	0	270

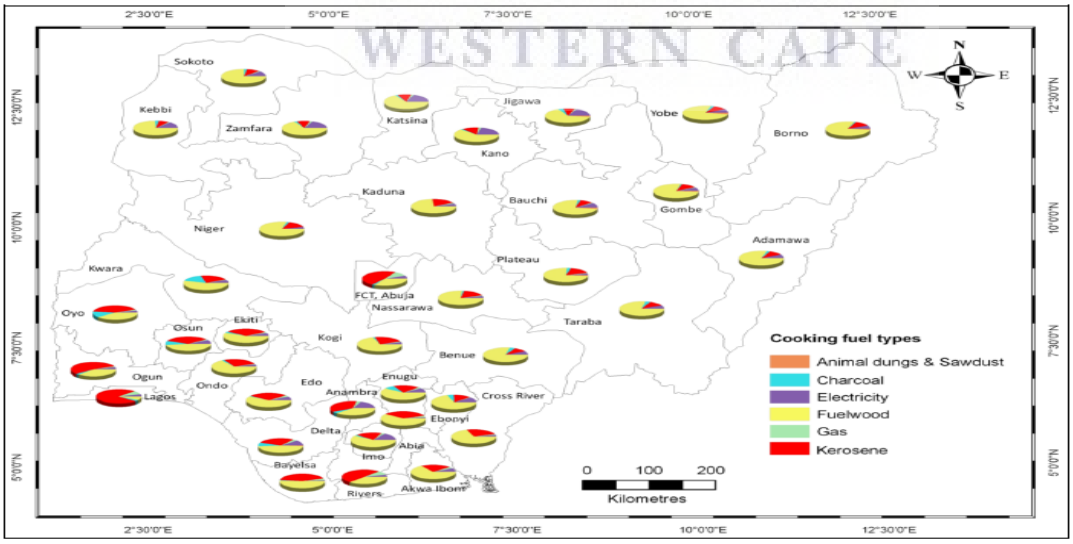
Source: HSRC and DoE (2012:22)

According to the table, electricity use is dominant in the urban formal and informal settlement of South Africa (fuel-wood in the informal areas came third after candle and paraffin). In rural areas and farm

centers, fuel-wood is the dominant energy. The provincial pattern of consumption shows Limpopo province consumes more fuel-wood than other provinces despite the electrification, followed by North West, Eastern Cape, and Mpumalanga. Gauteng and Western Cape Provinces have the least household fuel-wood consumption.

In comparative terms, Nigeria's pattern of household energy use is quite different from South Africa, the household sector accounts for the largest share of energy use by about 65% and cooking accounts for a staggering 91% of the household consumption, then followed by lighting 6% (Oyedepo, 2012:11). As mentioned earlier that is among the major oil-producing and exporting countries (ECN, 2007:3, Cline-Cole and Maconachie, 2015:1), despite that the country is still lagging behind South Africa in term of an adequate, secure and reliable supply of energy. The household energy patterns in Nigeria showed urban households utilize different energy sources to satisfy their day to day energy requirements. This is what is also obtain in South Africa. The difference between South Africa and Nigeria as it relates to urban household patterns of energy consumption is that in Nigeria, fuel-wood, kerosene, and gas are the dominant energy sources with little electricity due to unreliability in supply, while in South Africa electricity dominate with less of fuel-wood, kerosene, and gas. In the rural areas due to lack of electricity and precarious fossil fuel supply driven by poor transportation and middlemen malpractices, fuel-wood energy is second to none in Nigeria. Even South Africa where there has been progress in modern energy supply, fuel-wood consumption is well established in the rural areas. Analysis of domestic consumption of different fuel types by Nigerian households revealed that more fuel-wood is being used for cooking than any other fuel type. The 28,197,085 households in Nigeria (NPC, 2010) showed that only the Lagos state uses less fuel-wood. Out of 2,195,842 households in Lagos State, about 1,771,100 households (more than 80%) solely rely on Kerosene for their domestic cooking and boiling (NPC, 2010). The northern Nigerian households are the largest users. This goes to show that fuel-wood is the most important source of energy followed by kerosene (modern fuel) as the second most important fuel after fuel-wood (in terms of usage among households), the use of kerosene dominates the southern part of the country, particularly in the states of Lagos, Oyo, Rivers, and Ogun. In contrast, more than 70% of households in most northern states use fuel-wood for their domestic cooking and boiling. Below map shows the energy consumption patterns among Nigerian households;

Figure 2.1: Map of Nigeria showing the pattern of household energy use according to states



Source: Naibbi (2013:127).

Information on figure 3.2 above shows that fuel-wood is in almost every state in the federation, meaning that even though there are multiple energy sources in Nigeria, fuel-wood is the most important household energy, then kerosene, gas, and electricity respectively.

2.4 Fuel-wood Value Chain

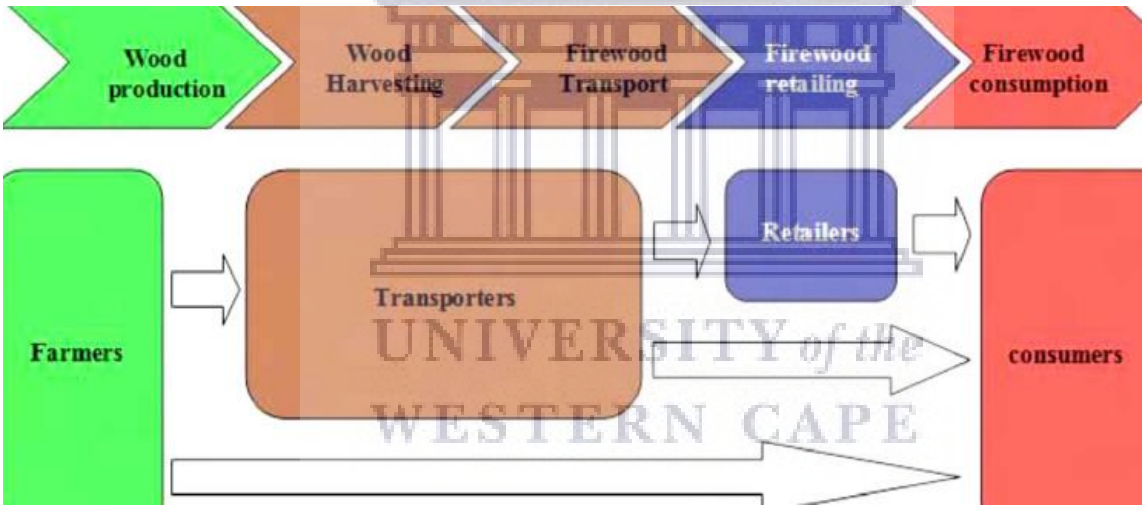
Currently, developing countries including South Africa and Nigeria account for about 90% of global fuel-wood consumption. The dependence on tree products by many households is seen as a form of livelihood strategy. Mechanisms to sustain or revamp income generation through the harvesting of wood for selling is one of the livelihood strategies adopted by households. The degree to which forests contribute to livelihoods is significantly determined by local tenure arrangements, the degree to which management responsibility has been devolved, and how secure any user rights are. Millions of households in the developing world depending on food from forests to supplement their diets especially as emergency food during droughts, famines and war periods. To add on, a billion people depend on forests as a direct source of income or livelihood. Approximately the same number also depends largely on fuelwood for their cooking and heating (Bernard, 2013:66).

In this context, the fuel-wood value chain in the fuel-wood energy sector is a process that helps us to understand the economic flows between the actors. This makes it possible to gauge and interpret the importance of fuelwood at the regional, national or micro scale, its contribution to job creation and income generation, the potential for the creation of fiscal revenue and the impact of the substitution of energy sources (USAID Ghana, 2015:11). A fuel-wood value chain is a tool used to understand the sequence of fuel-wood business activities from production, trading to consumption. It spelled out the role of all the operators in the chain. The value chain leads to the identification of capacities and incentives of the actors where intervention can be made to eliminate the bottlenecks. According to Geoffrey (2010:22), value chain analysis provides a platform that identifies money flow, bottlenecks in the chain and their causes. It also allows us to understand the relationships between fuel-wood business in the chain and other market players, the role of specific market functions and the rules that govern the value chain. The value chain analysis leads to the identification of capacities and incentives of the actors where intervention can be made to eliminate the bottlenecks (USAID Ghana, 2015:11). For example, Eba (2014:21) was able to point out that the entrance of the middlemen in the value chain of the fuel-wood market in Enugu, South- Eastern Nigeria had threatened the poor harvesters thereby discouraged them to supply more to the market, and in turn affected the performance of the market. To have a smooth and favorable framework that will create a condition that will promote competitive enterprises, sustainable jobs and income for local people, there must be a proper value chain.

The engagement in the fuel-wood value chain involves stages that allow for evaluation of the level of each of the operators. The first stage is related to the product flow, how fuel-wood supplies reach the final energy consumers. In rural areas, fuel-wood is a commodity that is collected almost free from the local environment (in most cases, fuel-wood is harvested without paying any fees to the government because of corruption between fuel-wood producers and government officials), while in the urban areas, urban households buy fuel-wood from traders and retailers. Section 2.2 of this study has highlighted how fuel-wood commodity in the urban areas competes with other fuels to satisfy the energy requirements of the households. In this regard, the flow of wood is seen as a rural-urban trading network existing in relation to fuel-wood use in urban areas and the fuel-wood collection practices in rural areas. In both cases, there exists engagement of people with resultant monetary benefit or income. It involves production whereby trees are cut down, chopped to a practical size or requested size, dried, parked and transported to the market for sale. The processes and the impact on the livelihood of traders in South Africa and Nigeria are described by (Nosiru et al, 2013, Madubansi & Shackleton, 2007, Morenikeji et al, 2006, Dovie et al. 2004).

The second stage is the processing of fuel-wood after it reached the dealers from the forest, it can be carried out by the same people involved in the production or by specialized wood processing groups. At this stage, the splitters are hired to split the logs of wood so that it can be neatly parked in bundles. This activity can take several days, depending on the number of splitters hired by the dealer. Furthermore, splitting can equally be done at all levels of retail, because consumer preference for fuel-wood sizes differs. The next stage in the value chain is the distribution and retail stage which comprises of wholesalers (dealers) and retailers (vendors). Wholesalers can be characterized into two groups: those with their transport and those which hire transportation. Wholesalers without their transportation pay a fixed price for a truckload. There are the possibilities that wholesalers who own their transport make more profit than those wholesalers that hire trucks because of the high charges by the truck drivers, more especially during the rainy season where routes are inaccessible. Retailers buy fuel-wood from the wholesaler. Sales are either organized via depots or direct to markets. Sometimes when retailers buy fuel-wood from the wholesaler they also repack the product in smaller quantities for sale in the different neighborhoods. Retailers resell at specialized fuel-wood markets, common markets, at roadsides in local neighborhoods or in small kiosks (Jolien et al, 2014:6).

Figure 2.2 Fuelwood value chain



Source: Geoffrey, 2010:44 and USAID Ghana, 2015:12.

Generally, the fuel-wood value chain employs a significant number of actors such as producers, transporters, traders, wholesalers, retailers, consumers and (traditional and official) authorities that make a livelihood.

2.4.1 Structure of Commercial Fuel-wood Vending

Debates around the nexus between fuel-wood and environmental changes in developing countries have a long rich history and this seems to overshadow the viability of the fuel-wood industry in terms of job opportunity and poverty alleviation in the existing energy literature (Cline-Cole and Maconachie, 2015:17). Cline-Cole, et al. (1987:1) have pointed out that, the process of urbanization in the third World countries involves very large numbers of people, many of whom retain rural habits concerning energy use as a result of scarcity of modern fuels, this situation leads to rural-urban energy crisis where large quantities of fuel-wood are supplied from rural areas to urban areas. Along this line of thought, Brandt (2011:20-23) and Jolien et al. (2014:1-7), Geoffrey (2010:15-28), have stressed the relevance of the fuel-

wood industry as an organized business that provide job security for many families through the process of commercial fuel-wood vending and fuel-wood value chain. Fuel-wood vending is a product of fuel-wood demand by households as a result of fuel scarcity situation. While the fuel-wood value chain is the link between the set of operators performing the functions of producers, processors, traders, and distributors of fuel-wood products to the household consumers through various business transactions (Jolie et al, 2014).

Commercial fuel-wood vending entails the labor involved in the procurement of fuel-wood to satisfy the domestic needs of households. According to Geoffrey (2010:15), the process is characterized by a marked fragmentation of operators (producers, operators, and retailers) who tend to work in isolation on an individual or family basis. On the contrary, Naibbi (2013) described the process as highly organized, having a strong association that if any member of the association commits infraction in the procurement process, the fuel-wood vendors association intervene to save the member from prosecution. However, the two divergent positions are likely to happen, for the simple reason that, Naibbi's (2013) studies was conducted in the northern Nigeria where fuel-wood consumption is unabated and most of the fuel-wood consumed by the households in the area is sourced from government forests and grazing reserves while Geoffrey's (2010) work was conducted in Kenya and Rwanda where household fuel-wood supply came from plantations and there are strict laws that ban the practice of wood procurement from the forest. It is worth noting that commercial fuelwood supplies in South Africa and Nigeria are sourced from government forests, personal woodlots, and farmland or grazing reserves. Sourcing of wood from government forests or grazing reserves is through permits paid to the government by the suppliers (although there may be high levels of corruption taking place among the stakeholders). For farmlands owned by individuals, families, and communities, fuel-wood is often acquired at a price except in cases where the producer or supplier owns the farmland.

Stakeholders in fuel-wood production and trading are broken down below:

a. Professional fuelwood producers/ Traders: This category people are very important in the fuel-wood production activities. They are the people or individuals that send people that are often referred to as fuel-wood harvesters to the forest to cut down trees for fuel-wood. They are the entrepreneurs that use their resources to carry out the activities of fuel-wood production. Fuel-wood producers in some countries often own their woodlot. The wood producers are sometimes referred to as wood harvesters they play the main role in wood production, and are the entrepreneurs that cut down trees for sale. The harvester may own and manage his/her forest. Another feature of fuel-wood producers is that they are the foremen on the site who organize a team of often temporary and local laborers who are involved in the cutting of wood. As mentioned, the fuel-wood business is conducted in an informal way, where the business is solely owned by a single person. In most cases, producer or trader owns a shed in the market (informal office mostly made from local materials). They are also be seen along the streets or shopping centers with heaps of wood where the business is coordinated from these locations. Fuel-wood is sold in either of the two forms;

1. The tree trunk or big logs of woods (purchased as a trunk of wood and then split into pieces).

2. Bundles. This is a neatly packed wood, it could either be from small branches of trees or logs that have been split.

b. Forest cutters: In the fuel-wood procurement process, forest cutters play a significant role. They are the group that enters the forest and cuts down trees. They are always in a group, normally hired by producers.

c. Drivers and their assistants: These are the people who drive the vehicles into the forests and convey wood to the market. Wood is brought to either a middle man or retailers or markets where it then sold directly to the consumers. The transporters may either own or rent the truck. Furthermore, they may either be hired by an entrepreneurial fuel-wood harvester, or by a middle man. Drivers are often men, mostly

urban-based, who travel around production zones to collect wood or travel to a village after being contacted by producer groups. Wholesalers, who have their means of transport, are also sometimes involved in transport and trade. (Jolien et al, 2014:6)

d. Laborers / Assistants: These groups perform two roles in the fuel-wood procurement process. They help in loading and unloading of wood in forests and markets. That is to say, they work in the forests and the market place.

e. Splitters: These are the laborers hired to split logs of wood when it reaches the market from the forest so that it can be neatly packed into separate bundles for consumers to buy.

f. Borrowers: These are the category of people that are directly linked to the dealers as distributors. They take wood in credit from vendors and return the money after fuelwood is sold. Vendors normally give wood to people at a discounted price based on personal trust.

g. Distributors: These are the category of people that sell wood locally either in a wheelbarrow or smaller trucks.

h. Household sellers: These are a group of wood sellers that sell wood in their homes. They are mostly old men and women who cannot go to the market or own a market stand. In Nigeria, married women engage in this kind of business. This class of people either collect (borrowers) or purchase wood at a discounted price from vendors.

i. Wheelbarrow Pushers: When customers buy wood from the market wheelbarrow pushers convey the goods from the market to the customer home at a certain price.

k. Middlemen: Middlemen provide the services of linking producers to consumers. They also provide services for distribution. Middlemen are businessmen in the activity of the fuelwood supply chain.

In addition to the above stakeholders that actively take part in the value chains, there are of course also public bodies or stakeholders who intervene in the fuelwood value chains through policies, regulations, and taxes. It can be stated that policies and regulations are only intended to improve the sustainability of forest resources without taking on board the significance of fuel-wood activities in the value chains. Hence many of the policies proved to be inefficient, in Sub-Saharan Africa countries formal authorities exercise control over tree resources and commercialization. The division of authority is such that local traditional authorities provide access to land, government officials control official land registration and monitor production and trade regulations. Regulatory tools regarding fuel-wood extraction can constitute producer or trader taxes, licenses, permits, fees and imposing minimum harvestable tree diameters or restrictions on certain tree species. However, no matter the regulation and control by the authorities, the informal and diffuse nature of the fuel-wood business will still be impervious to government control. Some studies have even concluded that government intervention through legislation and taxes has very little effect in improving the situation of forest resources and reducing the fuel-wood flow, apart from making it difficult to monitor fuel-wood trade (Attwell et al., 1998). In the fuelwood energy sector, the value chain helps us to understand the economic flows between the actors. It is on the strength of these activities within the fuel-wood energy sector that the study stressed the relevance of the fuel-wood industry as an organized business that provides means of livelihood to many people in South Africa and Nigeria.

2.5 Chapter Summary

This chapter revealed intense discussions and debates on issues surrounding domestic energy consumption for South Africa and Nigeria. The review unpacked the significance of fuel-wood in the household energy mix. The conclusions that could be drawn from the review in this chapter is in two folds. Firstly, there is a strong nexus between political economy and fuel-wood consumption. Meaning that the consumption of fuel-wood in South Africa and Nigeria has become inescapable considering the enormity of socio-economic challenges facing the households. Furthermore, the variation in energy policies in the two countries has expounded the level of fuel-wood consumption for each country. Nigeria is still struggling to achieve adequate electricity supply, as a result, fuel-wood consumption is very high among both rural and urban households, South Africa, on the other hand, has developed a robust energy policy, stable electricity supply, fuel-wood consumption is found only among households living in rural areas and few urban informal settlements as many poor households are finding it difficult to afford the cost of modern energy. The chapter also discussed the fuel-wood value chain. The fuel-wood value chain provides a remarkable involvement of different sets of people participating in the process to meet up with their daily livelihood. The complexity of activities involved in sourcing fuel-wood for domestic usage, which was in the past considered to be a free product and solely the task of women, more especially on the social organization of fuel-wood procurement was identified.

In conclusion, the consumption of fuel-wood in the two countries appeared inescapable considering that the reliability and affordability of fossil fuels and electricity is uncertain, and livelihood derived from the fuel-wood business is enormous. Therefore, whatever the level of fuel-wood consumption in South Africa and Nigeria, to what extent the policy environment defines and coordinates the fuel-wood energy sector remains the main issue for two countries and motivating factor in the conduct of this research.

CHAPTER THREE: REVIEW OF RELATED LITERATURE

The previous chapter has attempted to explore fuel-wood energy consumption in South Africa and Nigeria from a comparative standpoint. In this Chapter, the attention is turned to socioeconomic and demographic variables of fuel-wood energy consumption. Generally, studies that dealt with causality or a cause-effect relationship require a robust methodology that could be applied to the relevant variables causing the effect. This requires the knowledge of the household's socioeconomic status that influences their decisions to consume a range of energy available to them. In response to these challenges, researchers are using many methodological approaches to overcome the challenges. Some of these variables that capture the attention of the researchers from different countries were discussed. The chapter also unpacked the significance of fuel-wood business to livelihood development using the household Economic Portfolio Model (HEPM). It further presents the constraints to the growth of the fuel-wood energy sector.

3.1 Socio-economic Factors

3.1.1 Income

Empirical evidence on the extent household income determines fuel-wood energy consumption was provided by (Kuunibe et al, 2013:192). In a study conducted in the Upper West Region of Ghana, 200 households were selected using a multistage random sampling procedure in four suburb settlements randomly selected. The findings indicate that, as households' monthly income increases, the probability that they will choose traditional fuel decreases by (-0.004). It, therefore, suggests that income is the main determinant of household fuel choice. These findings to a greater extent support the energy ladder hypothesis which showed as household income increases, they will abandon low quality energy like fuel-wood to better energy such as LPG and electricity. Similarly, this was disclosed by Demurger & Fournier (2011) in their study of ten villages in the Labagoumen Township in Northern China using descriptive statistics from the household survey to analyze household's dependence on forest resources and energy consumption patterns in the studied villages. The study used the Probit Model to determine the marginal effects of various socio-economic variables on coal consumption. It observed that income is a key factor in explaining energy use and fuel substitution. It also noted that income is a significant and negative determinant of household fuel-wood consumption. Lay et al. (2013) study in Kenya where the multinomial logit model used to assess the roles of renewables in the energy transition. The result showed that an increase in expenditure push households to go for electricity and solar energy over kerosene and fuel-wood showing that the energy ladder explains household movement from traditional energy to modern energy.

As earlier stated, that empirical evidence is emerging that questioned the simplistic income dependence hypothesis of the energy ladder model showing that the effect of income on fuelwood demand in rural and urban households may sometimes be insignificant regardless of how income is measured (Muller and Yan, 2016:9). For example, Heltberg (2004, 2005) observed in many different countries, households tend to combine modern fuels into their energy mix instead of completely substituting traditional energy from their menu with an increase in their income. This shows that the fuel stacking model is also useful in explaining fuel-wood consumption among households.

3.1.2 Price of other Energy

Concerning prices of other energy, an investigation in Senegal showed that, after the elimination of subsidies, consumers returned in large numbers to wood-based biomass for cooking (International

Institute for Sustainable Development, 2010). Meaning that an increase in the price of modern energy will automatically increase the level of fuel-wood consumption. In Nigeria, Maconachie et al. (2009) revealed that low and middle-income households in peri-urban regions have begun to switch back to biomass-based alternatives as prices of kerosene and petroleum-based domestic fuels have risen. Shackleton, Gambiza & Jones, (2007) examined the household fuel-wood use in small electrified towns of Makama District of Eastern Cape, South Africa using ANOVA to analyze the variables between three towns of Riebeck East, Alicedale and Grahams town. The study found the price of other sources of energy such as electricity is the determinant of fuel-wood use. Also, Bamiro and Ogunjobi (2015) examined the determinants of household energy consumption in Nigeria, evidence from Ogun State. 150 respondents using a stratified random sampling technique were used. Multinomial Logit and Tobit regression models were employed for the analysis of the determinants of energy consumption. Prices of kerosene and electricity were found to be significantly and positively influential in the choice of fuel-wood by the households. Furthermore, cross-price effects could also be an important driver of fuel substitution. For instance, Peng et al. (2010) conducted a study in Hubei, rural China and used a logit model to determine household level fuel switching. The results showed high coal prices have increased the probability of choosing biomass in China, suggesting that coal and biomass may be substitutes.

3.1.2 Educational qualification

Research into the impact of education on fuel-wood consumption has identified households whose heads have little or no formal education (Western education) to consume more fuel-wood than those with some background of formal education. Silviconsult (1991) identifies modern education as a motivation for people to make use of cleaner and less health risky energy sources than traditional fuel-wood. According to Muller and Yan (2016:14), more education generally implies a higher income. Education is also seen as a powerful determinant of fuel switching because higher awareness of the negative health impacts of dirty fuels can enhance knowledge about the efficiency and convenience of modern fuels (Farsi et al. 2007). The importance of education in the decision-making process of fuel use is emphasized in many studies. For example, education level is found to have a negative relationship with fuel-wood consumption (Démurger and Fournier2011). Gupta and Köhlin (2006) in Kolkata India and Baiyegunhi and Hassan (2014) in rural Nigeria observed that higher education level induces households to move away from fuel-wood dependence towards the use of kerosene and LPG. Lay et al. (2013) used a multinomial model in rural and urban Kenya to show how higher education level is associated with a higher probability of using electricity and solar energy and the lower probability of using fuel-wood and kerosene. Study in Tigrai, northern Ethiopia by Gebreegziabher et al. (2012) revealed that the higher the education level the less likely households could choose fuel-wood, and the more likely households could choose electricity.

3.1.3 Household size

In a typical African society, larger families command some level of recognition and security (Saad and Bugaje, 2016). However, Rao and Reddy (2007:144) argue that developing countries in larger households are often related to lower incomes. They have limited capacity to purchase commercial fuels to feed a large family that requires a large amount of fuel (Pundo and Fraser 2006:33). Fuelwood is cheaper due to its lower prices compared to kerosene LPG and electricity. Rao and Reddy (2007) studied the variation of energy use by households in rural and urban India. Using a multinomial logit model, the result showed households with larger families are less likely to choose modern fuels over solid fuels. Also, Özcan et al. (2013) studied the economic and demographic determinants of household energy use in Turkey. Using a multinomial logit model, the result revealed that larger households prefer dirty fuels over clean fuels.

3.1.4 Household Age

Empirical findings on the role of age in explaining household fuel use remain contradictory. Some studies found age is positively associated with preference for traditional fuels (Muller and Yan, 2016:13) as older people stay at home more often and need to use more energy, especially for heating purposes. This supports the idea that older people tend to perpetuate traditional heating and cooking habits more than younger households and consequently use fuel-wood more intensively. Démurger and Fournier (2011) studied poverty and fuel-wood consumption among rural households in Northerner China. The finding showed household average age had a positive and significant impact on fuel-wood consumption. This is supported by the work of Baiyegunhi and Hassan (2014) in rural Giwa, Nigeria. The study observed that an increase in the age of household head has induced many households to shift away from natural gas towards fuel-wood. On the contrary, Özcan et al. (2013) in Turkey showed age is positively associated with preference for modern fuels instead of traditional fuels. It was observed that older household heads are more likely to shift away from fuel-wood towards natural gas, liquid fuel, and electricity. In India, Farsi et al. (2007) and Gupta and Köhlin (2006) provided evidence showing older household heads prefer LPG over fuel-wood.

3.1.5 Housing type/ Dwelling Characteristics

Dwelling characteristics such as house size, number of rooms, drinking water source, ownership of a house, electrification of house and type of house were all found to significantly affect household energy consumption (Yoo et al., 2007). The study of Meier and Rehdanz, (2010) in Britain to determine residential space heating expenditure. The results indicated that the apartment/block of flats consumes less energy than semi-detached or detached houses. Dwelling characteristics are often considered as proxies of a household's wealth and living conditions. Dwelling characteristics can also be seen as constraints to choices (Muller and Yan, 2016:17). For instance, inflammable house material may deter the use of fuel-wood. Baiyegunhi and Hassan (2014) observed that households living in traditional houses are less likely to choose natural gas and electricity over fuel-wood in Nigeria. Heltberg (2005) studied factors determining household fuel choice in Guatemala. Using the multinomial logit model, the results showed the association of the number of rooms has led households to switch away from fuel-wood towards LPG exclusively.

3.1.6 Culture

Most often, households use fuel-wood for cultural rituals, a situation whereby households gather family members and offer ritual sacrifices for some different reasons. Fuel-wood is used for ritual (often specific species) and for cooking food for the assembled kins. Shackleton (2007) showed households use fuel-wood in their ritual activities in Grahamstown. Culture and traditional beliefs equally play a significant role in fuel-wood consumption. Findings by Bugaje and Saad (2016:138) in Nigeria revealed that traditional Hausa-Fulani households living in northern Nigeria preferred fuel-wood in cooking more especially with clay pots and traditional three stones. There is the belief that food is tastier than the one cooked with aluminum pots on kerosene stoves, which they said has some unpleasant odors. Moreover, during festivities like naming or wedding ceremonies that bring many people together in one house to eat food. The food is normally cooked in large pots using fuel-wood.

Overall, this study notes that the understanding of empirical literature will provide different views with varying perspectives of analysis concerning the determinants of household fuel-wood consumption. This phenomenon can be attributed to several factors, including estimation techniques, choice of variables, study period, and level of development of the country being studied, among other things. However, the reviewed literature felt short in providing evidence on a comparative basis. To the best of my knowledge, there has not been any study that compares drivers of fuel-wood energy consumption between South Africa and Nigeria and at the same time using more than one analytical tool.

3.2 Fuel-wood Trade and Livelihood

3.2.1 Forest livelihood

Livelihood is the people's capacity to generate and maintain their means of living, enhance their well-being and that of future generations. Households own certain resources and are engaged in multiple production, consumption and investment activities. The household resources and activities are linked by two opposing flows (expenditure flow and income flow). The expenditure household flow represents both individual and joint household resources that are used to support household livelihood activities and markets while the income household flow represents the income generated from activities of production and investment. The interaction between household resources and household activities determines the livelihood of the household. Forests are important assets in South Africa and Nigeria, they offer numerous goods and services in the national economy. The forest sector contribution to the economy is not well established. Evidence has shown that cash and noncash contributions made by forests and natural resources to household income and livelihoods are not accurately captured by official statistics in South Africa and Nigeria due to the informality of most forests' businesses and perceived negative environmental implications. Forests and woodlands are recognized as an important resource base for social and economic development, and the provision of many basic benefits and opportunities to rural and urban communities. Along this line of thought, Nosiru et al, (2012:12955) argued that the factors that conditions household's economic reliance on forest resources vary, depending on the resource endowment of the household, demography of the household, economic characteristics and other factors like markets, prices and technologies. Due to high rates of poverty and unemployment mostly in the rural areas many people are joining the fuel-wood energy sector as a source of income and employment. This concurs the observation of Bhargava (2006) that many of the worlds poor depend on forests for their livelihoods, a billion people depend on the forest as a direct source of income or livelihood. Forests can, therefore, play a significant role in realizing the millennium development goals.

3.2.2 Poverty, Livelihood and Environment

Poverty entails hunger, lack of shelter, being sick and being not able to go to school, not knowing how to read, not being able to speak properly, not having a job, fear of the future, losing a child to illness brought about by unclean water, powerlessness, lack of representation and freedom (Olalekan, 2016:8). Poverty is also defined as a human condition characterized by sustained or chronic deprivation of resources, capabilities, choices, security, and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights (Olalekan, 2016:8). Generally, the relationship between poverty, livelihood, and environment is perceived as a 'vicious circle'. Poverty and quest for livelihood led people to overutilization and overburdens their natural environment. Some environmentalists have come up with different views on the relationship between poverty and environmental degradation. According to Eade (1995), the poor are caught in a downward spiral of cause and effect hence poverty can cause environmental degradation as poor people overexploit already strained resources. Environmental degradation causes further poverty as people are unable to find the resources to meet their daily needs. Bernard (2013:65) and Eade (1995) concurs in this regard and posited that poverty is both the cause and result of environmental degradation. Once a community is subjected to poverty, there is a vicious poverty-environment circle which is difficult to break. In terms of livelihood, people make use of forest resources to reduce vulnerability with include vulnerability to environmental disasters food shortages to mention a few. Therefore, the contribution of forest resources to livelihoods and poverty reduction cannot be overemphasized.

3.2.3 Household Economic Portfolio model (HEPM) on Fuel-wood Business

Most of fuel-wood energy production activities take place in the farms or forested areas. Generally, households have own resources which they use in production and consumption activities. The productive activities are sometimes for market purposes and sometimes for consumption. Therefore, it is difficult to separate the two (consumption and production activities) because of their interdependence. In this

context, assets and outcomes are integrated into the process of production and consumption. Thus, understanding this relationship in household decision making concerning resource mobilization and allocation is important. At the household level, forest resource is one of the natural resources owned by households. Many of the world's poor depend on forests for their livelihoods (Bernard, 2013:66). In analyzing rural development, the household is at the epicenter of the analysis to know how low-income households strategize and mobilize resources to achieve livelihood outcomes. Then an approach that puts the household at the center of analysis provided by the Household Economic Portfolio Model (HEPM) is important in this study. Household Economic Portfolio Model explains the interactions between economic activities (production, consumption, and investment) and resources (human, natural, physical and financial) that are carried out by the household. It is assumed in this study that forest resources (fuel-wood) will affect household economic activities (production, consumption, and investment) which will, in turn, affect their livelihood. Even though, Gross Margin Analysis (GMA) has been commonly used in linking fuel-wood contribution to household livelihood (Nosiru et al, 2013). Unlike the HEPM, the GMA approach is not a household oriented.

In this regard, the purpose of the model was to analyze household fuel-wood trader's livelihood development through the provision of income, food security, health security, and children's education. In a rural setting, fuel-wood generates employment to many that are involved in the value chain. It also represents a value such as a woodlot and a farm acquisition, household gadgets, etc. Fuel-wood is viewed as a source of material market values that generated income for the households. The model views household as a portfolio or system made up of resources, household activities and circular flow of the interaction between them. We discuss this relationship below;

3.2.3 Household Resources

There are five types of household resources (or assets) which are set of human, natural, physical, financial and social resources or assets available for use by the household in a given time. The human resources are the labor, skills, time and labor of the household members while the natural resources included forest, land, water and everything on it. Forest resources proved to be a very important variable in the fuel-wood energy sector, it is the main source of raw material. The physical resources are tangible items that are at the disposal of household members. For example, buildings, equipment, machinery, livestock, and personal items. Financial resources may include cash and other forms of liquid savings. Social assets included kinship networks and social and political groups.

3.2.4 Household Activities

Household activities are the set of consumption, production, marketing and investment activities that fuel-wood traders undertake in a given period. Consumption activities mean the satisfaction of material wants and needs of the fuel-wood traders through the provision of items like food, education, and medical services. Production activities include income-generating activities of the fuel-wood traders. Investment activities can either be tangible or intangible. It is an enhancement of resource and asset base of the household, example farmland, woodlot, etc. Investment activities involve the use of household resources to create the potential for additional income in future periods. The income-generating activities mean activities that create productive enterprises that generate a marketable good or service which gives the household income. The household maintenance activities include daily meal preparation for the family, clothes washing and repair, maintenance and improvement of the house and water. This model assumes that household fuel-wood traders as a unit of consumption wished to maximize their utility namely, food security, health security, and children's education.

3.2.5 Fuel-wood Business Impact

Fuel-wood is important to many countries. In the Democratic Republic of Congo (DRC), fuel-wood contributes 12% to producers' household income, it supports 65% of the basic needs of fuel-wood producers living around Kisangani, thereby helping to reduce poverty (USAID/ Ghana, SFMPb, 2015:1).

The impact of fuel-wood at household level depends on the extent of household consumes and trader's supply fuelwood. It is expected that there will be a positive effect on household trader's income, food security, health care, and the children's education It is on the strength of this that World Bank (2011:7) observed that increased employment in the biomass (fuel-wood) sector can provide poverty relief to numerous households, helping in achieving poverty reduction targets. As far as the food security and income of the household are concerned, USAID (1992:2) asserts that food security exists when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life. Households food security can improve if they engage in income-generating activities like fuel-wood trading. Household income from fuel-wood trading allows them to stabilize food consumption, pay their children school fees, settle their medical bills. A study on Wood fuel in Kano closed-settled zone in Northern Nigeria by Cline-Cole et al. (1987:4) reported a significant level of employment of people by the fuel-wood industry. Generally, the fuelwood business was suitable for the socio-economic livelihood of rural poor, contributing to their household income as well as providing a safeguard against food-shortages, unemployment, and other similar poverty-related risks. Similarly, Shackleton et al (2001:6) in South Africa have reported fuelwood gathering and sales have become very important to the livelihoods in forest fringe rural communities.

In reviewing the impact of fuel-wood business on livelihood. Globally fuel-wood is a major source of income for the poor (Arnold & Persson, 2003). In practice, huge numbers of people continue to rely on fuel-wood as a source of energy or income which translates into a livelihood. Jamal & Anthony (2016) in the Northern region of Ghana showed that fuel-wood commercialization has reduced the income inequality from district to district. It also contributed significantly to poverty reduction and welfare enhancement and safety nets amongst entrepreneurs. Bernard and Jenias (2013) analyzed how to reduce urban poverty through a fuel-wood business in Masvingo city, Zimbabwe using the qualitative and quantitative research methodology. Their contention was fuel-wood business had created sound opportunities for the urban poor who are in the transport business, hired to fetch fuel-wood from the bushes. It has also created entrepreneurial activities for urbanites that had nothing to do. An investigation was conducted in Swaziland by Manyatsi & Hlope (2010) using a Land Set Enhanced Thematic Mapper of 1994 and 2006 for the study. The results showed the majority of the fuel-wood harvesting was monitored. The sale of fuel-wood to the livelihood of the sellers was about $67 and $133 per month. The study further stated that fuel-wood has contributed to the livelihood of the population of Swaziland. In Kenya, Geoffrey (2010) reports that vendors seem to make the highest profit per stere of wood sold compared to transporters. The vendors interviewed said they use to sell about two steres of wood per week, translating to a profit of KSh. 11,600 per month. Similarly, Geoffrey (2010) reports in Rwanda showed most of the wood is traded informally with only a small proportion consumed. The analysis of the supply chain was based on fuel-wood that moves regularly along the chain which might be a way forward if the sector is to be sustainable and economically beneficial to the stakeholders especially the farmers. Nosiru et al. (2013) used descriptive statistics and gross margin analysis to evaluate the economic contribution of fuel-wood to the livelihood of rural households in Oyo State, Nigeria. The findings indicated that the fuelwood business is very lucrative. The rate of profit is high due to the active involvement of family labor which drastically reduces the cost that might have been incurred if such labor is hired.

3.3 Fuel-wood Energy Sector Funding

The third objective of this research is to empirically determine the factors affecting fuel-wood energy sector funding in Nigeria. The study sought the need to discuss sources of finance and financial structure of fuel-wood energy sector

3.3.1 Equity

Equity is the owner's contribution either from family, friends or retained earnings and is used widely by small businesses. Contributions from friends and family members are acknowledged as one of the important sources of equity. According to Fatoki (2012), equity is a financing vehicle that has a residual claim on the firm, it does not create a tax advantage from its payments and does not have priority in bankruptcy. Small and medium businesses prefer equity over external sources of finance like debt to reduce the cost of finance (Carpenter and Peterson, 2002). This means it will cost small business owners to get external funds than to use the equity of retained earnings and the owner's funds. This allows the firm's owners to retain control of the firm, avoid floatation costs such as legal, accounting and underwriting fees as well as allowing flexibility to the owners (Carpenter and Peterson, 2002).

3.3.2 Retain earnings

Retained earnings are the net profit the firm has accumulated in business since its establishment and a central source of finance in any firm. Small and medium business retained earnings are the most important financing sources (Rugani, 2009). Hamilton and Fox (1998) assert that retained earnings is one of the most convenient ways managers funds their profitable business opportunities. According to Rugani (2009), a positive relationship exists between utilization of retain earnings and the size and profitability of businesses, meaning that retain earnings increases firm growth. The profitability of small and medium businesses will initially rely on retained earnings. However, profitable firms may have better access to other sources of finance than less profitable firms, The need for external finance may be lower for highly profitable firms if the retained earnings are sufficient to fund new investments (Abor and Biekpe, 2009).

3.3.3 Term loan

This is a loan from a bank with a floating interest rate and the amount borrowed must be paid off at a certain period. The term loan has a maturation date but no amortization. Interest is paid monthly, quarterly, or annually as required by the borrower/lender but the principal is paid only on maturity. There are two types of term loans, short term loans usually run for less than three years and are generally repaid in monthly installments from the cash flow of the business. On the other hand, long term loans are commonly set for three and ten years, in some instances for as long as twenty years (Lorey, 2012). For example, the Microfinance Policy Regulatory and Supervisory Framework of Nigeria 2005 launched by the Central Bank of Nigeria directed that term loans should be extended to informal micro-businesses.

3.3.4 Bank overdrafts

Bank overdrafts are another source of funding available for the informal sector and are divided into clean, secured and temporary overdrafts. The clean overdraft is allowed only against Demand Promissory Note. The advantage is that the customer does not pay interest for days during which there is a credit balance in the account. Secured overdrafts are for longer periods and are normally granted against the security of tangible assets. While temporary overdrafts are for a short period to customers who maintain their accounts satisfactorily. Based on this classification, overdrafts are known to be a facility that assists an enterprise with short term working capital to meet their day to day expenses. In the South African and Nigerian context, an overdraft is a very expensive source of finance for the informal sector. Rungani (2009) and Ogujiuba (2004) observed that overdrafts have higher rates compared to other products like credit cards. Considering the nature of the fuel-wood energy sector in South Africa and Nigeria,

the expensive nature of bank overdrafts is not a recommendable facility for such type of business more especially at their infant stage.

3.3.5 Cash credit

This is a facility granted for financing inventory by pledging the goods with the bank. The goods against which the facility is granted are either in the direct control of the bank or of an agent appointed by the bank for this purpose. There are situations where the goods remain under the possession of the borrower and periodic stock reports are obtained from the borrower to determine the extent of drawing under the cash credit limit. This type of financing is not known to many people in informal businesses such as fuel-wood.

3.3.6 Clean loan

The clean loan is a credit facility under which a fixed amount is lent to the customer without taking any security and the customer pays interest from the first day drawing on the amount of loan till its repayment. If the arrangement to repay the loan in installments is agreed, the customer pays interest on reduced balance from time to time. Under the loan facility, the entire amount of sanctioned is debited to the loan account of the customer and deposited in the current account. Initiatives such as Bank of Industry (BOI) in Nigeria was established to provide these types of microloans to informal businesses to support their social capital mobilization to grow their income and asset base. This type of facility can be used by fuel-wood business operators.

3.4 Pecking Order Theory

According to the pecking order theory, retained earnings are better than debt and debt is better than equity. The theory argues that a firm follows a pecking order if it prefers internal to external financing and debt to equity (Myers, 1984). The theory further posited that most businesses will be better up with internal finance than external finance because of high agency costs. The theory reflects the motivations for the financial manager (or owner-manager) to obtain control of the firm to reduce the agency costs on equity and avoid the seemingly inevitable negative market reaction to an announcement of the new equity issue (Migiro, 2005). This financial theory implies that management prefers to finance first from retained earnings, then with debt, followed by hybrid forms of finance like convertible loans, and lastly by using externally issued equity. According to Myers (1984), the pecking order theory can be an appropriate description of small medium and micro enterprises' financing practices. The pecking order hypothesis is keeping with the prior findings that debt is by far the largest source of external finance for small and medium businesses. Therefore, by implications, the theory means that external equity finance may be inappropriate to the owner-managers control over operations and assets. If pecking order theory holds, then internal equity finance will be preferred for small businesses as the form of finance does not surrender control. Also, Migiro (2006) considers pecking order theory as the most appropriate description of financing practices of small and medium businesses. Even though, it was initially thought that pecking order theory was mainly to explain the observed financing practices of the large public-traded corporation. However, it was later realized it can also apply to the financing practices of non-public traded small and medium businesses.

3.5 Funding Constraints of the Fuel-wood Energy Sector

This section of the chapter looks at the funding of the fuel-wood energy sector. The literature on informal sector financing (fuel-wood being an informal business) indicated that finance is a constraint to the growth of informal businesses. According to Jolie et al. (2014:1), a fuel-wood value chain is generally

characterized by informal practices and often unequal benefits, leading to a situation whereby the sector has little incentives to attract for its growth. To this end, three types of financial constraints hinder the growth of small businesses as identified by (Omer, 2016:68) based on Bolton's report (1971). It could also apply to the fuel-wood energy sector. They are; lack of access to finance, lack of awareness of financial services and lack of professional financial advisors.

3.5.1 Lack of access to finance

Generally, the fuel-wood business is recognized as an informal business characterized by a marked fragmentation of operators (producers, transporters, and retailers) who tend to work in isolation on an individual or family basis. Even though a study in northern Nigeria by Naibbi (2013) and Cline-Cole and Machonachie (2015) have reported a strong association of fuel-wood traders. However, this cannot be confirmed in South African especially in the urban areas where there is electrification. Many identified access to finance as critical to the growth of the fuel-wood energy sector. For example, Sepp and Mann (2009:7) observed that the fuel-wood market is underfinanced, is generally weak with under-valued and underpriced products, despite the growing scarcity of the wood. The cost of wood where it is collected for free from government and trust land is never reflected in the transaction. This underpricing generally translates into wasteful and inefficient production which in turn created formidable disincentives in the business. Access to finance has become a major difficulty for the fuel-wood business. Most of the actors in the chain are facing financial difficulties when it comes to business expansion, resulting in little available investments to place in forests leading to minimal returns. For instance, 75% of South African small firms fail due to a lack of access to finance. It is very difficult for an informal business like fuel-wood to qualify for loans from financial institutions particularly banks due to tied credit policy (Fatoki and Odeyemi, 2010:128)

Accordingly, 75% of small firm loan applications are rejected in South Africa (Fatoki and Adeyemi, 2010:129). In Nigeria, commercial bank's total credit to small scale enterprises stood at meager 0.5% in 2010 and the ration is still falling unabated (Adedayo et al, 2014). Even in a situation where loans are available, informal business owners are reluctant to take the loan due to high-interest rates, in most cases collateral to cover the exposure has to be given before loan is granted. For instance, transportation is one of the activities that need a huge capital layout in the fuel-wood value chain but it is always difficult to secure a loan to buy a new truck due to the informal nature of the fuel-wood business. Dealers also needed money to the stock to boost their profit, but loans are always difficult to obtain because of the perception given to the fuel-wood business. Dealers run the business without any formal enterprise registration or operating licenses preventing them from getting loans for expansion.

3.5.2 Lack of awareness of financial services

The informality of the fuel-wood energy sector makes it looks like a poor man's business, poor man's trade and poor man's fuel. This means that policymakers and financial institutions ignore the sector leaving it in the hands of semi-illiterate members of the society who have no technical know-how limiting technological adoption and investment (Geoffrey, 2010:77). Even though many actors along with the fuel-wood value chain in South Africa and Nigeria have associations, still high level of informality of the sector and lack of organization makes the sector not to have strong bargaining power, and could not push for access to information from the financial institutions. Furthermore, criminalization of the fuel-wood energy sector by the government officials in many countries including South Africa and Nigeria made many key players operate underground, so much so that the issue of getting knowledge and innovations from government or financial institutions becomes very difficult. Prices of fuel-wood in the market is determined by fuel-wood traders themselves and can be altered by traders at their will showing a huge gap between traders and larger conventional markets. Lack of policy regulations on the fuel-wood markets makes the fuel-wood energy sector inept. For example, Shackleton et al (2006) and Naibbi (2013) showed that the majority of households are at the mercy of fuel-wood vendor. Fuel-wood is sold in

many un-standard units of measurement with retail prices varying in terms of location, the volume of sales, responsibility for the delivery and special relationship between seller and buyer. Thus fuel-wood pricing strategy explains the absence of synergy and information flow between the sector, government and financial institutions.

3.5.3 Lack of professional financial advisors

Fuel-wood energy sector in Nigeria has for a long time operated without policy or laws guiding the day to day operation and where legislations have been made, they are either piecemeal or misguided without a proper implementation framework. More so, the sector usually operates underground, it has become almost impossible to engage the major stakeholders of the sector. For these reasons, it lacks formal recognition to warrant professional advice from either the public or private sector. Professional financial advice entails services of lawyers, financial consultants, tax experts and so on, that are extended to businesses for their survival and growth. Such advice revolves around identifying the type of activity, necessary inputs, and market information, regulation, and legislation, accounting, managerial advice, referrals to appropriate bodies and interlinkage information (Agaje, 2004). Agaje, (2004) observed that lack of access to relevant professional and appropriate financial advisors posed serious constraints to business growth. In the third world countries (South Africa and Nigeria inclusive), professional advice on small businesses can only come through government policies. For example, South African White Paper on national strategy on development and promotion of small business, 1995 (Timms, 2011: 20). The Paper outlined, among other things, the need for the Government to create an enabling legal framework, facilitate access to information and advice for small businesses. In Nigeria, National Enterprise Development Program (NEDEP) being implemented by Bank of Industry (BOI), Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and Industrial Training Fund (ITF) was designed to provide professional services in form of skills acquisition and entrepreneurship training based on One Local Government One Product (OLOP) program to small businesses. However, this plethora of initiatives did not in any way assist the fuel-wood energy sector. Most of the fuel-wood traders learned from watching others doing or simply being trained by parents, relatives or friends.

3.6 Chapter Three Conclusion

The chapter examined the socio-economic and demographic variables of fuel-wood consumption and concluded that domestic fuel-wood consumption is a continuous phenomenon among South African and Nigerian households. The review showed livelihood is dependent on a host of variables and is often influenced by the environment in which they operate. The review gave an account of how the fuel-wood energy sector is linked to positive social and economic outcomes of the households. The review also noted the pivotal role the fuel-wood energy sector plays in economic development through the creation of employment opportunities and livelihood. The Household Economic Portfolio Model is used to situate fuel-wood business and household livelihood outcomes. Finally, the literature showed that, despite the importance of the fuel-wood energy sector, it faces considerable funding constraints that inhibit its growth. These include lack of access to finance, lack of information on the available financial products and lack of government support. Based on the above, it is imperative to provide the missing link in the literature considering the significance of the sector in the supply of energy and as a source of livelihood. Studies have downplayed this linkage.

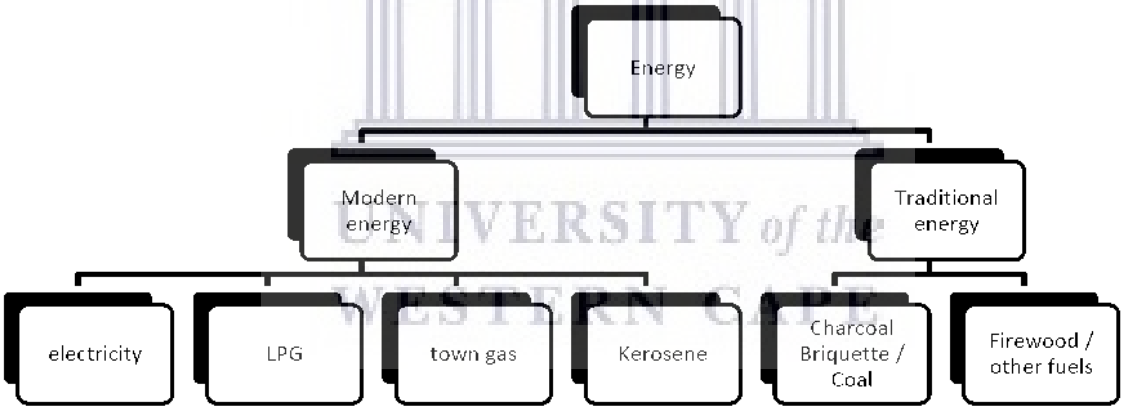
CHAPTER FOUR: THEORETICAL AND CONCEPTUAL FRAMEWORK

This chapter reviews theories and concepts to explain the nexus between fuel-wood energy consumption and demographic and socioeconomic variables influencing energy consumption. The main theories underlying the study are two; the Energy Ladder Model and Energy Stacking Model that was often used to explain domestic fuel choice in developing countries. The first section of the chapter deals with the meaning of modern and traditional forms of energy as well as domestic energy types. The second section deals with models of domestic energy consumption in developing countries. The third section presents theories of the informal sector and issues surrounding the informal sector in South Africa and Nigeria.

4.1 Modern and traditional Forms of Energy

Domestic energy is classified into two groups namely; modern/conventional forms of energy and traditional dirty forms of energy. The traditional forms of energy sources are fuelwood, charcoal, crop residue, and animal waste. They are referred to as biomass energy obtained from the environment. The modern energy sources are kerosene (DPK or Paraffin), coal, liquefied petrol gas (LPG), electricity and nuclear (Getamesay, Workneh Getachew, et al. 2015:1). The modern commercial energy is harnessed in large-scale in the coalmines, in oil fields and gigantic hydro and nuclear power stations and distributed over long distances to the actual consumers. These types of energy are well suited for modern industrial organization, which requires centralized production and control of economic activity (Nazer, 2016:53).

Figure 4.1: distribution of household energy by type of energy



Source: Nazer, (2016:53).

The above diagram shows a wide range of energy options available to households in the form of modern and traditional energy types. Modern energy in the diagram comprises electricity, LPG (gas) and kerosene, and traditional energy include, charcoal, briquette, and fuel-wood. Households have the option of using the available energy in the diagram.

4.2 Types of Domestic Energy

Domestic energy is used for households' chores or services such as cooking, heating, boiling that support the overall improvement of life. Households utilize a range of energy options to satisfy their day to day activities either from modern or traditional energy. Therefore, understanding the types of energy available for African households is critical in this study. Some of the domestic energy types are discussed below;

4.2.1 Biomass

Biomass is organic and non-fossil material of biological origin; they are often referred to as naturally occurring combustible material. The components of biomass include fuel-wood, grasses, crop residues, or dung. In the class of biomass, fuel-wood is the major, desirable and most efficient component in the group, dung is perhaps the least desirable form of biomass and using it signifies extreme fuel poverty (Toole, 2015:10). Biomass is distinguished from other forms of domestic energy types for its high degree of accessibility. It is almost free and widely available in many areas of the globe compared to modern energy (even though there is an opportunity cost associated with time and labor in procuring biomass). The opportunity cost is higher with wealthier and educated households that have a higher value of time.

Biomass forms one of the most important sources of energy in Sub-Saharan African countries, being used by both households for domestic energy and industry (sugar refining plus pulp and paper). The use of biomass in Nigeria was reported by (Sambo, 2005:15) that the country is using 80 million cubic meters (43.4 x 109 kg) of fuelwood annually for cooking (this amount must have increased over the years). As for forage grasses and shrubs, the estimates show that 200 million tonnes of dry biomass can be obtained from them and this comes up to 2.28 x 106MJ of energy. For crop residues and wastes, it is estimated that about 6.1 million tonnes of dry biomass are produced annually. Leave residues energy content was approximated at 5.3 x 1011 MJ (Sambo, 2005:15). For South Africa, the availability of biomass is generally poor. Half of the land areas in South Africa consist of desert and semi-desert, only 1.2% is under forest (Winkler, 2006:48), but it is still an important source used by the households for domestic energy.

4.2.2 Charcoal

Charcoal is a dark grey residue consisting of carbon and remains of ash. It is produced by a slow process of heating wood and other substances in the absence of air (Girrard, 2002:30). The process of heating of wood in the absence of oxygen is called pyrolysis that involves heating wood to burn off most of the material leaving nearly pure carbon. The process is slow and can be conducted even within the home from gathered fuelwood. Although charcoal is an old energy source, it is still being used as energy for cooking, heating and boiling in rural and urban areas. It is widely used in many small-scale industries, for example, bread baking, cottage metal smelting operations, and brick kilns. Due to the informal nature of charcoal production and marketing, the precise quantity of charcoal produced and consumed is not easily determined. However, worldwide 24 million tonnes of charcoal is consumed annually and developing countries accounted for nearly all of this consumption. Africa alone consumes about half of the world's production (Babalola and Opii, 2012:69). Urbanization has made the charcoal sector to acquire a considerable economic weight. For example, in Niger and Mali, ESMAP researched in the late 1980s and found that charcoal business is mainly in the informal sector but accounts for an annual turnover of several million dollars and it can be compared to cash crops in terms of employment (Girard, 2002:30)

4.2.3 Kerosene

Kerosene is the proportion of crude oil that boils when heated between 145 and 300°C. Kerosene as domestic energy is cleaner and more efficient biomass. Households that use kerosene for domestic purposes have to depend on the supply and distribution of the product Toole (2015:15). This means that remote areas that lack local markets or transport infrastructure may find kerosene unobtainable for reasons of inconvenience or prohibitive pricing. The widespread use of kerosene as a domestic fuel for cooking, heating, and lighting shows that over 500 million households globally consume kerosene or other liquid fuels for lighting. This corresponds with the estimate of (Nicolas, Kirk, Smith, and Alison, 2012:397) that annually 7.6 billion liters of kerosene are used by households. Urban areas of the developing countries have exhibited high consumption of kerosene compared to electricity and LPG that are expensive and unreliable. In the rural areas, kerosene is often used as a backup when fuel-wood or

another biomass is unavailable. Kerosene is regarded as a step up the energy ladder from fuel-wood and solid fuels.

4.2.4 Liquefied petroleum gas (LPG)

LPG is also domestic energy that comes from the pressurization of natural gas and oil refining processes. LPG can contain propane, butane, or a combination of the two, propane-butane blend. It is essentially used for cooking, boiling and heating LPG allows for quicker heating of food or water with fewer emissions. It is considered a clean and environmentally-friendly source of energy compared to kerosene. In urban and peri-urban areas of developing countries, LPG is mainly used as cooking fuel by middle- to high-income households. LPG is seen by the International Energy Agency (2006) posited that LPG is the only means that can be used to move away from unsustainable use of biomass for cooking. It was a target that through stimulation, 1.3 billion people will switch to LPG from biomass thereby reducing 50% of biomass consumption. The household sector is the highest consumer of LPG (49 %), followed by the petrochemical industry (21.6 %) and other industrial uses (11.8 %). Direct consumption in refineries and finally the agricultural sector makes up 2 % of global consumption. Other sectors (e.g. Autogas) added up to an aggregated 9.3 % of total consumption (Stealthgas, 2013)

4.2.5 Electricity

Electricity is the energy that is fueled by the transfer of electrons from positive and negative points within a conductor (KMPG, 2013). Electricity is widely used for providing power to buildings, electrical devices and even automobiles and rated as the cleanest and most efficient of all fuels for domestic uses. The source of electricity, can either be grid electricity or non-grid. The grid electricity draws from large-scale sources such as coal, gas, and nuclear. Non-grid electricity utilizes small-scale oil generators or renewable energy. Electricity can also serve many other purposes apart from domestic cooking like lighting and the use of other appliances like fans and refrigerators. Electricity remains among the fastest growing forms of energy. According to IEA (2014:204), electricity had met 23% of the world's energy needs by 2014 meaning that a 12% increase has been recorded in 2012. Several reasons explain the attractiveness of electricity to consumers. Firstly, it offers a variety of services from mechanical power to light. Secondly, it is more practical, convenient, effective and cleaner than other alternative forms of energy. For some applications like electronic appliances, electricity is the only option. Also, electricity produces no waste or emissions at the point of use and is available to consumers immediately on demand (where service is reliable) without any need for storage.

The industrial sector remains the single largest end-use, its share of total electricity use rose from 27% in 2012 to 32% in 2014. Growing demand is higher in the residential sector, its share of total energy use in the sector surged from 21% in 2012 to 34% in 2014. In the services sector, electricity reinforces its position as the main fuel, its share of total energy use reached 55% in 2014 (IEA, 2014:207).

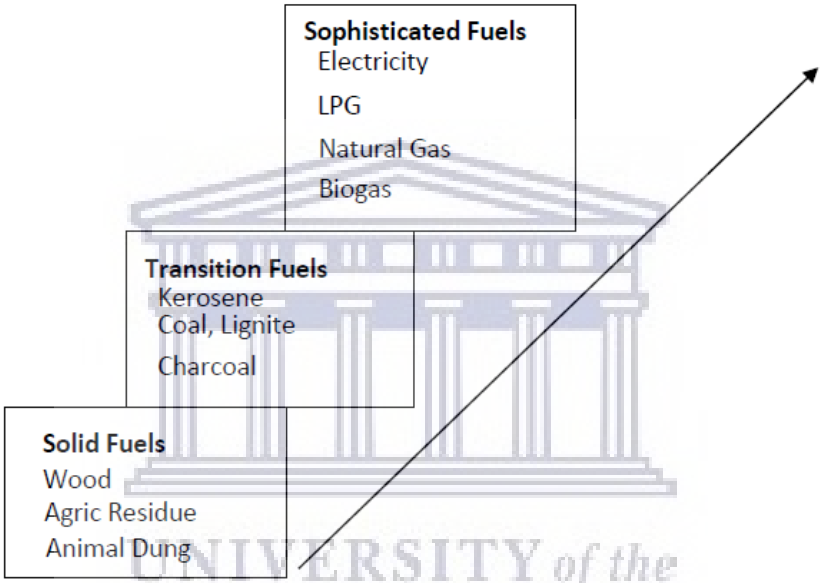
4.3 Theoretical Explanation of Domestic Energy Consumption

4.3.1 Energy Ladder Model

The perception of fuel-wood crisis in the 1970s and 1980s by many scholars brought about the idea of energy ladder model (Toole, 2015:3), Since then, the model has become one of the models that always used to explain domestic fuel choices in the developing countries (Maconachie et al., 2009, Shackleton, 2007, Canbell et. al. 2003, Alamon, Sathaye and Barnes 1998, Leach 1992, Davis Hosier and Dowd 1987). The conventional view in the model is that economic growth will trigger a reduction in demand of fuel-wood and other biomass energy by the households and shifted towards the use of commercial fuels like kerosene, LPG and electricity (World Bank, 2011:29). The energy ladder model described the movement from dirty or traditional to conventional or modern energy services in the event of an increase in income or economic status of the households or vice versa (Nazer, 2015:51). The model is predicated

on the economic theory of consumer behavior Hosier and Kipondya, (1993) argues that when income increases, households not only consume more of the same good they also shift to more sophisticated goods with higher quality. Meaning that as income increases, households will firstly move away from traditional fuels to transitional fuels (charcoal and kerosene) before finally moving to modern fuels (grid-based electricity and LPG) which are superior to traditional or transitional fuels. The main reason for the movement is because households prefer clean fuels, ease of use and efficiency. Modern fuels have these qualities unlike traditional fuels (fuel-wood, crop residues, and dung) (Darazo and Babayo, 2016:84). The energy ladder also assumes that more expensive technologies are locally and internationally perceived to signify higher status. Families desire to move up the energy ladder not just to achieve greater fuel efficiency or less direct pollution exposure, but to demonstrate an increase in socioeconomic status (Masera et al. 2000: 2084).

Figure 4.2: Energy ladder model



Source: Abdullahi et al. (2017:353)

Fuel switching becomes the central concept of the energy ladder hypothesis, referring to the displacement of one fuel by another. Movement of the household up to a new fuel is automatically a move away from the fuel used before (Van Der Kroon et al, 2013:6). Hosier and Dowd (1987) presented a five-rung ladder to describe the linear movement of the energy ladder. They are; gathered fuelwood, purchased fuelwood, transition fuels, kerosene, and electricity. Also, Reddy (1995) proposed a six-rung ladder, namely; dung/waste, fuelwood, charcoal, kerosene, LPG, and electricity. While Van Der Kroon, et al. (2013) separated fuels into three classifications, primitive, transition and advanced, with multiple fuels under each. IN table (2.1), Nazer (2016) sheds more light on the energy ladder as it relates to the level of economic development. Household energy use was classified into (cooking, lighting, boiling, and equipment) based on income levels and level of economic development. In developing countries, low-income households consume only traditional energy (fuel-wood, charcoal, animal dung, and agricultural residue). The middle-income households' combines both traditional and modern fuels (fuel-wood and kerosene) while high-income households in the developing countries consume less of traditional fuels and more of modern fuels (kerosene, LPG and electricity). In developed countries, traditional energy consumption is almost absent.

Table:3 The Energy Ladder

Sector	Energy consumption	Developing Countries			Developed Countries
		Low Income Households	Middle Income Households	High Income Households	
Household	Cooking	Wood, charcoal, briquettes agricultural residues, animal manure	Wood, residues, dung, kerosene and biogas	Wood , kerosene LPG, natural gas, electricity, coal	Electricity, natural gas
	Lighting	Candles and kerosene	Candles, kerosene , petrol, paraffin	Kerosene, electricity and gas	electricity
	Room heater	Wood , residues , livestock manure	Wood, residues, livestock manure	Wood , residues, dung, coal , electricity	Oil, natural gas , electricity
	other equipments	There is no	Electricity , batteries and accumulators	Electricity	Electricity

Source: Nazer, (2016:51).

In summary, the energy ladder model expounds strong nexus between household fuel choice and income. The model portrays fuel-wood as an inferior good and modern energy as superior good. Many cross-country comparisons revealed a positive correlation between economic growth and uptake of modern fuel. This suggests that as a country progresses through the industrialization process, its reliance on petroleum products and electricity increases on one hand, on the other hand, the importance of traditional energy decreases (Van Der Kroon et al. 2013:7, Hosier and Dowd, 1987: 347). Contrary to this, studies on household energy consumption conducted in some developing countries (Maconachie et al. 2009, Madubansi and Shackleton 2007, Ouedraogo 2006, Mesara, 2005, Campbell et al. 2003 and Heltberg et al. 2000;) provided other pieces of evidence that does not support the energy ladder hypothesis. Instead showed a relationship between household fuel choice and income level is rarely as strong as assumed by the energy ladder hypothesis. Factors such as income, access to electricity and forest scarcity play a significant role in determining fuel transition. In the same way, Maconachie et al. (2009), Krutilla, and Hyde (2002) and Barnes and Floor (1999) alluded that the main driver affecting movement up the energy ladder is hypothesized to be income and relative fuel prices.

Given the above, it is very difficult to use the only income to estimate the determinant of household fuel choice. Van Der Kroon et al (2013:19) asked for the consideration of a broader spectrum of influential factors besides income. The next section will discuss the limitations of the energy ladder model.

4.3.2 Limitations of Energy Ladder Model

The complexity of household fuel use and fuel switching processes in developing countries has rendered the energy ladder model insufficient to explain energy consumption dynamics. The early critics of the model were Masera and Navia (1996) who exposed the deficiencies of the energy ladder model based on a study conducted in three Mexican states between 1992 and 1996. Masera et al. (2000) went further to argue that transfer or complete switching of fuel is not possible among households. A process should be considered resulting from simultaneous interactions of factors pushing households away from biofuels and pulling them back towards biofuels i.e a bi-directional process. Factors such as convenience from the use of modern fuels, the pride associated with the use of these fuels, the social status may push consumers up the ladder while economic factors such as incomes and prices can push consumers down the ladder. Therefore, the energy ladder failed short of linking economic and socio-cultural issues. Other studies that faulted the energy ladder model include; Peng, Hisham and Pan (2010:241) in rural Hubei in China

showing household resistance to abandon biomass, only less than 10% of the sample fully abandoned the use of biomass as a result of an increase in income. In Uganda, 83% of the households on the top quintile in the urban areas use biomass as their primary cooking fuel (World Bank, 2011:29). Similarly, Campbell et al (2003:560-561) confirmed that the energy ladder model has failed in Zimbabwe because of the resistance of the households to abandon fuel that occupies the middle rungs of the ladder. Kerosene was not abandoned even after they adopted electricity. Taylor et al (2011:924) in Guatemala, concluded that 77% of the migrant households maintained fuel-wood as a primary energy source despite ownership of LPG. Maconachie et al. (2009) showed most families in Kano, Nigeria are reverting to the use of fuel-wood from modern fuels due to poverty and inconsistency in the supply of modern energy. In South Africa, fuelwood has remained the most important energy source even after electrification due to high electricity price in the Bushbuckridge region of Limpopo (Madubansi and Shackleton, 2003)

It is agreed that an increase in household income can increase the uptake of modern energy, also changes in relative prices of fuels can influence the type and quantity of fuel consumed. However, culture and social factors may make consumers behave contrary to these expected patterns. Factors such as education level of the household, dwelling characteristics, preparation of traditional meals and gender of the head of the households could also contribute to the complexity of the energy ladder model (Masera, 2000). In summary, the energy ladder model has been used to explain domestic energy consumption dynamics in developing countries. In its general principle and specification provided a limited view on the reality of household energy consumption. The model fell short in its ability to provide the actual determinants of domestic energy consumption among households. This limitation necessitates the need to study another model.

4.3.3 Fuel Stacking (Multifuel Model)

More recently, there have been arguments that households in developing countries do not switch to modern energy sources, instead they consume a combination of fuels. This may entail combining solid fuels with non-solid fuels. Instead of the household moving up the ladder step by step as incomes increase, households choose different fuels from a menu. This method of fuel usage is known as fuel stacking (Mekonnen et al 2009:1). The fuel stacking model envisaged that energy transition does not occur as a series of simple, discrete steps, instead, households simultaneously use multiple different fuels. According to Masera et al. (2000), households choose to consume a portfolio of energy options at a different point along an energy ladder instead of switching fuels. Income increase makes households adopt the use of modern fuels, but at the same time continue using traditional fuels for some activities, thus 'mixing' various energy sources. The transition towards the use of modern fuels takes place in the context of the simultaneous use of various types of fuels. In this view, poorer households usually use a small variety of traditional fuels like fuel-wood, animal residue and charcoal (Elias and Victor, 2005:3, Van Der Kroon et al., 2013:7).

Multiple fuel use arises for several reasons. Firstly, households may not have enough funds to immediately purchase new energy-consuming appliances at the time they gain access to new energy more especially in the situation where they have invested significantly in "traditional" technologies (e.g., wood-burning stoves). Secondly, the expensive nature of modern energy services. Finally, multiple fuels can provide a sense of energy security as complete dependence on commercially-traded fuels leaves households vulnerable to variable prices and often their services are unreliable. Therefore, households must have one or two fuels that can be used as backups if their primary fuels are temporarily unavailable Elias and Victor (2005:3). Table 2.1 below adopted from World Bank (2011) explains fuel stacking among households.

Table 4: Reason for using various energy sources (fuel stacking)

	Fuelwood	Charcoal	Kerosene	LPG	Electricity
Inexpensive	89%	71%	23%	53%	2%
Easy to purchase	33%	52%	27%	22%	28%
Easy to use	19%	28%	71%	42%	70%
Traditionally used by household	19%	12%	n/a	n/a	9%
Low initial investment costs	15%	12%	21%	8%	2%
Gives high heat/cooks fast	15%	5%	48%	61%	48%
Safe to use	n/a	20%	2%	8%	26%
Food tastes better	n/a	10%	n/a	n/a	4%
No negative health effects	n/a	6%	n/a	14%	26%
Clean to cook with	n/a	2%	6%	47%	59%

Source: World Bank (2011:29).

Empirical studies in many developing countries have validated the fuel stacking hypothesis. The model has shown that households can adopt new fuels and technologies that serve as partial, rather than perfect substitutes for more traditional ones with an increase in income. Ogwumike et al. (2014:255) shows that, instead of Nigerian households to abandon traditional fuels as their income increases, they stacked different forms of fuels consistent with consumer preferences in the face of supply constraints. A similar situation was also found in South Africa, Makana district, a small electrified town where most of the households continued to use fuelwood for cooking and heating despite the widespread of electrification (Shackleton et al, 2007:6). In Ethiopia, Mekonen et al. (2009:4) found households in Tigrai, Northern Ethiopia switched to multiple fuels strategy (fuel stacking).

Fuel stacking behavior is seen as a livelihood strategy that enables households to cope with unstable income flows, protect themselves from fragile markets and hold on to their cultural practices while benefitting to some extent from modern fuels. The model has stressed the need to look beyond household income as the prime driving force behind fuel switching (Van der Kroon, 2013:19).

4.4 The Informal Sector in South Africa and Nigeria

Although limited information exists on the size of the informal sector in South Africa and Nigeria despite the sector offers employment, economic and livelihood opportunities to millions of people, especially those living with low-incomes. In Nigeria, the informal sector is estimated to account for 57.9% of Nigeria's GDP (UNDP, 2014). More importantly, between July 2012 and June 2014 about 2.48 million jobs were created, in Nigeria. Interestingly, the informal sector contributed the most with 1.41 million (57%) (NBS, SMEDAN, 2013:15). This corroborated a survey conducted by Ijaiya et al (2010:2) that discovered informal businesses to have contributed to 58% of Nigeria's Gross Domestic Income (GDI) and 50% of the urban jobs. In South Africa, the informal sector not only made a significant contribution to the Gross domestic product but is a major potential source of entrepreneurship and income for the less educated and less skilled. More than 7.7 million jobs are from informal businesses and provided a GDP of 16% and 40% (Tshuma and Jari, 2013:251).

In a nutshell, the informal sector is a dominant sector in South Africa and Nigeria, especially in manufacturing, commerce, finance, and mining. Trade-related activities, including street vending, are the most common form of activity in the informal sector. In South Africa and Nigeria, the contribution of the informal sector varies from rural to urban contexts. For example in the rural areas, informal businesses supplement seasonal agricultural income, link the agricultural household to the local market, and provide employment opportunities for those not directly involved in agricultural activities while in the urban

areas, informal businesses form the petty trading activities that provide means of survival to urban poor households and may also play a more critical role in household economic security due to limited employment options in the formal sector of the economy.

4.4.1 A theoretical Description (informal sector)

It is well documented that fuel-wood production and trade in South Africa and Nigeria are conducted informally. Even though in South Africa fuel-wood is sold in supermarkets and shopping malls for heating purposes. Therefore, this section discussed the theories of the informal sector. Four dominant schools of thought to explain the nature and composition of the informal fuel-wood energy sector in South Africa and Nigeria. Three dominant schools explain the nature and composition of the informal fuel-wood energy sector.

The 'Dual Theory' or the Lewis two-sector model: The Dualist sees informal fuel-wood energy sector of the economy as comprising of marginal activities distinct from and not related to the formal sector that provides income for the poor and is considered as a safety net in times of crisis. The Dualist argues that informal operators in the fuel-wood energy sector are excluded from modern economic opportunities due to imbalances between the growth rates of the population of modern industrial employment, and a mismatch between people's skills and the structure of modern economic opportunities (Tika, 2018:28). According to the theory, the formal sector comprises of economic activities in urban regions that have features such as wage labor, capital intensive firms, and high marginal productivity that create incentives for capitalists to invest in labor and machinery (Godfrey, 2011:243). While the informal fuel-wood energy sector operates essentially in rural areas and is characterized by low wages and labor-intensive firms/actors (Godfrey, 2011). The dualist subscribe to the notion that informal units and activities in the fuel-wood energy sector have few (if any) linkages to the formal economy but, rather, operate as a distinct separate sector of the economy and that the informal workforce in fuel-wood energy sector is assumed to be largely self-employed and comprises of the less advantaged sector of a dualistic or segmented labor market.

The Legalists or neoliberal focus on informal enterprises and the formal regulatory environment and the relative neglect of informal wage workers and the formal economy per se. The legalist theory argues that a hostile legal system leads the informal sectors like the fuel-wood energy sector to operate informally with their informal extra-legal norms (Tika, 2018:28). The legalists' school sees the informal fuel-wood energy sector as comprised of "plucky" micro-entrepreneurs who choose to operate informally to avoid the costs, time and effort of formal registration and who need property rights to convert their assets into legally recognized assets.

The illegal or hidden/underground production school is another approach that often focuses on developed or transition countries. Illegal production means production activities that are not following the law or which become illegal when carried out by unauthorized producers; while underground production refers to production activities which are according to the law or legal and in compliance with regulations, but which are deliberately concealed from authorities. Fuel-wood energy sector production fits this description, mostly the entire production operates illegally and in most cases, the activities are dominated by corruption. Given the heterogeneity of the informal sector in the economy, these schools of thought captured the nature and characteristics of the informal fuel-wood energy sector in South Africa and Nigeria.

4.5 Chapter Four Summary

The chapter reviews the classification of energy types and the informal sector in South Africa and Nigeria. In the review, the energy was classified as modern energy and traditional energy forms of energy. The chapter also examined the energy ladder model and the views of analysts who are critical of

the energy ladder model and the fuel stacking model as the alternative model. In the overview of their works, analysts who are critical of the energy ladder model have indicated the debates that have been raging in the literature on the subject. Their contributions continue to shape the discourse on domestic energy consumption and how households consume energy. Whatever the standing of energy consumption models at this stage, it has nevertheless cast its influential net over several approaches to domestic energy consumption in developing countries. It is only the continuous accumulation of empirical evidence that will pronounce a verdict on their efficacy as a mode of analysis for domestic energy consumption. It is the hope that the analysis of the research findings will add to the already existing empirical evidence. On a theoretical review of the informal sector. All three theories appeared adequate in explaining issues surrounding the fuel-wood energy sector in South Africa and Nigeria.

CHAPTER FIVE: METHODOLOGY

This chapter attempts to present an overview and discussion on research design and methods of data collection. The chapter also presents the justification for choosing the mixed methods approach in data collection and methods of data analysis that were utilized in Chapters 6 and 7 of this study. Finally, the chapter discussed quantitative and qualitative research design (mixed methods) that was used to obtain data that will address the research questions. Survey data was collected from household fuel-wood consumers and fuel-wood traders to assess dynamics and socioeconomic variables of household fuel-wood consumption, the contribution of fuel-wood business to trader's livelihood as per income, food security, health security, and children education. Focus group discussion (FGD) was used on fuel-wood energy sector funding, using Nigeria as our case study.

5.1 Areas of Study

This study was conducted in the Western Cape Province of South Africa and Katsina State, Northern Nigeria. Western Cape Province and Katsina state are two separate political entities with contrasting features. Western Cape is seen as a more affluent province in South Africa and a bigger contributor to the country's GDP as opposed to Katsina that was rated as the second poorest state in Nigeria (NBS, 2010). Western Cape Province was rated as the second most affluent province in South Africa scoring 30.6% (StatsSA 2012). On the contrary, Katsina state is economically and educationally backward compared to many states in the southern and northern Nigeria. According to the Nigerian National Bureau of Statistics (2013), 74.5% of the population of Katsina state are living below the poverty line.

One of the common challenges facing fuel-wood energy research is the lack of an accurate and timely database. Most of the data are mainly on surveys carried out at irregular and on ad hoc basis by different individuals and institutions independently. No consistent data exist on fuel-wood consumption and trade to the extent that trends are impossible to establish over reasonably long periods. The recent work of HSRC &DoE (2012) revealed the geographic variation of provinces on the pattern of household fuel-wood consumption in South Africa. For example, electricity is used by more than 90% of the households living in the western cape province for domestic activities making fuel-wood data almost impossible in the province (even though, informal households have exhibited some level of fuel-wood consumption).

Although, Statistics SA (2012) revealed that despite the general increase in connectivity proportion of people who use electricity for heating purposes in the Western Cape have decreased. This is most likely due to the high cost of electricity. Nevertheless, there remains a significant portion of the population within the region that either does not have access to the electricity supply by the national grid or cannot afford the cost of electricity. For example, in cape town city alone, there are over 200 informal settlements that are mixed with formal settlements (Franks and Prasad, 2014). These households have no formal electricity connection their accessibility to electricity is difficult more especially for domestic activities. Reports from the Western Cape Government (2013) showed many of these households typically resort to the use of biomass especially- fuel-wood for energy needs. Statistics collected during the 2011 census revealed that 7% of lighting needs, 13% of cooking needs and 21% of heating needs are satisfied through means other than electricity (Statistics SA 2012).

Fuel-wood protest in Katsina city in the early May 1992 organized by fuel-wood urban-based dealers in the middle of kerosene and gas shortage by withholding supplies in protest of the constant official harassment of drivers of long-distance delivery trucks (Cline-Cole, and Maconachie, 2015:13) explains the significance of fuel-wood to the Katsina households. A study revealed that low income and poverty have forced the majority of the people to use fuelwood and sorghum stalks (Silviconsult, 1991). Moreover, Musa (2011) examined fuel-wood trading and consumption rates in some urban communities of the savanna region of Nigeria. Katsina urban community was found to have the highest consumption rate of 21.9kg, followed by Bauchi and Zaria with 19.9kg and 19.6kg respectively.

Based on the above, investigating fuel-wood energy consumption is significant in the two areas. South Africa and Nigeria are the two strongest economies in Africa. Both countries are sufficiently different in terms of urbanization and income distribution. Western Cape Province is the most affluent province and leading in terms of modern energy access in South Africa. Conversely, Katsina State is rated as the second poorest in Nigeria after Sokoto State with poor energy infrastructure.

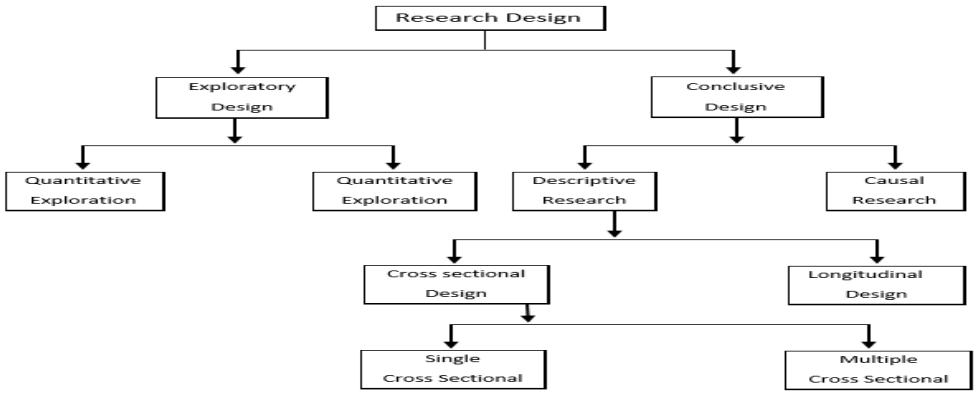
5.2 Research Design

This is a plan, structure, and strategy of the study in view which the researcher obtains the required answers to research questions as well as puts all variables under control. The plan has to do with the overall scheme of the program of the study, the structure gives the outline of the study in a paradigm manner, while the strategy specifies the method of data collection, presentation, and analysis. It also states the statistical tools adopted for data evaluation.
According to Adefila (2008:101), the need for research designs emanated from three (3) primary reasons namely;

1. To provide a solution to research questions
2. To enable adequate control of variances, and
3. To bring about reasonable conclusions.

Herek (2012:1) and Megan (2013:1) support the above premise, the moment a research problem has been formulated, the nature of the data and the analysis method will become evident. The nature of what researchers want to find out, the particular characteristics of the research problem, and the specific sources of information determines the reasons for choosing particular data collection and analysis methods. It will be required first to investigate the research problem, and then establish the type of data that needs to be collected, to make that analysis.

Research design as explained above is useful for fashioning out answers to research questions as well as help in controlling extraneous variance which will consequently affect the reliability of the conclusions. Research design, in general, derives its usefulness in being able to assist the researcher to have a laid down pattern on how to collect relevant data which will produce a clear message. It also helps to choose the appropriate techniques that will enable the processing of those messages and bring about purposeful findings that will allow for meaningful interpretation (Adefila, 2008:101). The result of all this is, to obtain clear, concise, comprehensive and unambiguous facts which will lead to the generation of such findings that can be transcribed into a meaningful result of the study. Malhortra and Birks (1999) classified research design into two broad areas namely; exploratory and conclusive. While the exploratory research seeks to give objective insight and comprehension into the problem confronting the researcher, the conclusive research on the other hand assists in the evaluation and selection of the best course of action under a given situation. The diagram below presents the various classification of research design under the two broad headings.
Figure 5.1: Classification of research designs



Source: Malthortra N.K and Birkss, D. A. (1999)

5.2.1 Exploratory Research

As the name connotes, this type of research is usually conducted with the primary aim of satisfying the researcher's curiosity by gaining more understanding of the subject issue. By so doing, the researcher will be at an advantaged position to understand the issue at stake. It also helps to access the feasibility of gaining more knowledge on a more careful study and it can also be employed to bring about better methods to be adopted on a more complex study.

It is a type of research that is handy in obtaining background knowledge most especially on the research of an isolated case or breaking a new ground entirely. Being a type of research that is always handy in a situation of breaking new ground, it is relatively very flexible and versatile, as regards to the method adopted since it may not follow any formal protocol as the situation on the ground will dictate the direction and the next course of action to be taken. This is so since, if a discovery is made that is quite different from the entire focus at the beginning, the researcher may redirect his exploration to that direction which may be followed to a conclusive end. However, with all the usefulness expected of an exploratory study, Babbie (1985) opined that exploratory study cannot provide satisfactory answers or solutions to research questions.
The two major classifications are qualitative and quantitative as shown in the table above.

5.2.1 Conclusive Research

Conclusive research is a type of research that helps the decision-maker to evaluate alternatives and select the best approach in a given situation. This is more formal and structured research. Moreover, by its nature, it usually covers large samples which are representative samples and such data is amenable to quantitative statistical analysis. The two classifications under conclusive research design are;
1. Descriptive research
2. Causal research

5.2.2 Descriptive Research Design

This has to do with the description of a scenario or occurrences or an issue as the case may be. It is conclusive research in the sense that it described a situation or event which is an end on its own. The descriptive research is again subdivided into cross-sectional survey research and longitudinal survey research.

5.2.3 Cross-Sectional Survey Research

This is a type of survey which seeks to measure some variable at a single time. It can be a single cross-sectional or multiple cross-sectional. In the case of a single cross-sectional, in the target population, only one sample respondent is drawn while more than one sample comes from multiple where the researcher receives information therefrom. The sample is drawn just only once.

The cardinal problem with cross-sectional research emanates from the fact that even though the researches are meant to explain a scenario that occurred over time, the conclusions are based on a particular time observation or a single time observation i.e. one-time observation is usually used to explain a casual process that happened over time. This presupposes that what is observed in that singular time is assumed to be an adequate explanation for all other times within the study period when the observation was not made (Adefila, 2008:106).

5.2.4 Longitudinal survey research

This is when a population from which a fixed sample has been selected in a survey on a given particular issue repeatedly within different times (Adefila, 2008:106). In this type of research, samples remain the same but investigation carried out are various and in different types.

Longitudinal research can be classified under three (3)

1. Trend studies
2. Panel studies
3. Cohort studies

Based on the above discussion, the current study is suited for a cross-sectional type of research, is that only one single respondent in each case was drawn from the target population of fuel-wood consumers and traders to address our research questions.

5.3 Research Methods

The specific method of data collection and analysis is one of the major elements of the research approach, Research method allows the researcher to follow data collection approach to acquire knowledge and skills in the field of research and prepare to apply the knowledge and skills on the study area. Three types of research methods are at our disposal namely; quantitative, qualitative and mixed methods. The nature of the research design determines the types of the method adopted. The study will use a mixed-methods approach combining quantitative and qualitative approaches in a single study to collect that will provide answers to our research questions.

5.4 Mixed Methods Research

The mixed methods research approach is popular in social, behavioral and health sciences research. Researchers collect, analyze, and integrate both quantitative and qualitative data in a single study or in a sustained long-term program of inquiry to address their research questions. As complex issues are dealt with in social, behavioral and health sciences, sometimes it is not enough to use either quantitative or qualitative methods alone to address the complexity. The combination of both qualitative and quantitative methods often referred to as mixed methods are most appropriate as it presents a synergy of information and also enhances the validity and reliability of research findings (Creswell, 2013:6)

Considering the paucity of data on fuel-wood studies, many studies and institutions like World Bank, African Development Bank, and USAID, have either used quantitative or qualitative methods in collecting data. For example, one of the most recent was the study of the fuel-wood value chain in 27 districts of Volta, Greater Accra, Central, Eastern and Western Region of Ghana using 1400 respondents by USAID/Ghana (2015).

Recently, the use of mixed methods is being encouraged because mixed methods research gives insight and deeper understanding of research, it gives more strength to the study than when only quantitative or qualitative methods are used.

5. 4.1 Justification for a Mixed Methods Research in Fuel-wood Energy Consumption Study

The mixed-method approach has become common in recent times due to renewal emphasis on finding explanations for behavioral patterns that cannot easily be quantified. The use of mixed method research is not unique to this thesis as many authors have endorsed it. The approach is believed to have promoted the conduct of excellent research and provided a complementary strength to one set of results with another. Several related studies on fuel-wood energy that have adopted a mixed-methods approach include, Moore et al., (2011) and Naibbi, (2013).

According to Creswell (2009), social and health science researchers deal with complex issues, the use of quantitative or qualitative methods alone is sometimes not enough to address this complexity. Different approaches should be used to focus on the same phenomenon that provides the same result, which is "collaboration" which means superior evidence for the result (Adamu, 2006:67). A mixed-method approach complements one set of results with another, to expand a set of results or to discover something that would have been missed if only the quantitative or qualitative approach had been used.

In light of the plethora of challenges facing developing countries in the areas of domestic energy supply and emerging environmental challenges, it is useful to use a well-thought-out combination of methods, this will undoubtedly increase the analytical richness of a study and provide an investigational basis for making policy recommendations.

Therefore, the combination of both quantitative and qualitative methods often referred to as mixed methods is the most appropriate. It presents the synergy of information and enhances the validity and reliability of research findings (Tashakkori & Teddlie, 2003). This study is about household fuel-wood consumers and fuel-wood traders, the use of a mixed-methods approach is justified.

5.4.2 Quantitative Research

The quantitative approach entails the use of surveys and statistical analysis in research (Babbie and Mouton, 2001:49). The central issue in quantitative research is the procedures that use precise definitions that use objectivity-seeking methods for data collection and analysis that are replicable so that findings can be confirmed or disconfirmed and are systematic and cumulative. The quantitative technique covers the ways research participants are selected randomly from a study population in an unbiased manner. The quantitative approach suits this study because participants who are the fuel-wood consumers and fuel-wood traders were selected randomly, in an unbiased manner to measure their opinion, any association or differences that exist in their responses to make comparisons. The survey method in the quantitative approach became imperative when the study involves a relatively large number of people to obtain data on the same issue or issues, often by posing the same question to all (Jankowicz, 2000: 222). This is especially relevant in this case where data that has the same questions is required from two different countries (South Africa and Nigeria). A quantitative approach is adjudged to save time and allows for flexibility in asking questions on many variables simultaneously (Adamu, 2006:62). Many researchers have employed the use of a quantitative approach with the help of a questionnaire in capturing fuel-wood energy consumption and fuel-wood businesses in South Africa and Nigeria. The most widely cited researches are that of Madubansi and Shackleton (2006), Dovie et. al (2002), Cline-Cole et. al (1987), Morenikeji et. al (2006), Nosiru et. al (2012). The authors used a quantitative approach and quizzed respondents through a questionnaire about their reasons for fuel-wood consumption and the significance of fuel-wood businesses on their livelihood. Based on the above discussions, this study recognizes the need for greater use of the quantitative approach for data collection, which was an important requirement for the research questions developed for the thesis.

5.5 Survey Methodology

Survey methodology includes cross-sectional and longitudinal studies using questionnaires or interviews for data collection with the intent of estimating the characteristics of a large population of interest based on a smaller sample from a population.

In this study, a questionnaire will be used to obtain data for;

O*bjective No.1 (a). Analyze and compare the dynamics of domestic fuel-wood energy consumption in South Africa and Nigeria. 1(b). To estimate the impact of socioeconomic and demographic variables on the level of domestic fuel-wood energy consumption in South Africa and Nigeria.*

Objective No.2. Analyze the contribution of fuel-wood business to trader's livelihood between South Africa and Nigeria.

5.5.1 Questionnaire

According to Adefila (2008: 124-132), a questionnaire is a form of correspondence developed to procure authoritative information from many persons through the medium of well-directed questions. The recipients of a questionnaire are those who recognize the importance of the subject and the merit of questionnaires as factors leading to the desired information.

In this thesis, a structured or close-ended questionnaire on a six-point Likert scale for fuel-wood consumers and a nine-point Likert scale for fuel-wood traders were adopted. The contents in the questionnaire will capture necessary information on domestic fuel-wood energy consumption and contribution of fuel-wood business on the livelihood of fuel-wood traders as per income, food security, health security and children education in both South Africa and Nigeria. The designed questionnaire targets households that are the direct consumers of fuel-wood and traders that sell fuel-wood to the households. The study divided the questionnaire into two, the first questionnaire is for the fuel-wood consumers, meaning those households who make use of fuel-wood for their domestic activities like cooking, boiling, and heating while the second questionnaire is for the fuel-wood traders, those people that sell fuel-wood to the household consumers.

Household consumption of fuel-wood can differ in several respects due to some socioeconomic and demographic factors such as gender, age, marital status, education level, household size, the structure of the house, monthly income, employment status, etc. At the same time, households are interested in income, health security, food security and education of their children to maintain a minimum threshold of livelihood that led them to engage in the fuel-wood business.

Random sampling survey was employed on the household fuel-wood consumers and household fuel-wood traders to whom questionnaires were administered to obtain data that is essential to the analysis in this research. The questionnaire was designed to capture information on socioeconomic and demographic variables on fuel-wood energy consumption and fuel-wood trade. The questionnaire in the study is designed in a close-ended manner that will prevent any variation in the responses from the respondents. The questionnaire was drawn through referring to questionnaires developed by NIDS, Human Science Research Council and Department of Energy, Nigerian National Bureau of Statistics (NBS), Central Bank of Nigeria and World Bank Group Wood Biomass Report.

The questionnaire for fuel-wood consumers has ten parts namely; information on socio-economic and demographic that include, household's educational background, family size, household employment status, household income, age, household employment, marital status, gender, structure of the house, availability of fuelwood, affordability of fuelwood, accessibility of fuelwood, fuel-wood energy expenditure and price of other energy, etc. The questionnaire for the fuel-wood traders has ten parts such as information on demographic and socioeconomic variables like the business of the household, living condition of the household, employment, household food consumption and expenditure, household health expenditure, spending on children's education, household assets**,** availability and accessibility of social services, etc.

5.5.2 Sampling Procedure

Considering the nature of the research that covers two countries with a large population of households who use fuel-wood for domestic activities and fuel-wood sellers who supplies fuel-wood, the study is faced with large or wide range of the population which because of convenience and practicability would not be feasible to cover all the sample units in the population. Selection of some members (sample) within the larger population to represent the entire population was made. At this point, three (3) questions were kept in the mind.

1. What is the size or how large is the study population (i.e. the entire population under focus)?

2. How many people or (study unit) do the study select (sample) for the study population to be adequately represented?

3. How (on what basis) will these people (or study units) be selected (or sampled)?

The study will make use of two-stage stratified random sampling technique was used in the study because of its simplicity. The technique is known for taking a large sample in a small group of a population. According to Adefila (2008:35) stratified random sampling enables the researcher to get a sample that is big enough to obtain valid conclusions about the study population thereby reducing the unnecessary collection of samples of other large groups. The first stage will involve the delineation of clusters of housing units called Enumeration Areas (EAs). In the second stage, simple random sampling will be used to select the households and traders residing in the housing units in the EAs.

5.5.3 Enumeration Areas (EAs) in South Africa and Nigeria

The study will make use of 608 enumeration areas (EAs) demarcated for Western Cape Province during the 2011census in South Africa. According to Dorlin (1993), Census data are particularly valuable for scientific research because they have the advantage of asking everyone in-depth questions for every location in the country concurrently. Three censuses were conducted in South Africa since the first democratic elections in 1994 (1996, 2001 and 2011). Census 2011 has captured many populations and household attributes as well as a variety of indicators (Census, 2011) that could be of immense help to our study.

In Nigeria, the 120 EAs that were demarcated to Katsina State by the Nigerian National Bureau of Statistics (NBS) for socio-economic development data will be used. NBS is the custodian of Nigeria's socio-economic data. The agency is responsible for the development and management of official statistics and the authoritative source of official statistics in the country. NBS is the apex statistical agency for all the three tiers of Government. NBS coordinates Statistical Operations of the National Statistical System in the production of Official Statistics in all the Federal Ministries, Departments and Agencies (MDAs), State Statistical Agencies (SSAs) and Local Government Councils (LGCs) Nigeria operates Federal System of government with 36 states and Federal Capital Territory and 774 Local Government Areas (LGAs).

5.5.4 Sample Size

To address objective no. (1a) of the study: Analyze and Compare the dynamics of domestic fuel-wood energy consumption in South Africa and Nigeria. (1b) estimate impact of socioeconomic and demographic variables on the level of domestic fuel-wood energy consumption in South Africa and Nigeria

Two (2) households (HH) or sampling units will be randomly selected from each of the EA and questionnaires would be administered to them, a total of 1199 households (HH) respondents will be collected in the 608 enumeration areas (EAs) in Western Cape Province. In each of the housing units where the households live, the enumerator will survey the odd number of buildings in the first selected

street and even number buildings in the second selected street and so on. In each household in the housing unit, a respondent will be identified and administered a questionnaire.

In Katsina State, Nigeria, ten (10) households (HH) or sampling unit will be randomly selected in each EA and questionnaires would be administered, and a total of 992 households (HH) response will be collected in the one hundred and twenty (120) Enumeration Areas (EAs) of Katsina State. The enumerators will survey the odd buildings in the first selected street and even buildings in the second selected street and it goes on until the questionnaires are exhausted. In each household in the housing unit, a respondent will be identified and administered a questionnaire.

To obtain data to address objective no 2: Analyze the contribution of fuel-wood business to the trade's livelihood between South Africa and Nigeria.

In the Western Cape Province, the same approach will be used in getting samples. The 2011 Census Enumeration Areas (EAs) will be used. In each three (3) EAs, one (1) fuel-wood traders will be given a questionnaire to fill. Meaning that the enumerators will randomly select 200 fuel-wood traders from the 608 EAs. It is pertinent to note that fuel-wood is sold in open market places, at shopping centers, in residential areas and along the roads and road corners. The selection of the respondents will be done randomly in depots and selling points in the EAs. In Katsina State, because the enumeration areas (EAs) are only 120, unlike Western Cape Province that has 608 EAs. The administration of a questionnaire to the fuel-wood traders will be done in such a way that in each one (1) Enumeration Area (EA), two (2) fuel-wood traders will be interviewed. The enumerators will randomly select fuel-wood traders and administered the 209 questionnaires in the depots and selling points that are located in the EAs.

5.5.5 Pilot Test

This is a mock, small-scale trial study or field-testing of a particular research component of the instrument or method to be used for data collection. In other words, it is a system designed to examine the practicability, reliability or validity of the intended methods of study. This will enable a "feel" of the suitability of such a method or a well-constructed study aimed at yielding definitive results. To put it simply, a pilot study is a process of conducting out a preliminary study by going through the entire research process with a small sample.

It is envisaged that pre-testing minimizes the respondent's difficulty in answering questions at the same time minimizes the danger of taking data that is incorrect and establishes the shortcomings of the design. A pre-test pilot study serves as a fore-runner that allows the researcher to identify potential problems that the proposed study my face to make amendments as deemed necessary. Although this means extra effort at the beginning of the research project, the pre-test or pilot study allows the researcher to identify problems on a rather small scale before embarking on a major study. This will allow for adaptations to save a good deal of resources in the long run. Before we embarked on collecting data from household fuel-wood consumers and fuel-wood traders, the questionnaire was pilot-tested among a small group of consumers and suppliers. For the fuel-wood consumers, the pilot test was carried out on 120 respondents in South Africa and 120 respondents in Nigeria respectively. For the fuel-wood traders, 25 respondents were used in South Africa and Nigeria. The enumerators interviewed an average of twenty respondents per day making a total of six days to complete the 120 questionnaires for the fuel-wood consumers and the fuel-wood traders, 5 respondents were interviewed per day making a total of 25 respondents in five days. The exercise took five to ten minutes per questionnaire and the pilot test was conducted between 5th July- 10th July, 2018 in Katsina state while in the Western Cape Province the exercise took place between 20th September – 25th September, 2018. The responses received from the pilot tests conducted in South Africa and Nigeria showed the reliability of the instrument in getting the information needed for the study.

5.6 Data Collection Procedure

The data collection took place in Nigeria from the 17th July, 2018 to 20th August, 2018. A supervisor was appointed to control the collection of data due to the vast geographical area and number of EAs involved. Each enumerator was sent to a specific EA under the supervision of a supervisor who has many enumerators under him to refer to and from whom to get assistance. A councilor representing various wards were contacted by supervisors and enumerators for introduction and guidance. Enumerators were provided with detailed EAs and the number of households in each EA. The process went smoothly in all the EAs and no major problems were reported. 992 questionnaires were received from fuel-wood consumers and 209 questionnaires were received from fuel-wood traders given the response rate of 78% for fuel-wood consumers and 93% for fuel-wood traders. In South Africa, data collection took place from 15th October, 2018 to 10th November, 2018. Enumerators were engaged under a supervisor in the collection of data based on demarcated enumeration (EAs) and households, and councilors were used for introduction and guidance. 1199 questionnaires were received from fuel-wood energy consumers and 200 questionnaires were received from fuel-wood traders, given the response rate of 85% for fuel-wood consumers and 95% for fuel-wood traders.

5.7 Quantitative Method of Data Analysis

It is important to note that, the study attempts to answer three (3) research questions using different methods of data analysis. We start with the quantitative method that has two (2) research questions.

(1) What are the impacts of socioeconomic and demographic variables on domestic fuel-wood consumption in South Africa and Nigeria? The study employed the use of frequency tables, chi-square test, and logit regression to address this research question.

(2) Does fuel-wood business improve the lives of traders in South Africa and Nigeria? The study used frequency tables to establish a livelihood contribution of fuel-wood business on fuel-wood trader as per income, food security, health security, and children's education.

In reviewing the use of quantitative method analysis techniques applied in this study, many approaches were found to have been used to estimate the impact of socioeconomic and demographic variables on fuel-wood energy consumption. One recent study was undertaken by Kuunibe et al (2013), they applied a logit regression and frequency tables to examine the factors determining household decisions regarding wood-based biomass fuel for cooking purposes in the upper west region of Ghana. The result of their study showed that household size, price of wood, level of education and income had a negative relationship with fuel choice. Other studies that applied logit regression methods include, Peng et al (2010), in Hubei, China, Sehjpal et al. (2014) in India, Lee et al. (2015) in Eastern Indonesia. Kuunibe et al (2013:184) argue that the advantage of using logit regression in analyzing factors that drive households to consume uses fuel-wood is that it does not require any strict adherence to the assumptions of normality, linearity, equal variance and covariance of error terms.

The use of frequency tables in the analysis of the contribution of fuel-wood business to trader's livelihood is further supported by USAID Ghana' (2015) study of fuel-wood Value Chain. The study analyzed the fuel-wood value chain for the fish smoking industry in four coastal regions of Ghana. Thus, the techniques used are suitable for data analysis in this study.

5.8 Model Specification

5.8.1 Frequency Distribution

Frequency tables are basic means of data presentation. A very good frequency table aids data analysis by displaying facts, figures or information in an orderly fashion within a small space so that an important result can easily be seen in a glance, and hence, enables an easy assessment of the relationship between variables (Adefila, 2008:8). Furthermore, frequency tables make easy the physical presentation of

numerical facts and the attention of the readers is automatically directed to relevant information. Some of the possible reasons that frequency tables are constructed are:

1. Data is rendered easily comprehensible
2. Tables leave a lasting impression
3. Comparison is easier and quicker to make
4. Unnecessary details and repetitions are avoided
5. Summation of items and detection of errors and omissions are made easier

5.8.2 Chi-Square Analysis

Chi-square test (X^2) is a procedure for testing whether two categorical variables are related to each other in any way. Chi-square test help in assessing the independence of two variables in a contingency table. According to Hair et al. (2010), Researchers use the Chi-square test to test for statistical significance between the frequency distributions of two or more nominally scaled variables in a cross-tabulation table to determine if there is an association between the variables. Chi-square test is based on two underlying assumptions:

1. Observation is randomly selected from a large population.
2. The number of expected observations in a given category should be large, at least no category should be less than an expected frequency of five observations in any analysis.

The expected frequencies constitute the prediction made under the null hypothesis. The steps to follow in testing the hypothesis are as follows:

i. Determine whether the data were collected using a nominal or ordinal scale.
ii. State the null (H_0) hypothesis.
iii. Perform the analysis using the statistics and establish whether to reject or retain the null hypothesis.
iv. Interpret your result in line with the stated hypothesis.

The next thing to do is to calculate the Chi-square (X^2) score. The X^2 score summarizes the discrepancies between the observed and expected frequencies. The general rule for calculating expected frequencies for the X^2 Goodness-of-fit test is summarized in the formula presented below:

$$X^2 = \sum \frac{(O - E)^2}{E}$$

Where O= observed frequency in a given category.
E= expected frequency in the same given category.

It is important to note that the Goodness-of-fit test is the most frequently used kind of non-parametric, it is a very suitable statistical tool for testing both countable and rank-able data.

5.8.3 Logit Regression

Regression is a technique that shows the relationship between two variables, it is predicated on using the relationship for prediction. Meaning that, if two variables were correlated perfectly, then knowing the value of one score permits a perfect prediction of the score on the second variable. Generally, whenever two variables are significantly correlated, the researcher may use the score on one variable to predict the score on the second. Researchers want to predict one variable from another to perform a regression analysis because of many reasons. Some of these reasons were explained in homoscedasticity assumptions by Ho (2006).

1. For each subject in the study, there must be related pairs of scores. That is, if a subject has a score on variable X, then the same subject must also have a score on variable Y.
2. The relationship between the two variables must be linear, i.e., the relationship can be most accurately represented by a straight line.
3. The variables should be measured at least at the ordinal level.

4. The variability of scores on the Y variable should remain constant at all values of the X variable.

The purpose of logit regression is to model the relationship between the independent/explanatory and dependent/ response variables. The logit regression equation with eight independent variables on household's decision to consume fuelwood energy is hypothesized to be determined by a combination of socioeconomic and demographic factors namely; gender, age, marital status, education level, household size, structure of the house, monthly income and employment status. Therefore, the equation is written as follows;

$y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + \acute{\varepsilon}_i$

Where:

y represents the value of the dependent variable, what is being predicted or explained
b_0 (Alpha) is the constant or intercept
b_1 represents the slope (beta coefficient) for *x1*.
x_1 represents the first independent variable that is explaining the variance in *y*
b_2 represents the slope (beta coefficient) for *x2*
x_2 represents the second independent variable that is explaining the variance in *y*
b_3 represent the Slope (Beta coefficient) for *x3*
x_3 represent the third independent variable that is explaining the variance in *y*
b_4 represents a slope (Beta coefficient) for x_4.
x_4 represents the fourth independent variable that is explaining the variance *y*
b_5 represents a slope (Beta coefficient) for x_5.
x_5 represents the fifth independent variable that is explaining the variance *y*
b_6 represents a slope (Beta coefficient) for x_6
x_6 represents the sixth independent variable that is explaining the variance *y*
b_7 represents a slope (Beta coefficient) for x_7
x_7 represents the seventh independent variable that is explaining the variance *y*
b_8 represents a slope (Beta coefficient) for x_8
x_8 represents the eight-independent variable in explaining the variance *y*
$\acute{\varepsilon}_i$ represents the error term, disturbance term, or noise. This variable associated with an estimated measured *y* variable and captures all other factors which influence the dependent variable.

The regression equation for fuel-wood energy consumption is represented as:
Where *y* is fuel-wood consumption= = $b_0 + b_1x_1$ (gender) + b_2x_2 (age) + b_3x_3 (marital status) + b_4x_4 (education level) + b_5x_5 (household size) + b_6x_6 (structure of the house) + $b_7x_7 + b_8x_8$ (employment status) + $\acute{\varepsilon}_i$ (is the error term). Indeed, both theoretical and empirical literature has shown that these variables are expected to likely determine fuel-wood energy consumption among households. The advantage of using logit regression is because it does not require any strict adherence to the assumptions of normality, linearity, equal variance and covariance of error terms (Hair et al., 2006, Kuunibe, 2013).

5.9 Measurement of Selected Variables for Logit regression

5.9.1 Income

Several empirical econometric studies have investigated the effects of income on fuel-wood energy consumption. Numerous studies have also shown the significance of income in the uptake of modern fuels as against the uptake of traditional fuels. For example, Hosier and Dowd (1987) found Zimbabwean urban households have moved away from wood to kerosene and electricity as their income rises. Similarly, Baiyegunhi and Hassan (2014) in rural Nigeria showed the transition from fuelwood to kerosene, natural gas and electricity occur along to rising income. The same trend was observed in the urban Indian households by Gupta and Köhlin (2006) where households moved from fuelwood and kerosene to LPG (Light Petroleum Gas) due to a rise in income. Lay et al. (2013) in Kenya revealed rising expenditure induces households to choose electricity and solar energy over wood and kerosene. Also,

Démurger and Fournier (2011) provided evidence showing Chinese rural households responded to a rising wealth by substituting coal for firewood. However, Muller and Yan (2016) argued that a simple pattern of income dependence is increasingly questioned by emerging empirical evidence. The effect of income on fuelwood demand in rural and urban households may sometimes be insignificant regardless of how income is measured. Mekonnen (1999), Israel (2002), Lee (2013) and Guta (2014) reported that in some context's fuelwood is not an inferior good as often thought. Edwards and Langpap (2005) showed wood as a normal good for low-income households, but an inferior good for high-income households in Guatemala (i.e., an inverse U relationship between income and wood consumption). Heltberg (2004, 2005) observed in different countries that increasing income may push households to add modern fuels into their mix as partial rather than perfect substitutes for traditional ones. Based on these pieces of evidence, household income is hypothesized to have a positive relationship with fuel-wood consumption. This study measured income in determining household fuel-wood consumption.

5.9.2 Household Size

Households with more family members are expected to consume more fuel-wood than households with smaller family members. According to Prais and Houthakker (1995), variations in household size have large effects on household consumption. In situations where income does not change much across the households then the size of the household explains consumption variation more than income. Many studies have shown that larger households prefer fuel-wood energy or dirty fuels over clean energy Reddy (1995), Ouedraogo (2006), Rao and Reddy (2007), Pandey and Chaubal (2011), Özcan et al. (2013) and Muller and Yan (2016). One possible reason is that household size is often larger in poorer households that cannot afford modern fuels. However, Hosier and Dowd (1987), Gupta and Köhlin (2006) and Baiyegunhi and Hassan (2014) have shown the opposite trend that established larger households decided to choose modern fuels instead of fuel-wood or dirty fuels. Heltberg (2004) provided a middle course where households combined dirty fuels (fuel-wood) and modern fuels (i.e. fuel stacking). These arguments are enough to hypothesize that there is a positive relationship between household size and fuel-wood consumption.

5.9.3 Prices of other energy sources

One challenge that is facing the fuel-wood industry is the lack of cross-sectional data on fuel-wood prices making it impossible to incorporate the effect of prices on consumption coupled with the fact that fuel-wood prices are not captured in the national statistics of most developing countries. Literature has emphasized the role of other fuel prices in household fuel use. Evidence suggests that there is a significant relationship between the prices of other fuels (i.e kerosene, gas coal) consumed and the probability of choosing fuel-wood. Peng et. al (2010) on their work in rural China revealed that an increase in the prices of coal had increased the probability of households choosing biomass (fuel-wood). Heltberg (2005) has reported a significant substitution effect between light petroleum gas and wood in Guatemala because of price. Similarly, Pitt (1985) found a significant substitution effect between kerosene and firewood in Indonesia due to price differentials. However, these findings were challenged by pieces of evidence provided by other authors like Kaul and Liu (1992) and Zhang and Koji (2012). Their findings revealed an insignificant estimated coefficient of coal prices in explaining fuelwood consumption in China. Gupta and Köhlin (2006) concluded that coal and fuelwood have negative cross-price elasticities in India. Akpalu et al. (2011) also claimed to have observed complementarities between LPG and firewood in Ghana. Lay et al. (2013) reported a statistically significant negative effect of kerosene price on choosing wood in Kenya. The above arguments have provided the latitude to hypothesize that the price of other energy has a positive relationship with fuel-wood consumption.

5.9.4 Educational qualification

The level of education may affect the possibility of households consuming fuel-wood. Households easily perceive and respond to information faster on innovation if well-educated (Feder et. al1985). Meaning

that information regarding the environmental and health implications associated with fuel-wood consumption can easily be understood with a high level of education. According to Thomas (1972) educational attainment is a factor affecting psychogenic needs that arise as a result of association with other people and the need for affiliation, achievement, and power. Thus, the consumption pattern of people depends on their associates and reference groups. In the case of consumption, level of education determines the level of exposure of the household to different technologies, lifestyle, social class and status in the society. It could be hypothesized that educated households are likely to be associated with the use of electricity and other sophisticated methods of domestic cooking, boiling, and heating than the use of fuel-wood. Likewise, more education generally implies higher income. In India and Nigeria, higher education was found to have induced households to move away from fuel-wood dependence towards the use of kerosene and LPG, Gupta and Köhlin (2006) and Baiyegunhi and Hassan (2014). Households with a higher education level in Ethiopia were found to have less likelihood of choosing fuel-wood, while more likely to choose electricity for their domestic consumption (Gebreegziabher et al., 2012). Additionally, lay et al. (2013) revealed that higher-level education is associated with a higher probability of using electricity and solar energy for domestic purposes in Kenya than in fuel-wood and kerosene.

5.9.5 Age

Age is an important demographic factor that potentially affects fuel-wood consumption. Although empirical findings on the role of age in explaining household fuel use remain contradictory (Muller and Yan, 2016). However, the majority of the studies found a positive relationship between the age of the household and fuel-wood consumption. Older people need to use more energy, especially for heating purposes because they more often stay at home. Edwards and Langpap (2005) showed a positive and significant association of household head's age with fuel-wood consumption in Guatemala. According to Rahut et al. (2014), households with older heads of the household prefer fuelwood to electricity in Bhutan. In northern China, Démurger and Fournier (2011) found that household average age has a positive and significant impact on fuel-wood consumption in rural households of Northern China.

5.9.6 Household employment

Household employment is a significant factor as there is the probability that if the head of the household is employed it will affect the type of energy consumed by the household members. The probability of using modern energy is higher if the household is employed. This goes to show that households with employment may always be committed to monthly earnings and payment of monthly bills for domestic energy. Conversely, unemployed heads of households even if they can generate income may be unable to meet with the bills of modern energy because of the unreliability of their source of income, hence fuel-wood may be the commonest source of domestic energy.

5.10 Reliability and validity of the questionnaire

5.10.1 Reliability

Reliability in research is a term that also connotes reproducibility or repeatability. It is the stability or consistency of the occurrences of an event. In other words, it is the extent to which the same or similar information is supplied or obtained when the measurement is repeatedly performed. Reliability implies that someone else applying the same principle in the same situation should be able to obtain findings that are the same. If a method is not reliable, the repeated performance of the method will result in outcomes of diverse variability or change in the measured attribute. Sometimes a method may be reliable but not valid. As far as this study is concerned, all the necessary changes were made after the pilot test so that the reliability of the instrument can be improved. Moreover, the interrelated question that is in the questionnaire will also enhance the reliability and validity of the instrument. The most popular and frequently used measure of internal consistency and reliability of an instrument in the study is the

Cronbach alpha coefficient. Cronbach's Alpha was used to test for inter-item consistency. Based on the Cronbach alpha coefficient, those reliabilities in the range of 0.8 and those in the range of 0.7 are deemed as acceptable. If the closer the reliability coefficient gets to 1.0, the better.

5.10.2 Validity

Primarily a study is usually set out to measure a particular thing, the ability of a study to accomplish this primary objective for which it has undertaken refer to as validity. In other words, validity is the ability of a study to measure what a researcher primarily set out to measure or achieve.

Validity is attained when the independent variables have a recognized effect on the dependent variables in the course of the research. Hence, the validity of the research design could be said to have been fulfilled when the relationship exists between the independent and dependent variables are clearly unambiguous, non-complex and easily understood without complications (Adefila, 2008:113).

5.10.3 Criterion validity

This is the extent of correlation (both in size and direction) between observed and true measurements. Most research outcomes could be compared with a criterion. Otherwise known as a standard to which either true position or close in the truth. By this type of comparison, the extent to correlation (both in size and direction) between the observed and the true measurement will accept the criterion validity. As earlier highlighted, the recent study adapted some instruments that were tested and found that the data collected was found to match with the data that used criterion validity, hence it assumes that the instrument used in the research could be valid. This is despite the existence of extraneous variables that are always in the system.

5.10.4 Predictive Validity

This is a situation whereby a study is conducted to see the relationship between its outcome and subsequent event that follows. The extent to which subsequent events confirm the outcome of the study will determine the degree of the predictive validity of the result. The extent to which subsequent events confirm the outcome of the study will determine the degree of the predictive validity of the result.

5.10.5 Content Validity

Content validity involves measuring all the component elements of the variables. When a study involves the measurement of a composite variable (with many components) to appraise it, validity will involve the researcher ensuring that all the component elements of the variable are measured. The measurement and confirmation of all the elements therefrom determine the degree of content validity. In the current study, content validity was used through meticulous design and the development of questionnaires. Expert advice in the particular field of study was sought, and criticisms, comments and issues raised were all incorporated in the questionnaire. In this study, expert supervisors of the thesis assessed and refined the questionnaire to capture all the relevant variables in the study.

5.10.6 Construct Validity

This has to do with the degree of relationship that exists between a particular measure and other related measures consistent with theoretically derived hypotheses as regards the concept or construct under measurement or observation. In other words, this is to say that, a measure (presence) of one variable or attribute would imply the occurrence or presence of other related variables or factors as the case may be.

5.10.7 Consensual Validity

Instances do arise where expert's opinion needs to be sought on some topical issues confronting a researcher, in such a situation, when experts gather and agree that a measure is valid, such common or consensual agreement constitute what is called consensual validity.

5.11 Qualitative research

Qualitative research is a method or technique of knowledge generation through face-to-face contact between the researcher and the subject of the research. It involves personal involvement and empathic understanding of behavior and attitudes in their natural setting and is connected with the nature and content of which is being said as opposed to the frequency with which it is said or the artificial setting surveys (Babbie and Mouton, 2001: 270). Knowledge and information are collected in a qualitative approach in many ways. These techniques include; focus group discussion (FGD), rapid appraisal and participant observation.

In recent times, focus Group Discussion (FGD) is becoming increasingly popular in social and behavioral sciences research for exploring what individuals believe or feel as well as why they behave in the way they do. FGD offers a useful vehicle for involving users. In a focus group discussion, several respondents can be systematically or simultaneously interviewed (William, 2012:54). According to Krueger (1998), because of the strength of convenience, economic advantage, high face validity, and speedy results of FGD is applauded and widely used in recent times. Many authors also subscribed to the notion that FGD is advantageous for its purposeful use of social interaction in generating data (Merton et al., 1990). Its use of social interaction distinguishes it from other qualitative research methodologies (Merton et al., 1990).

Researchers, such as Hughes and Du Mont (1993: 776) have characterized focus groups as group interviews. They alluded that focus groups are in-depth group interviews employing relatively homogenous groups to provide information around topics specified by the researchers. Kreuger (1998: 88) also defined focus group discussions as a carefully planned discussion designed to obtain perceptions on a defined environment. Myers (1998: 85) also viewed focus group discussion as performances in which the participants jointly produce accounts about proposed topics in a socially organized situation. Participants and the moderator are 'operating under the shared assumption that the purpose of the discussion is to display opinions to the moderator. Furthermore, Dlakwa (2006:45) describes FGD as a rapid appraisal technique that involves a semi-structured discussion on a selected topic by a group of six to ten people. FGD's main aim is to elicit responses from participants on particular issues based on their personal views, knowledge, and experiences. In essence, FGD enables researchers to gain "insights into people's shared understandings of everyday life and how individuals are influenced by others in a group situation.

The advantage researcher drive from the use of focus group discussion is the sense of belonging and cohesion between the researcher and the participants of the group discussion. The participants feel safe with the researcher and share information, hence the type and range of data generated through the social interaction of the participants are often deeper and richer. Furthermore, Onwuegbuzie et al (2009:2) stressed the need for FGD in qualitative data collection because it involves engaging a small number of people in an informal group discussion (or discussions) that focused around a particular topic or set of issues. Based on the above attributes of FGD, this study utilized the FGD method to obtain data for *objective no 3: Determine factors affecting fuel-wood energy sector funding from the perspective of stakeholders (Case study of Nigeria).*

5.11.1 Sampling size and data collection

The researcher also made use of the same enumeration areas (EAs) and randomly selected ten (10) fuelwood sellers as a focus group. Ten (10) groups were formed in Nigeria making a total of 100 fuel-wood traders. The interviews for each group were conducted from 25th August to 30th August, 2017 by the moderator (researcher) and assistant moderator following Krueger's (1994) suggestion, that for an ideal FGD there must be a moderator team that typically comprised of a moderator and an assistant moderator. The responsibility of a moderator (researcher) is to facilitate the discussion, prompting members to speak, requesting the talkative members to let others talk and encouraging all members to participate. Series of questions were asked to the fuel-wood traders by the moderator (researcher) and their responses were recorded through audio by the assistant moderator.

5.11.2 Qualitative method analysis technique

To date, there has not been a particular framework that delineates the type of technique for qualitative analysis of data from focus group interview despite the method has been in existence for around eighty years (Morgan, 1998, Onwuegbuzie et al, 2009). However, in this study, a Content Comparison Analysis was used in the analysis of data obtained from the FGD held with fuel-wood traders to answer *research question No.3: What factors affect fuel-wood energy sector funding?* Content comparison used to describe the respondent's utterances and classify the various meaning expressed by the respondents. The technique was used to understand the diverse aspects of data collected through an investigation of the relationships between fuel-wood business and financing institutions to determine the factors affecting fuel-wood energy sector funding in Nigeria. The following steps were taken:

1. Data grouping: Group answers from all the interviews to each question were grouped. For each question, what respondents say was grouped and coded.

2. Information level: All the answers given by the groups were organized and classified and each group was leveled to its answer.

3. Knowledge findings: Information or answers obtained were evaluated to see if it can answer the research question.

4. Themes arising from the results: Three themes arise from the results, they are;

1. Lack of access to finance,
2. Lack of awareness of available financial services and
3. Lack of government support.

5.12 Ethical approval

Ethical approval from the University of the Western Cape's Higher Degree Committee was obtained. For the study to adhere and respect the highest ethical standard, an outmost precaution was also taken by the researcher. In the approval, issues relating to confidentiality, anonymity and participant's right of refusal to participate in the surveys and interviews were captured. The researcher's responsibility is to avoid omission, falsification, misinterpretation, and fabrication of data that will in any way distort the research outcome. To this effect, a clear and complete record of data acquired as well as proper referencing of ideas and data sources were made to preserve accurate documentation of observed facts. Also, respondents were fully and adequately informed about the research. As the analysis of fuel-wood energy consumption, fuel-wood business and fuel-wood energy sector financing requires information from the household fuel-wood consumers and fuel-wood energy traders, due consideration was given to the ethics. Thus, the researcher informed the participants about the purpose of the study and they were given the assurance that their identity would be kept confidential even when research report or publication is published to safeguard their welfare and safety. They were also clearly informed that they had a full personal right not to accept being interviewed or they can withdraw at any point during an interview, and even to request for the deletion of their recordings without incurring any negative consequences whatsoever. The permission of the authorities was asked before embarking on the distribution of the questionnaire. Field assistance all times carried their identification and identify themselves to the respondents.

5.13 Conclusion

Comparing domestic fuel-wood energy consumption, the contribution of fuel-wood energy business to trader's livelihood between countries and making a case study of the fuel-wood energy sector funding depends on many factors, issues, and constructs that were discussed in chapter 2, 3 and 4. This chapter explains how the research was conducted in the Western Cape Province of South Africa and Katsina State in Northern Nigeria. In this regard, the chapter explains how samples were collected, sources of data, instruments used in collecting data, descriptive statistics, econometric model and content comparison

analysis adopted to obtain and analyze the data. In the research design that described the methodological framework for the thesis, we elaborated on the appropriateness of the methods, tools, and instruments that were used throughout the research project life cycle of data collection, analysis, and interpretation. The necessity to use the mixed-method approach (qualitative and quantitative and approaches) in the methodology to make a comparative analysis of domestic fuel-wood energy consumption was also demonstrated.

A two-stage stratified random sampling was applied at Enumeration Areas (EAs) and household levels. Cross-sectional data were collected through a structured questionnaire on a set of household fuel-wood energy consumers and fuel-wood energy traders. Additionally, focus group interviews were conducted with the fuel-wood energy traders in Nigeria. Descriptive statistics, Logit regression, and Content comparison analysis were applied as methods of analysis, meaning that each research question has a separate method of analysis. Frequency tables were used to compare the dynamics of domestic fuel-wood energy consumption between South Africa and Nigeria. Chi-square analysis and Logit regression were specified and variables were defined and described to compare the impact of socioeconomic and demographic variables of domestic fuel-wood energy consumption between South Africa and Nigeria with their hypothesized signs expected. Frequency tables were used as an empirical estimation strategy to estimate and compare the contribution of fuel-wood energy business on the livelihood of the traders as per income, food security, health security, and children's education. Finally, Content comparison analysis is believed to be more appropriate in the analysis of the focus group interviews conducted with the fuel-wood energy traders to determine factors affecting fuel-wood energy sector funding in the case study area (Nigeria).

CHAPTER SIX: FINDINGS AND DISCUSSION

This chapter compares domestic fuel-wood energy consumption between South Africa and Nigeria in terms of frequency of using fuel-wood as the major source of energy, reasons for using fuel-wood as the major source of energy and reasons for combining fuel-wood with other forms of energy using descriptive statistics and econometric methods. The chapter also discussed results from data collected on dynamics and socioeconomic variables of domestic fuel-wood energy consumption, contribution of fuel-wood business on traders livelihood as per income, food security, health security and children education from 1199 fuel-wood energy consumers in South Africa and 992 in Nigeria, and 200 fuel-wood traders in South Africa and 209 in Nigeria as well as factors affecting fuel-wood energy sector funding through FGD from 10 groups of fuel-wood traders in Nigeria.

6.1 Findings and Discussion (objective 1a): Analyze and Compare the Dynamics of Domestic Fuel-wood Energy Consumption in South Africa and Nigeria.

6.1.1 Frequency of Using Fuel-wood as Major Energy Source in SA and NIG.

Table 6.1: Frequency of using fuel-wood as major energy source SA

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid		Once a day	292	24.4	24.4	24.4
		Twice a day	729	60.8	60.8	85.2
		Trice a day	112	9.3	9.3	94.5
		Other	48	4.0	4.0	98.5
		5	18	1.5	1.5	100.0
		Total	1199	100.0	100.0	

A recent study on biomass consumption for Sub-Saharan African countries has indicated that fuel-wood is the dominant source of energy for household activities, where 81% of the households rely on it (World Bank, 2011). The frequency table 6.1 for consumer impact on energy source in South Africa showed out of 1199 of the respondents 24.4% responded that they frequently use fuelwood energy source once in a day, 60.8% said they use energy source twice. This is an indication that more people use fuelwood more than once a day and less than three times a day. The fact that South Africa has attained remarkable success in the electrification project, Petrie and Macqueen (2013) claimed that there is significant inequality in South Africans energy use. Roughly 20% of urban households and half of the rural households are not connected to electricity. This makes fuel-wood consumption frequent among households.

Table 6.2: Frequency of using fuel-wood as major energy source NIG

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Once a day	13	1.1	1.3	1.3
	Twice a day	88	7.3	8.9	10.2
	Trice a day	866	72.2	87.4	97.6
	Other	24	2.0	2.4	100.0
	Total	991	82.7	100.0	
Missing	System	208	17.3		
Total		1199	100.0		

According to Cline- Cole, and Maconachie (2015:9), Nigeria is the single largest producer and consumer of fuel-wood, the country consumes 85% of the total wood consumed in West Africa. The frequency table 6.2 for consumer impact on energy source in Nigeria showed out of the 992 of the respondents 1.1% responded said they use fuel-wood as their source of energy once in a day, 7.3% said twice a day and 72.2% said they use fuel-wood as a source of energy thrice a day. This shows that more people use fuelwood three times in a day. Based on the result, the use of fuel-wood in Nigeria surpasses the use of other forms of energy despite the country is so rich in crude oil. Nigeria has more than half of the continent's domestic refining capacity to meet the growing demand for modern energy for household consumption. Unfortunately, there is still a deficit due to the smuggling of petroleum products and poor refineries maintenance caused by corruption. That is the main reason fuel-wood consumption becomes very high in Nigeria surpassing all the countries in Sub-Saharan Africa, including South Africa.

In comparing the results on how frequent Nigerians use fuelwood energy with their South African counterpart. From the results, it can be seen that Nigerians households use fuelwood more than South African households. This could be due to differences in energy policies. According to Nigeria's National Renewable Energy Efficiency Policy (NREEP, 2015), only 40% of Nigerians can boast of having electricity. In South Africa, access to electricity migrated from 36% in 1994 to 87% in 2012 as a result of Power Sector Reform initiated by South Africans democratically elected government since 1994 even though there are still challenges of grid connectivity in rural areas and some urban areas more especially urban informal settlements. The South African Integrated National Electricity Programme made electricity always available but in Nigeria, load shedding is a constant phenomenon.

6.2.2 Reason for Fuel-wood as Major Energy Source in SA and NIG

Table 6.3: Reason for fuel-wood as major energy source SA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A bit affordable	143	11.9	11.9	11.9
	Relatively affordable	817	68.1	68.1	80.1
	Affordable	135	11.3	11.3	91.3
	Very affordable	104	8.7	8.7	100.0
	Total	1199	100.0	100.0	

According to a survey on Energy-Related Behavior and Perceptions in South Africa (2011), the household spends 14% of its monthly income on energy needs which is higher than the international benchmark of 10%. Household choice of particular energy over the other energy could be due to affordability reasons. Frequency table 6.3 showed 68.1% of the respondents in South Africa confirmed that the reason they use fuelwood as a major energy source is that it is relatively affordable. 8.7% said is very affordable11.9% said it is a bit affordable while 11.3% said it is affordable. The difference between those that accepted using fuelwood is a bit affordable and those that said it is very affordable was only 0.3%. This shows that more people use fuelwood because it is relatively affordable. This result corroborated the findings of Madubansi and Shackleton (2003) on five electrified rural villages in the Bushbuckridge region of Limpopo that showed fuel-wood remained the most important energy source even after electrification for affordability reason.

Table 6.4: Reason for fuel-wood as major energy source NIG

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid		A bit affordable	30	2.5	3.0	3.0
		Relatively affordable	48	4.0	4.8	7.9
		Affordable	748	62.4	75.5	83.4
		Very affordable	164	13.7	16.5	99.9
		6	1	.1	.1	100.0
		Total	991	82.7	100.0	

Missing		System	208	17.3		
Total			1199	100.0		

Human Development Index (HDI) scores for Nigeria have consistently been among the lowest in the world since 1980, revealing a slow underlying rate of improvement and painting a clear policy challenge facing the country (NHDR, 2015). Life in Nigeria involves a daily struggle against hunger and a total lack of housing and health facilities This prevailing situation has serious ramifications on energy use among Nigerian households. Respondents were asked to state the reason for using fuel-wood as a major source of energy. The result in table 6.4 shows that 62.4% of the respondents confirmed the reason they use fuelwood as a major energy source is that it is affordable. 13.7% said it is very affordable, 2.5% said it is a bit affordable while 4.0% said it is affordable. This showed more people use fuelwood in Nigeria because it is affordable. This result corroborated the findings of Maconachie et al., (2009), Abd, Razaq et al., (2012) and Zaku et al., (2013) that showed modern energy prices have increased over the years making fuel-wood a viable alternative energy as many poor households cannot afford the cost of modern energy. It is estimated that from 1991 to 2012 about 73% of Nigerian households were badly affected by the increase in modern energy prices (Abd, Razaq, et al. 2012).

Comparing the results on reasons Nigerian households use more fuelwood than South African households as a major energy source compared to South Africa. The results show that fuelwood is the major energy source in Nigeria and Nigerian households use more fuel-wood as energy than South Africans because it is affordable. Apart from poor energy infrastructure Nigeria, there is a high cost of energy as a result of the gradual withdrawal of subsidy by successive regimes. South Africa on the other hand, made a remarkable stride and has been making an effort in protecting poor households against high energy costs. For example, Free Basic Electricity (FBE), Free Basic Alternative Energy (FBAE) and Inclined Block Tariff (IBT) policies were initiated to ensure that poor households do not get trapped into energy poverty and vulnerability (HSRC and DoE, 2011).

6.2.3 Reason for Combination of Fuel-wood with other Energy Types in SA and NIG

Table 6.5: Reason for the combination of fuel-wood with other energy types SA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Price	143	11.9	11.9	11.9
	Culture	817	68.1	68.1	80.1
	Family	135	11.3	11.3	91.3
	Other	104	8.7	8.7	100.0
	Total	1199	100.0	100.0	

One of the criticisms that led to many proposals for the need to modify the energy ladder hypothesis was its inadequacy to capture other factors that drive household energy used apart from income. Authors questioned the validity of the energy ladder model for its failure to consider the influence of demographic, cultural and socioeconomic factors, instead of focusing exclusively on income. In chapter four of this study, we discuss the significance of other factors apart from income like education, fuel availability, household composition, tradition, and urbanization in household decision to consume energy. To this end, respondents were asked to state their reason for combining fuel-wood with other energy types (fuel stacking). According to above table 6.5, 68.1% of the respondents in South Africa said the reason they combine electricity and fuelwood for cooking and other domestic activities is because of culture. 11.9% said it is due to price while 11.3% said it is due to family size. The difference between those that said using both electricity and fuelwood is due to price and those that said it is due to the family is only 0.3%.

This shows more people use both electricity and fuelwood because of culture and price. These findings are similar to Akpalu et al. (2011) study in Ghana that shows the complementarity between LPG and firewood due to price. Similarly, in Kenya, Lay et al. (2013) show a statistically significant negative price effect of kerosene price on choosing wood in Kenya.

Table 6.6: Reason for the combination of fuel-wood and other energy Types NIG

		Frequency		Percent	Valid Percent	Cumulative Percent
Valid	Price	433		36.1	43.6	43.6
	Culture	55		4.6	5.5	49.2
	Family	482		40.2	48.6	97.8
	Other	22		1.8	2.2	100.0
	Total	992		82.7	100.0	
Missing	System	207		17.3		
Total		1199		100.0		

Similarly, Nigerian respondents were asked to state their reason for combining fuel-wood with other energy types (fuel stacking). 48.6% of the respondents said family size is the reason for combining fuel-wood with electricity. 43.6% said price is the reason and 5.5% combine fuel-wood with electricity because of culture as shown in table 6.6. Accordingly, Pandey and Chaubal (2011) and Özcan et al., (2013) indicated that larger households prefer dirty fuels over clean fuels. Comparatively, family size and price are the major drivers of fuel stacking behavior among households in Nigeria. While culture and price are the major drivers for fuel stacking in South Africa. The possible explanation on the influence of family size among Nigerian respondents is the religion and culture of the study area have allowed one man to marry up to four wives (polygamy) as a result, many people have larger families.

6.2 Cross-Tabulation of Socioeconomic/Demographic Variables on Dynamics of Domestic Fuel-wood Energy Consumption Using Chi-square Analysis

This section presents the results of socioeconomic and demographic variables generated from 1199 respondents in South Africa and 992 respondents in Nigeria. The Pearson Chi-Square test and logit regression were used to test relationships between variables that determine fuel-wood energy consumption among households. Concerning this, gender, marital status, education level and age, household size, monthly income and structure of the house were used as our household socioeconomic and demographic characteristics to determine the frequency of using fuel-wood as major source of energy, reason for using fuel-wood as major source of energy and reason for combining fuel-wood with other energy types of energy. The variables in the equation under logit regression are; age, consumer gender, education level, marital status, household size, structure of the house, monthly income and employment status.

6.2.1 Frequency of Using Fuel-wood as Major Energy Source* Gender

Table 6.7: Frequency of using fuel-wood as major energy source SA * Gender

		Gender		Total
		Male	Female	
FreqMajEnergySourceSA	Once a day	43	249	292
	Twice a day	119	610	729
	Trice a day	12	100	112
	Other	10	38	48
	5	5	13	18
Total		189	1010	1199

The result in table 6.7 showed no significant difference between frequencies of using fuel-wood as a source of energy and gender. Tradition in African society plays a critical role in the allocation of various tasks, gender can have significant implications in energy consumption. In a household setting, women are often responsible for household chores. All things being equal, females are more likely to use more fuel-wood than their male counterparts because of the traditional responsibility of cooking and taking care of some of the basic needs of the households. Based on the findings, females frequently use fuel-wood as a major source of energy than men in South Africa. Out of 1199 respondents, 729 were females, the result showed more females were captured using fuel-wood than men. They have indicated that they use fuel-wood twice in a day as their major energy source. This finding is similar to that of, Link et al. (2012) in Nepal showing a high proportion of females induces their households to use fuelwood.

Table 6.8: Frequency of using fuel-woos as major energy source NIG * Gender

		Gender		Total
		Male	Female	
FreqMajEnergySourceNIG	Once a day	4	9	13
	Twice a day	11	77	88
	Trice a day	128	738	866
	Other	5	19	24
	Total	148	843	991

Similarly, in Nigeria, results in table 6.8 revealed no significant difference between the frequency of using fuel-wood as a major energy source and gender. Females frequently use fuelwood as a major energy source than men. Out of 991 respondents, 866 use fuelwood trice a day as their major source. It is apparent from the result women cook more food than men and the majority of the respondents were females.

Comparing the results on how frequent Nigerians use fuelwood energy compared to South Africa, concerning gender, it can be seen that females frequently use fuelwood as a major source of energy than males in Nigeria and South Africa. From the result, Nigerians frequently use fuelwood as a major energy source (trice a day), and South Africans (twice a day). This could be due to the constant load shedding in Nigeria compared to South Africa where there is always electricity. There is no significant difference between the frequency of using fuel-wood as a major energy source and gender in both countries.

6.2.2 Reason for Using Fuel-wood as Major Source of Energy * Gender

Table 6.9: Reason for fuel-wood as a major source of energy SA * Gender

		Gender		Total
		Male	Female	
Reason as Major Source SA	A bit affordable	20	123	143
	Relatively affordable	121	696	817
	Affordable	26	109	135
	Very affordable	22	82	104
Total		189	1010	1199

Results in Table 6.9 showed no significant difference between the reason for using fuel-wood as a major energy source and gender in South Africa. When respondents were asked to state the reason for using fuel-wood as a major energy source. The findings indicated more females use fuelwood as a major source of energy because it is relatively affordable. Out of 1199 respondents, 696 females said the reason they use fuel-wood because of its relative affordability.

Table 6.10: Reason for fuel-wood as major energy source NIG * Gender

		Gender		Total
		Male	Female	
Reason as Major Source NIG	A bit affordable	5	25	30
	Relatively affordable	7	41	48

	Affordable	112	636	748
	Very affordable	24	140	164
	6	0	1	1
	Total	148	843	991

In Nigeria, table 6.10 showed no significant difference between reasons for fuel-wood as major energy source and gender when a similar question was asked on respondents. However, more females (636) said their reason for using fuel-wood as a major energy source because it is affordable. The high rate of response of females in the two countries may not be unconnected with the fact that Nigeria and South Africa share similar cultures in the area of household chores. But in comparative terms, the difference between South Africa and Nigeria as per the results hinges on relative affordability and affordability reasons, not in terms of gender responsibility. Hence, there is no significant difference between the reason for fuel-wood as a major energy source and gender in the two countries. However, the finding disagrees with the findings of Farsi et al. (2007), Rao and Reddy (2007) and Rahut et al. (2014). Their results show female-headed households prefer modern fuels to traditional fuels (fuel-wood and biomass). The reason could be health and environmental factors because are the most affected gender in terms of air pollution emitted from the burning of dirty fuels (Muller and Yan, 2016). However, this argument was challenged by An et al. (2002), Ouedraogo (2006) and Abebaw (2007) who observed that the coefficient of the gender of the household's head toward household energy use is insignificant in some context.

6.2.3 Reason for Combination of Fuel-wood with other Energy Types* Gender

Table 5.11: Reason for combination of fuel-wood with other energy types SA * Gender

		Gender		Total
		Male	Female	
Reason for Combination SA	Price	20	123	143
	Culture	121	696	817
	Family	26	109	135
	Other	22	82	104
Total		189	1010	1199

Respondents were asked to state why they combine fuel-wood with other energy types (fuel stacking behavior). The result in Table 6.11 showed no significant difference between the reason for the combination of fuel-wood with other energy types and gender. Culture is the major driver of fuel stacking behavior among South African respondents. 696 female respondents said they combine fuel-wood with other energy because of culture. Similar to this result was the finding of Shackleton (2007) in Grahamstown that showed the majority of households in the area use fuel-wood in their ritual activities as fuel use behavior and culture are closely linked (Muller and Yan, 2016:16). Pundo and Fraser (2006) found households preferring firewood over charcoal and kerosene when food requires lengthy cooking in Kenya.

Table 6.12: Reason for the combination of fuel-wood with other energy types NIG * Gender

		Gender		Total
		Male	Female	
Reason for Combination	Price	62	371	433
	Culture	10	45	55
	Family	71	411	482
	Other	5	17	22
Total		148	844	992

The result in Nigeria also revealed no significant difference between the reason for the combination of fuel-wood with other energy types and gender. The findings in table 5.12 indicated that the reason for

combining fuel-wood with other energy types in the study area was family size and price. 411 female respondents said family size was the main reason for their fuel stacking behavior. While 371 female respondents indicated price as the main driver of combining fuel-wood and other energy types. It was earlier mentioned that religion and culture of people in the study area allowed one man to marry up to four wives and there are the societal beliefs that larger families command some level of recognition and security. To support this result, Rao, and Reddy (2007), Pundo and Fraser (2006) argued that developing countries are often related to lower incomes. Households have limited capacity to purchase modern energy to feed their large families that use a large amount of fuel. Using fuel-wood will be quite cheaper compared to expensive kerosene, electricity, and LPG. Therefore, the quantity of energy consumed is dependent on the number of occupants in the household and the greater the number of occupants in a household the greater the level of fuel-wood energy consumed. This could be the reason Nigerian respondents indicated family size and price as the reason for fuel stacking behavior contrary to South African respondents who indicated culture as the reason for combining fuel-wood with other energy types. The result shows no significant difference between the reason for the combination of fuel-wood with other energy types and gender in both countries.

6.2.4 Frequency of Using Fuel-wood as Major Source of Energy * Marital Status

Table 6.13: Frequency of using fuel-wood as the major source of energy SA * Marital Status

		Marital Status					Total
		Single	Married	Divorced	Separated	5	
FreqMajEnergySourceSA	Once a day	139	91	30	29	3	292
	Twice a day	319	244	80	84	2	729
	Trice a day						112
	Other	61	33	6	12	0	48
		23	8	6	11	0	
	5	8	5	1	4	0	18
	Total	550	381	123	140	5	1199

The result in table 6.13 revealed no significant difference between frequently using fuel-wood as a major energy source and marital status. Marital status is an important factor that decides the frequency of households using fuel-wood for domestic activities. The findings showed more single respondents frequently use fuelwood as a major energy source twice a day. The possible explanation for singles frequent use of fuel-wood as energy in South Africa may be due to late marriage among women. Out of 1199 respondents, 729 frequently use fuel-wood as a major energy source twice a day.

Table 6.14: Frequency of using fuel-wood as major energy source NIG * Marital Status

		Marital Status						Total
		Single	Married	Divorced	Separated	5		
FreqMajEnergySourceNIG	Once a day	6	6	1	0		0	13
	Twice a day	42	27	10	9		0	88
	Trice a day	387	296	91	88		4	688
	Other	12	7	1	3		1	24
	Total	447	336	103	100		5	991

Similarly, there is no significant difference between frequently using fuel-wood as a major energy source and marital status in Nigeria. Table 6.14 showed more singles frequently use fuelwood as a major energy source trice a day. Out of 991 respondents, 688 frequently use firewood as a major energy source trice a day.

Comparing the result on how frequent Nigerians use fuelwood energy compared to South Africa, concerning marital status, it can be seen that singles frequently use fuelwood as a major source of energy in Nigeria as well as South Africa. However, from the result, Nigerians frequently use fuelwood as a major source of energy (trice a day) than South Africans (twice a day). Therefore, there is no significant difference between frequently using fuel-wood as a major energy source and marital status in both countries

6.3.5 Reason for Fuel-wood as Major Source of Energy * Marital Status

Table 6.15: Reason for fuel-wood as the major source of energy SA * Marital Status

			Marital Status			Total
		Single	Married	Divorced	Separated	
Reason as Major Source SA	A bit affordable	51	45	22	25	143
	Relatively affordable	382	273	74	83	817
	Affordable	65	36	17	17	135
	Very affordable	52	27	10	15	104
Total		550	381	123	140	1199

Table 6.16: Chi-Square Tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	21.253[a]	12	.047
Likelihood Ratio	22.117	12	.036
Linear-by-Linear Association	1.963	1	.161
N of Valid Cases	1199		

The Pearson Chi-Square test in table 6.16 showed no significant difference between reasons for using fuel-wood as a major energy source and marital status (Pearson Chi-Square value is 21.253 and the Asymp. Sig. (2-sided) 0.047). Table 5.15 indicated that more singles said the reason they use fuelwood as a major energy source is that it is relatively affordable. Out of 1199 respondents, 817 said the reason they use fuel-wood as a major energy source is that it is relatively affordable.

Table 6.17: Reason for fuel-wood as major energy source NIG * Marital Status

			Marital Status				Total
		Single	Married	Divorced	Separated	5	
Reason as Major Source NIG	A bit affordable	14	9	4	3	0	30
	Relatively affordable	19	19	3	7	0	48
	Affordable	342	251	76	75	4	748
	Very affordable	72	56	20	15	1	164
	6	0	1	0	0	0	1
Total		447	336	103	100	5	991

Similarly, results from Nigeria in table 6.17 indicated no significant difference between the reason for using fuelwood as a major source and marital status. More singles said the reason they use fuel-wood as a

major energy source is that it is relatively affordable. Out of 1199 respondents, 817 said the reason they use fuelwood as a major energy source is that it is relatively affordable.

Comparing the result on the reason Nigerians use fuelwood as a major energy source compared to South Africa. From the results, it can be seen that more singles use fuelwood as a major energy source in Nigeria because it is affordable while more singles use fuelwood as a major energy source in South Africa because it is relatively affordable. There is no significant difference between the reason for using fuel-wood as a major source of energy and marital status (Pearson Chi-Square value is 21.253 and the Asymp. Sig. (2-sided) 0.047) in both countries.

6.3.6 Reason for Combination of Fuel-wood with other Energy Types * Marital Status

Table 6.18: Reason for the combination of fuel-wood with other energy types SA * Marital Status

		Marital Status						Total
		Single	Married	Divorced	Separated	5		
Reason for Combination SA	Price	51	45	22	25		0	143
	Culture	382	273	74	83		5	817
	Family	65	36	17	17		0	135
	Other	52	27	10	15		0	104
Total		550	381	123	140		5	1199

Table 6.19: Chi-Square Tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	21.253[a]	12	.047
Likelihood Ratio	22.117	12	.036
Linear-by-Linear Association	1.963	1	.161
N of Valid Cases	1199		

The result in table 6.19 shows there is a significant difference between the reason for combining fuel-wood with other energy types and marital status (Pearson Chi-Square value is 21.253 and the Asymp. Sig. (2-sided) 0.047). Table 5.18 revealed more singles combine fuel-wood with other sources of energy. Out of 1199 respondents in South Africa, 817 showed they combine fuel-wood with other energy types because of culture and singles have the majority with 382. Another explanation relevant to culture and fuel-wood consumption is that the majority of traditional people prepare to eat food cooked with fuel-wood. Saad and Bugaje (2016:138) observed that one of the fundamental reasons Nigerian households continue using traditional fuels is because of their cultural belief, size of their household and perceptions. Households can under the fundamental reason why some households in Nigeria stick to traditional fuels is due to cultural factors, perceptions and the sizes of households. Traditional cooking techniques and taste preferences might make people prefer fuel-wood, even in situations where fuel-wood is expensive.

Table 6.20: Reason for the combination of fuel-wood with other energy source NIG * Marital Status

		Marital Status					Total
		Single	Married	Divorced	Separated	5	

Reason for Combination	Price		175	162	44	47		5	433
	Culture		20	26	3	6		0	55
	Family		241	141	55	45		0	482
	Other		12	7	1	2		0	22

Table 6.21: Chi-Square Tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	23.168[a]	12	.026
Likelihood Ratio	25.263	12	.014
Linear-by-Linear Association	5.852	1	.016
N of Valid Cases	992		

Table 6.20 showed more singles combine fuel-wood with other sources of energy. Out of 1199 respondents in Nigeria, 482 indicated family size and 433 said price were the reasons for the combination of fuel-wood with other energy types. The Pearson Chi-Square value in table 6.21 is 21.253 and the Asymp. Sig. (2-sided) 0.026 showed there is a significant difference between the reason for combining fuel-wood with other energy types and marital status in Nigeria. There is a significant difference between the reason for combining fuel-wood with other energy types and marital status in both countries with Pearson Chi-Square values of 21.253, 0.047 (SA) and. 21.253, 0.026 (Nig) respectively.

6.3.7 Frequency of Using Fuel-wood as Major Source of Energy * EducLevel

Table 6.22: Frequency of using fuel-wood as the major source of energy SA * EducLevel

		EducLevel					Total
		Primary	Secondary	Certificate	Diploma	5	
FreqMajEnergySourceSA	Once a day	292	0	0	0	0	292
	Twice a day	0	727	0	0	2	729
	Trice a day	0	0	112	0	0	112
	Other	0	0	0	48	0	48
	5	0	0	0	0	18	18
	Total	292	727	112	48	20	1199

Table 6.23: Chi-Square Tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	4673.140[a]	16	.000
Likelihood Ratio	2528.485	16	.000
Linear-by-Linear Association	1170.241	1	.000
N of Valid Cases	1199		

Education is significant in household decision making on the intake of energy at a given time. Education level is found to have a negative relationship with fuel-wood consumption (Abebaw (2007), Démurger and Fournier, 2011). The more the household is educated the more the possibility of higher income (Muller and Yan, 2016:14). Result in table 6.22 showed more respondents with secondary education frequently use fuelwood as a major energy source twice a day in South Africa. The possible explanation of having more respondents with secondary education with the higher frequency of using more fuel-wood than those with primary education could be Western Cape Province where the study is conducted has a high level of education compared to some other provinces. Out of 1199 respondents, 729 frequently use

fuel-wood as a major energy source twice a day. The Pearson Chi-Square value is 4673.140 and the Asymp. Sig. (2-sided) 0.000 which indicated that there is a significant difference between frequently using fuelwood as major energy source and education.

Table 6.24: Frequency of using fuel-wood as major energy source NIG * EducLevel

		EducLevel					Total
		Primary	Secondary	Certificate	Diploma	5	
FreqMajEnergySourceNIG	Once a day	4	5	2	2	0	13
	Twice a day	15	60	7	2	4	88
	Trice a day	215	523	82	35	11	866
	Other	8	15	0	1	0	24
	Total	242	603	91	40	15	991

The result in table 6.24 showed more respondents with secondary education in Nigeria frequently use fuel-wood as a major energy source trice a day. Out of 991 respondents, 866 frequently use fuel-wood as a major energy source trice a day. There is a significant difference between frequently using fuelwood as major energy source and education, Maconachie et al (2009) confirmed this finding in Kano Northern Nigeria where education level did not reduce the level of fuel-wood consumption and disagree with the study of Baiyegunhi and Hassan (2014) conducted in Giwa LGA Kaduna Northern Nigeria that higher education level induces households to reduce the frequency of using fuel-wood towards the use of kerosene and LPG.

Comparing the result on how frequently Nigerians use fuelwood energy compared to South Africans, concerning education. The result showed that those with secondary education frequently use fuelwood as a major energy source in Nigeria as well as in South Africa. Nigerians frequently use fuelwood as a major energy source (trice a day) than South Africans (twice a day). The Pearson Chi-Square value is 4673.140 and the Asymp. Sig. (2-sided) 0.000 indicated there is a significant difference between frequently using fuelwood as a major energy source and education in both countries.

6.3.8 Reason for Using Fuel-wood as Major Energy Source * EducLevel

Table 6.25: Reason for fuel-wood as major energy source SA * EducLevel

		EducLevel					Total
		Primary	Secondary	Certificate	Diploma	5	
Reason as Major Source SA	A bit affordable	26	101	9	7	0	143
	Relatively affordable	206	486	81	35	9	817
	Affordable	36	71	15	5	8	135
	Very affordable	24	69	7	1	3	104
Total		292	727	112	48	20	1199

Table 6.26: Chi-Square Tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	32.736[a]	12	.001
Likelihood Ratio	30.710	12	.002
Linear-by-Linear Association	.150	1	.699
N of Valid Cases	1199		

Result in table 6.25 showed more respondents with secondary education said they use fuelwood as a major energy source because it is relatively affordable. Out of 1199 respondents, 817 said the reason they use fuelwood as a major energy source is that it is relatively affordable. The Pearson Chi-Square value is

32.736 and the Asymp. Sig. (2-sided) 0.047 indicating there is a significant difference between the reason for using fuelwood as a major source and education level.

Table 6.27: Reason for using fuel-wood as major energy source NIG * EducLevel

			EducLevel					Total
		Primary	Secondary	Certificate	Diploma	5		
Reason as Major Source NIG	A bit affordable	6	17	4	2		1	30
	Relatively affordable	14	29	5	0		0	48
	Affordable	180	453	71	31		13	748
	Very affordable	42	103	11	7		1	164
	6	0	1	0	0		0	1
	Total	242	603	91	40		16	991

In Nigeria, table 6.27 showed more respondents with secondary education indicated the reason they use fuelwood as a major energy source is that it is affordable. Out of 991 respondents, 748 said the reason they use fuelwood as a major energy source is that it is affordable. There is a significant difference between the reason for using fuelwood as a major source and education level.

Comparing the result on the reason Nigerians use fuelwood as major source of energy with South Africa, concerning education, it can be seen that those with secondary education use fuelwood more as major source of energy in Nigeria because it is affordable while those with secondary education use fuelwood more as a major source of energy in South Africa because it is relatively affordable. There is a significant difference between the reason for using fuelwood as a major source and education in both countries.

6.3. 9 Reason for Combination of Fuel-wood with other Energy Types * EducLevel

Table 6.28: Reason for the combination of fuel-wood with other energy types SA * EducLevel

				EducLevel			Total
		Primary	Secondary	Certificate	Diploma	5	
Reason for Combination SA	Price	26	101	9	7	0	143
	Culture	206	486	81	35	9	817
	Family	36	71	15	5	8	135
	Other	24	69	7	1	3	104
	Total	292	727	112	48	20	1199

Table 6.29: chi-square tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	32.736[a]	12	.001
Likelihood Ratio	30.710	12	.002
Linear-by-Linear Association	.150	1	.699
N of Valid Cases	1199		

Result in table 6.28 showed, out of 1199 respondents in South Africa, 817 in all the educational level categories have indicated they combine fuel-wood with other energy types because of culture. Those with secondary education levels are the highest number of respondents 486 that combine fuel-wood with other energy types because of culture. The Pearson Chi-Square value is 32.736 and the Asymp. Sig. (2-sided)

0.001 indicating there is a significant difference between the reason for combining fuel-wood with other energy types and education.

Table 6.30: Reason for the combination of fuel-wood with other energy types NIG* EducLevel

				EducLevel			Total
		Primary	Secondary	Certificate	Diploma	5	
Reason for Combination	Price	102	265	43	16	7	433
	Culture	10	37	5	2	1	55
	Family	122	289	42	22	7	482
	Other	8	13	1	0	0	22
Total		242	604	91	40	15	992

In Nigeria, table 6.30 showed more respondents with secondary said the reason they use fuelwood as a major source of energy is because of family size and price. There is a significant difference between the reason for combining fuel-wood with other energy types and education.

Comparing the result on the reason Nigerians combine fuel-wood with other energy types with South Africa, concerning education, it can be seen that those with secondary education in South Africa combine fuel-wood with other energy because of culture while those with secondary education combine fuel-wood with other energy because of family size and price in Nigeria. There is a significant difference between the reason for combining fuel-wood with other energy types and education for both countries.

6.3.10 Frequency of using fuel-wood as the major source of energy * Age

Table 6.31: Frequency of using fuel-wood as the major source of energy SA * Age

		Age				Total
		17 to 29	30 to 44	45 to 60	60 above	
FreqMajEnergySourceSA	Once a day	26	206	36	24	292
	Twice a day	101	486	72	70	729
	Trice a day	9	81	15	7	112
	Other	7	35	5	1	48
	5	0	9	7	2	18
	Total	143	817	135	104	1199

Table 6.32: chi-square tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	28.460[a]	12	.005
Likelihood Ratio	27.299	12	.007
Linear-by-Linear Association	.000	1	1.000
N of Valid Cases	1199		

Age is a demographic factor that affects household health, income, productivity, and energy consumption. Studies found age to be is positively associated with preference for traditional fuels (Muller and Yan, 2016:13). Result in table 6.31 has indicated that South African respondents in the age bracket of 30 to 44 said they use fuelwood frequently as their major energy source twice a day. Across the ages from 17 to 60 above, more people frequently use fuelwood as their major energy source twice a day. The Pearson Chi-Square value is 28.460 and the Asymp. Sig. (2-sided) 0.005 indicating there is a significant difference between frequency using fuel-wood as major energy source and age.

Table 6.33: Frequency of using fuel-wood as major energy source NIG * Age

			Age			Total
		17 to 29	30 to 44	45 to 60	60 above	
FreqMajEnergySourceNIG	Once a day	2	9	0	2	13
	Twice a day	10	62	11	5	88
	Trice a day	98	601	95	72	866
	Other	4	17	1	2	24
Total		114	689	107	81	991

Table 6.33 showed Nigerians in the age bracket of 30 to 44 said they use fuelwood frequently, trice a day. Across the ages from 17 to 60 above, more people frequently use fuelwood as their major energy source trice a day. There is a significant difference between frequent major energy source and gender.
Comparing the result on how frequent Nigerians use fuelwood energy compared to South Africa, concerning age, respondents in the age bracket 30 to 44 have frequently use fuelwood as a major source of energy in Nigeria as well as South Africa. From the result, Nigerians use fuel-wood frequently, trice a day as a major energy source than South Africans (twice a day). There is a significant difference between the frequency of using fuel-wood as a major energy source and age in both countries.

6.3.11 Reason for Combination of Fuel-wood with other Energy Types * Age

Table 6.34: Reason for the combination of fuel-wood with other energy types SA * Age

			Age			Total
		17 to 29	30 to 44	45 to 60	60 above	
Reason for Combination SA	Price	143	0	0	0	143
	Culture	0	817	0	0	817
	Family	0	0	135	0	135
	Other	0	0	0	104	104
Total		143	817	135	104	1199

Table 6.35: chi-square tests

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	3597.000[a]	9	.000
Likelihood Ratio	2333.160	9	.000
Linear-by-Linear Association	1198.000	1	.000
N of Valid Cases	1199		

Result in table 6.34 showed out of 1199 respondents in South Africa, 817 between the ages of 30 to 44 indicated that they combine fuel-wood with other energy types because of culture. Those in the age bracket of 30 to 44 are the highest respondents that combine fuel-wood with other energy types because of culture. The Pearson Chi-Square value is 3597 and the Asymp. Sig. (2-sided) 0.000 indicating there is a significant difference between the reason for combining fuel-wood with other energy types and age.

Table 6.36: Reason for the combination of fuel-wood with other energy types NIG * Age

			Age		Total

		17 to 29	30 to 44	45 to 60	60 above	
Reason for Combination	Price	58	285	47	43	433
	Culture	6	37	9	3	55
	Family	50	351	49	32	482
	Other	1	16	2	3	22
Total		115	689	107	81	992

Result in table 6.36 showed respondents between ages 30 to 44 have indicated that family size and price are the reasons for combining fuel-wood with other energy types in Nigeria. There is a significant difference between the reason for combining fuel-wood with other energy types and ages.

Comparing the result on the reasons Nigerian respondents combine fuel-wood with other energy types compared to South African respondents, concerning age. Respondents between 30 to 44 years were the highest in both countries. However, the findings differ in some respect, South African respondents said culture was the reason for combining fuel-wood while Nigerian respondents indicated family size and price as the main reason for combining fuel-wood with other energy types. There is a significant difference between the reason for combining fuel-wood with other energy types and age in both countries.

Table 6.37: Reason for fuel-wood as major energy source NIG * Age

		Age				Total
		17 to 29	30 to 44	45 to 60	60 above	
Reason as Major Source NIG	A bit affordable	5	22	2	1	30
	Relatively affordable	5	34	4	5	48
	Affordable	88	503	87	70	748
	Very affordable	16	129	14	5	164
	6	0	1	0	0	1

Nigerians in the age bracket of 30 to 44 said the reason they use fuelwood major energy source is that it is affordable. Across the ages from 17 to 60, more people said the reason they use fuelwood major energy source is that it is affordable. There is a significant difference between the reason for using fuelwood as a major source and age.

6.3 Implication of findings for South African and Nigerian energy and environmental policies

From the results presented, it is apparent that fuel-wood is the major fuel that contributes towards meeting the energy needs of many Nigerian households (87.4% consumes fuel-wood thrice a day). In South Africa, the results indicated that fuel-wood is one of the fuels that meet the energy needs of South African households. Fuel-wood did not become the major energy source in South Africa as a result of high electricity coverage experienced in the last two decades (60.8% consumes fuel-wood twice a day). However, the results still portray a widespread use of fuel-wood in both countries which was linked to health and environmental problem. Even though fuel-wood consumption has negative consequences, negative impacts are resulting from dam construction that generates electricity and kerosene consumption. What differentiated fuel-wood impact from other impacts is the issue of deforestation. The study indicated that consumption of fuel-wood in both countries is largely driven by households' living circumstances like gender, marital status, education level, and age. Thus, a clear linkage exists between households' living circumstances and the environment. Household consumption behaviors are on one hand are influenced by utility maximization, while on the other hand, the environment is being affected by the behavior of households' demand for environment goods (i.e fuel-wood). In this context, the household's fuel-wood consumption has both environmental implications and welfare implications as indicated in the study. The concerns over the high rate of fuel-wood consumption in South Africa and Nigeria arise from the impact of wood harvesting on the environment. Deforestation and loss of

biodiversity are always the impacts associated with the high level of unsustainable fuel-wood consumption. Forest assessment report (FAO, 2010:21) highlighted that Nigeria recorded the highest percentage of forest loss among the ten top countries with the largest net loss of forest area since 1990. The report attributes this forest loss to fuel-wood consumption. In South Africa, Matsika et al., (2012), and Wessels et al., (2013) show that about 40% of woodland is being reduced due to fuel-wood consumption

Based on the above, South Africa and Nigeria should lay more emphasis on energy supply-driven factors by ensuring a sufficient and reliable supply of modern fuels. Also, policymakers may support the commercialization of the biomass energy sector. This can be done by subsidizing investment in the fuel-wood energy sector since trees in both woodlands and forests are renewable resources, the impact of fuel-wood consumption on the environment can be completely stopped by natural regeneration (environmental point of view). Economy-wide range policies should be directed towards influencing the quality of the environment to mitigate the impact of climate change. Finally, policies should influence the behavior of individuals, which in turn impacts on the environment (Chambwera, 2004:7). These include issues like employment, general income level, human capital, price of fuels, subsidies. No doubt that results from this study have indicated that demographic and socioeconomic factors seriously influences fuel-wood energy intake. Failure to link them with the overall energy and environmental policies of both countries will create policy failure.

6.4 Findings and Discussion (objective 1b): Determination of Impact of Socioeconomic and Demographic Variables on level of Domestic Fuel-wood Energy Consumption Using Logit Regression Model

Logistic regression allows you to test models to predict categorical outcomes with two or more categories. The predictor (independent) variables can be either categorical or continuous, or a mix of both in the one model. There is a family of logistic regression techniques available in SPSS that allow us to explore the predictive ability of sets or blocks of variables, and to specify the entry of variables. We, therefore, used a Forced Entry Method, which is the default procedure available in SPSS. In this approach, all predictor variables are tested in one block to assess their predictive ability, while controlling for the effects of other predictors in the model. Other techniques, for example, the stepwise procedures (e.g. forward and backward) allow you to specify a large group of potential predictors from which SPSS can pick a subset that provides the best predictive power. These stepwise procedures have been criticized (in both logistic and multiple regression) because they can be heavily influenced by random variation in the data, with variables being included or removed from the model on purely statistical grounds (see discussion in Tabachnick & Fidell, 2001: 535).

Binary Logistic Regression for Nigeria

Table 6.37: Logistic Regression

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	985	99.1
	Missing Cases	9	.9
	Total	994	100.0
Unselected Cases		0	.0
Total		994	100.0

a. If weight is in effect, see the classification table for the total number of cases.

Table 6.38: Dependent Variable Encoding for Nigeria

Dependent Variable Encoding

Original Value	Internal Value
Low fuelwood energy	0
High fuelwood energy	1

Table 6.39: Categorical Variables Coding

		Frequency	Parameter coding (1)
Employment Status	Employed	237	.000
	Not Employed	748	1.000
Marriage Category	Not Married	20	.000
	Married	965	1.000
Education Level	Secondary & Above Education	193	.000
	Primary Education	792	1.000
Household Size	Small HHSize	224	.000
	Big HHSize	761	1.000
Household Structure	Modern	200	.000
	Traditional	785	1.000
Monthly Income	High Income	142	.000
	Low Income	843	1.000
Age Category	Young	451	.000
	Old	534	1.000

Table 6.40: Block 0: Beginning Block

Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients Constant
Step 0	1	438.042	1.838
	2	346.287	2.654
	3	335.043	3.063
	4	334.655	3.158
	5	334.654	3.162
	6	334.654	3.162

a. Constant is included in the model.
b. Initial -2 Log Likelihood: 334.654
c. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table 6.41: Classification Table[a,b]

	Observed		Predicted Energy source: Low fuelwood energy	Predicted Energy source: High fuelwood energy	Percentage Correct
Step 0	Energy source	Low fuelwood energy	0	40	.0
		High fuelwood energy	0	945	100.0
	Overall Percentage				95.9

a. Constant is included in the model.
b. The cut value is .500

Table 6.42: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	3.162	.161	383.763	1	.000	23.625

Table 6.43: Variables not in the Equation

			Score	Df	Sig.
Step 0	Variables	Age Category (1)	.010	1	.919
		Marriage Category(1)	.046	1	.830
		Education Level(1)	2.866	1	.090
		Household Size(1)	.652	1	.419
		Household Structure(1)	9.995	1	.002
		Monthly Income(1)	7.023	1	.008
		Employment Status(1)	5.797	1	.016
	Overall Statistics		32.032	7	.000

Table 6.44: Block 1: Method = Enter (Iteration History[a,b,c,d])

Iteration		-2 Log likelihood	Coefficients Constant	Age Category (1)	Marriage Category(1)	Education Level(1)	Household Size(1)	Household Structure(1)	Monthly Income(1)	Employment Status(1)
Step 1	1	430.466	1.763	-.018	.082	.114	-.075	.091	-.346	.256
	2	327.509	2.546	-.049	.235	.300	-.205	.215	-.952	.651
	3	306.541	3.209	-.096	.474	.540	-.389	.328	-1.895	1.081
	4	302.596	4.057	-.130	.631	.670	-.507	.371	-2.919	1.256
	5	301.534	5.044	-.137	.656	.691	-.530	.377	-3.928	1.276
	6	301.151	6.047	-.138	.657	.691	-.531	.378	-4.931	1.276
	7	301.011	7.048	-.138	.657	.691	-.531	.378	-5.932	1.276
	8	300.959	8.048	-.138	.657	.691	-.531	.378	-6.933	1.276
	9	300.940	9.048	-.138	.657	.691	-.531	.378	-7.933	1.276
	10	300.934	10.048	-.138	.657	.691	-.531	.378	-8.933	1.276
	11	300.931	11.048	-.138	.657	.691	-.531	.378	-9.933	1.276

	12	300.930	12.048	-.138	.657	.691	-.531	.378	-10.933	1.276
	13	300.930	13.048	-.138	.657	.691	-.531	.378	-11.933	1.276
	14	300.930	14.048	-.138	.657	.691	-.531	.378	-12.933	1.276
	15	300.929	15.048	-.138	.657	.691	-.531	.378	-13.933	1.276
	16	300.929	16.048	-.138	.657	.691	-.531	.378	-14.933	1.276
	17	300.929	17.048	-.138	.657	.691	-.531	.378	-15.933	1.276
	18	300.929	18.048	-.138	.657	.691	-.531	.378	-16.933	1.276
	19	300.929	19.048	-.138	.657	.691	-.531	.378	-17.933	1.276
	20	300.929	20.048	-.138	.657	.691	-.531	.378	-18.933	1.276

a. Method: Enter
b. Constant is included in the model.
c. Initial -2 Log Likelihood: 334.654
d. Estimation terminated at iteration number 20 because maximum iterations has been reached.

Table 6.45: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	33.725	7	.000
	Block	33.725	7	.000
	Model	33.725	7	.000

Table 6.46: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	300.929[a]	.134	.427

a. Estimation terminated at iteration number 20 because maximum iterations has been reached

Table 6.47: Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	16.879	6	.231

Table 6.48: Contingency Table for Hosmer and Lemeshow Test

		Energy source = Low fuelwood energy		Energy source = High fuelwood energy		
		Observed	Expected	Observed	Expected	Total
Step 1	1	17	13.846	83	86.154	100
	2	2	6.865	99	94.135	101
	3	2	4.631	97	94.369	99
	4	1	.669	20	20.331	21
	5	9	7.669	240	241.331	249
	6	3	4.298	156	154.702	159
	7	6	2.022	108	111.978	114

	8	0	.000	142	142.000	142

Table 6.49: Classification Table[a]

			Predicted Energy source		
	Observed		Low fuelwood energy	High fuelwood energy	Percentage Correct
Step 1	Energy source	Low fuelwood energy	0	40	.0
		High fuelwood energy	0	945	100.0
	Overall Percentage				95.9

a. The cut value is .500

Table 6.50: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Age Category (1)	.138	.344	3.160	1	.038	3.871	1.644	10.711
	Marriage Category(1)	.657	1.064	.381	1	.537	1.929	.239	15.536
	Education Level(1)	-.691	.367	6.558	1	.047	2.397	1.673	9.095
	Household Size(1)	.531	.445	3.423	1	.033	3.588	1.546	8.809
	Household Structure(1)	-.378	.411	3.845	1	.044	1.859	1.452	7.264
	Monthly Income(1)	-18.933	3294.489	.000	1	.995	.000	.000	.
	Employment Status(1)	-1.276	.417	9.349	1	.002	3.582	1.581	8.116
	Constant	20.048	3294.489	.000	1	.995	509271343.077		

a. Variable(s) entered on step 1: Age Category, Marriage Category, Education Level, Household Size, Household Structure, Monthly Income, and Employment Status.

Table 6.37 showed 985 (99.1%) cases were involved in this study and there are missing cases of 9 (0.9%). Table 6.38 coding of dependent variables shows that low fuel-wood energy is represented by 0 and high fuel-wood energy is represented by 1. While the predictor variables (independent variables) are the demographic and socioeconomic variables in table 6.39. These include; employment status, marriage category, educational level, household size, household structure, monthly income and age category.

The classification table 6.39 predicted that 95.9% of Nigerian respondents are high fuel-wood energy consumers. To improve the accuracy of this prediction, Omnibus test (Goodness of Fit Test) was carried

out in table 6.45. In the test, a significant value of 0.000 is observed (P value < .0005). Therefore, the model is better than the analysis in classification table 6.40 (Block 0). Meaning that not all 95.9% of the respondents are high fuel-wood energy consumers. The Chi-Square value in the test is 33.725 with 7 degree of freedom which indicated that there is a high correlation between the variables.

Hosmer and Lemeshow test in table 6.47 showed there is a significant value of 0.231, p value>.05. This indicated that the model used is worthwhile. The Chi-Square value in this test is 16.879 with 6 degree of freedom which is also indicating support for the model. The model summary table 6.46 for Cox & Snell R square and Negel kerke R square value are 0.134 and 0.427 respectively. Indicating that 13.4% and 42.7% of the variability is explained by this set of variables. This also gives us the usefulness of the model.

Additionally, the classification table 6.49 shows how well the model can predict the correct category for each case (high fuel-wood energy consumption/ low fuel-wood energy consumption). We compare this table with the classification table in table 6.40 (Block 0). In this analysis, it can be concluded that there is no increase or improvement in the percentage of fuel-wood energy consumption when the predictor variables are included in the model (the percentage remains 95.9%) in both tables.

Table 6.50, the variable in the equation table gives us information about the contribution or importance of each predictor (independent variable) in the study. The test that is used here is known as Wald test. The variable that has less than .05 in the column levelled Sig. are the variables that contribute significantly to the predictive ability of the model. Based on this, the following variables that have results less than .05, namely; age category (p=.038), education level (p=.047), household size (p=.33), household structure (p=.44) and employment status (p=.002) and significantly explains respondents fuel-wood energy consumption. While other variables marriage category (.537) and Monthly income (.995) did not contribute significantly to fuel-wood energy consumption in the study area.

The B value in table 6.50 variables in the equation found ***age*** to have a positive and highly statistically significant relationship with the probability of consuming fuel-wood energy at (.138) and (p=.038) significant level. This implies that an increase in the age of the head of the household will probably increase fuel-wood consumption. This fact has been established in the literature in the work of Njong and Johannes (2011) who found that an increase in the average age of the household will probably increase the chances of consuming traditional fuel compared to modern fuel. Also, Baiyegunhi and Hassan (2014) found an increase in the age of household head induces rural households to shift away from natural gas towards fuel-wood in Nigeria. A similar result was presented by Rahut et al., (2014) that older heads prefer fuelwood to electricity in Bhutan. Such preferences for traditional fuels support the notion that older people tend to perpetuate traditional habits, related to fuels, more than young people (Muller and Yan, 2016).

However, other studies have found that preference for modern fuels is instead positively associated with age. For example, Özcan et al. (2013) reported that older household heads are more likely to shift away from wood towards natural gas, liquid fuel, and electricity in Turkey. Guta (2012) found that older household heads are more likely to prefer modern fuels to traditional fuels among Ethiopian rural households. Muller and Yan (2016:13) argue that a life cycle effect where young people facing liquidity constraints makes them to resort to cheaper fuels, contrary to old people that can afford cleaner fuels easily, hence most of the results from studies could be due to this reason.

The study found that there is a significant relationship between ***education level*** and fuel-wood energy consumption at (p=.047) level of significance. However, the B value in the second column is negative at (-.691). This means that an increase in education level decreases the probability of consuming fuel-wood. Heltberg (2003) confirmed that in urban India and rural Brazil that an increase in education level is associated with a higher probability of using modern fuels. Also, in Ethiopia, Mekonnen and Kohlin

(2008) reported similar evidence that showed households with a more educated member were more likely to use modern fuels instead of fuel-wood.

Household size was found to have positive B value at (.531) and a highly statistically significant relationship with the probability of consuming fuel-wood energy at (p=.033) level of significance. The result revealed that as household size increases, the probability of consuming fuel-wood energy will also increase. Generally, modern fuel does not necessarily meet the cooking needs of a large household, the expectation is that many households will more likely consume fuel-wood energy instead. Heltberg (2003), found household size to be inversely related to the use of LPG and kerosene such that smaller households were more likely to depend on LPG and kerosene, whereas larger households will use more of traditional fuels in urban India and rural Brazil. Njong and Johannes (2011) alluded that larger households will prefer to use traditional fuels as they are comparatively cheaper to cook for many people and reduce the consumption rate per unit of time relative to other alternatives. Also, the study of Kuunibe et al., (2013) confirmed a positive relationship between household size and the possibility of using traditional fuel in the upper west region of Ghana.

Household structure has negative and significant relationship with the probability of consuming fuel-wood energy at B value (-376) and (p=.044) level of significance. This implies that respondents who use modern structure are less likely to consume fuel-wood energy. For example, Muller and Yan (2016:16) argues that inflammable house material may deter the use of firewood. Arthur et al. (2010) found that house size as measured by the number of rooms is associated with the adoption of electricity and access to piped water induces an increase in the likelihood of using electricity in Mozambique.

Respondents ***Employment status*** was found to have negative significant relationship with the probability of consuming fuel-wood energy at (-.1.276) and (p=.002) level of significance. Meaning that gainfully employed household members are expected to have more income than unemployed household members. Numerous studies have shown that income is a major driver behind the uptake of modern fuels (Muller and Yan, 2016:8). For example, the study of Kuunibe et al., (2013) showed that as household's monthly income increases, the probability that the household will use traditional fuel decreases. Hosier and Dowd (1987) found Zimbabwean urban households tend to move away from the wood, towards kerosene and electricity, as their income rises.

The Exp (B) column or OR values in table 6.50 showed the values for variables are greater than 1, meaning that the more the independent variables the more the dependent variables. Except for monthly income with the p value of 0.000 suggesting the more the monthly income the less likely the dependent variable. Overally, this result disapproved the energy ladder hypothesis. Furthermore, for each of the (OR) values, there is lower and upper 95% confidence interval ranging from 0.000 to 15.536. This is quite wide range of value indicating that the result is statistically not significant since the confidence intervals contains a value of 1.

Binary Logistic Regression for South Africa

6.51: Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	950	79.2
	Missing Cases	249	20.8
	Total	1199	100.0
Unselected Cases		0	.0
Total		1199	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 6.52: Dependent Variable Encoding

Original Value	Internal Value
Low fuelwood energy	0
High fuelwood energy	1

Table 6.53: Categorical Variables Codings

		Frequency	Parameter coding (1)
Employment Status	Employed	280	.000
	Not Employed	670	1.000
Age Category	Young	769	.000
	Old	181	1.000
Marital Category	Not Married	628	.000
	Married	322	1.000
Education Category	Secondary & Above	726	.000
	Primary	224	1.000
Household Size	Small	824	.000
	Big	126	1.000
Monthly Income	High Income	225	.000
	Low Income	725	1.000
Structure of House	Modern	832	.000
	Traditional	118	1.000
Consumer gender	Female	806	.000
	Male	144	1.000

Table 6.54: Block 0: Beginning Block
Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients Constant
Step 0	1	498.044	-1.764
	2	431.154	-2.463
	3	425.789	-2.733
	4	425.716	-2.770
	5	425.716	-2.770

a. Constant is included in the model.
b. Initial -2 Log Likelihood: 425.716
c. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 6.55: Classification Table[a,b]

			Predicted Energy source		
	Observed		Low fuelwood energy	High fuelwood energy	Percentage Correct
Step 0	Energy source	Low fuelwood energy	894	0	100.0
		High fuelwood energy	56	0	.0
	Overall Percentage				94.1

a. Constant is included in the model.
b. The cut value is .500

Table 6.56: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-2.770	.138	404.457	1	.000	.063

Table 6.57: Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Consumer gender(1)	.931	1	.335
		Age Category(1)	.218	1	.641
		Marital Category(1)	2.101	1	.147
		Education Category(1)	.067	1	.796
		Household Size(1)	.030	1	.862
		Structure of House(1)	.190	1	.663
		Monthly Income(1)	11.058	1	.001
		Employment Status(1)	16.650	1	.000
	Overall Statistics		21.864	8	.005

Table 6.58: Block 1: Method = Enter

Iteration History[a,b,c,d]

Iteration		-2 Log likelihood	Coefficients Constant	Consumer gender(1)	Age Category(1)	Marital Category(1)	Education Category(1)	Household Size(1)	Structure of House(1)	Monthly Income(1)	Employment Status(1)
Step 1	1	490.710	-2.004	.081	.056	-.092	.017	-.010	.040	.126	.205
	2	413.478	-3.133	.199	.139	-.233	.045	-.024	.093	.341	.545
	3	399.959	-4.091	.314	.228	-.384	.083	-.035	.133	.653	1.026
	4	397.697	-4.747	.352	.263	-.440	.103	-.036	.136	.903	1.419
	5	397.525	-4.995	.356	.269	-.444	.106	-.035	.134	.996	1.575
	6	397.524	-5.023	.356	.269	-.444	.106	-.035	.134	1.005	1.594
	7	397.524	-5.023	.356	.269	-.444	.106	-.035	.134	1.005	1.594

a. Method: Enter
b. Constant is included in the model.
c. Initial -2 Log Likelihood: 425.716
d. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Table 6.59: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	28.193	8	.000
	Block	28.193	8	.000
	Model	28.193	8	.000

Table 6.60: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	397.524[a]	.129	.231

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Table 6.61: Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.281	7	.858

Table 6.62: Contingency Table for Hosmer and Lemeshow Test

		Energy source = Low fuelwood energy		Energy source = High fuelwood energy		
		Observed	Expected	Observed	Expected	Total
Step 1	1	93	93.470	1	.530	94
	2	83	83.265	1	.735	84
	3	93	92.496	1	1.504	94
	4	66	64.472	1	2.528	67
	5	96	96.517	6	5.483	102
	6	102	99.641	5	7.359	107
	7	154	155.251	15	13.749	169
	8	87	89.251	11	8.749	98
	9	120	119.638	15	15.362	135

Table 6.63: Classification Table[a]

			Predicted		
			Energy source		
	Observed		Low fuelwood energy	High fuelwood energy	Percentage Correct
Step 1	Energy source	Low fuelwood energy	894	0	100.0
		High fuelwood energy	56	0	.0
	Overall Percentage				94.1

a. The cut value is .500

Table 6.64: Variables in the Equation

	B	S.E.	Wald	df	Sig.		95% C.I.for EXP(B)

							Exp(B)	Lower	Upper
Step 1[a]	**Consumer gender(1)**	.356	.359	.984	1	.321	1.428	.706	2.888
	Age Category(1)	.269	.348	.600	1	.439	1.309	.662	2.588
	Marital Category(1)	-.444	.320	3.721	1	.016	4.641	1.442	18.202
	Education Category(1)	.106	.324	.107	1	.744	1.112	.589	2.099
	Household Size(1)	-.135	.423	3.007	1	.025	1.566	1.521	22.215
	Structure of House(1)	.134	.407	.108	1	.743	1.143	.515	2.538
	Monthly Income(1)	-1.005	.362	4.805	1	.039	3.733	1.346	13.004
	Employment Status(1)	-1.594	.353	5.958	1	.015	4.922	1.369	17.701
	Constant	-5.023	.727	47.736	1	.000	.007		

a. Variable(s) entered on step 1: Consumer gender, Age Category, Marital Category, Education Category, Household Size, Structure of House, Monthly Income, and Employment Status.

Table 6.51 shows that 950 (79.2%) cases or respondents were involved in South Africa and there are missing cases of 249 (20.8%). Table 6.52 coding of dependent variables showed low fuel-wood energy is represented by 0 and high fuel-wood energy is represented by 1. While the predictor variables (independent variables) are the demographic and socioeconomic variables in table 6.53. These include; employment status, age category, marriage category, educational level, monthly income, the structure of the house and gender.

The classification table 6.55 predicted that 94.1% of South African respondents are low fuel-wood energy consumers. To improve the accuracy of this prediction, Omnibus test (Goodness of Fit Test) was carried out in table 6.45. In this test, a significant value of 0.000 is observed (P value< .0005) which indicated the model is better than the analysis in classification table 6.40 (Block 0). Meaning that not all 94.1% of the respondents are low fuel-wood energy consumers. The Chi-Square value in the test is 28.193 is observed with 8 degree of freedom which indicated that there is a high correlation between the variables.

Hosmer and Lemeshow test in table 6.61 support our model since the significant value (0.858), >p value (.05). The Chi-Square value in this test is 3.281. A low Chi-Square value also indicates a significantly high correlation between the variables (low and high fuel-wood energy consumption) with 7 degree of freedom. The model summary table 6.60 shows a Cox & Snell R square and Negel kerke R square value of (0.129) and Negelkerke R square (0.231). These are pseudo R square statistics suggesting that between 12.9% and 23.1% of this variability is explained by the variables.

In order to know how well is the model in predicting correct category for each variable, the classification table in Block 0 is compared with that in Block 1, table 6.63. In this analysis, it can be concluded that

there is no improvement when the predictor variables are included in the model since the percentage remain the same (94.1%) in both tables.

In table 6.64 Wald test was carried out (variable in the equation table) to know the contribution of each predictor. The variable that contributes significantly to the predictive ability of the model is the marriage category (.010), household size (.25), monthly income (.39) and employment status (.015). Other variables are consumer gender (.0439), education (.744) and structure of the house, these variables have no significant contribution to household fuel-wood consumption. The B value in table 6.64 leveled variables in the equation shows that ***marital status*** has a negative and statistically significant relationship with the probability of consuming fuel-wood energy at (-.444) and (p=.016) significant level. This implies that as the household marital status changes, the probability of consuming fuel-wood will decrease. The reason behind this could be that the single respondents participated more than the other respondents in the study.

Household size was found to have a statistically significant negative relationship with fuel-wood energy. Even though Muller and Yan (2016:15) have explained that the effect of household size on fuel switching remains ambiguous empirically. Meaning that there is less probability of consuming fuel-wood energy in the study area. The negative relationship is statistically significant at (-.135) and (p=.025). This finding is in line with the works of Hosier and Dowd (1987), Gupta and Köhlin (2006) and Baiyegunhi and Hassan (2014) that showed households with larger members are more likely to choose clean fuels instead of fuel-wood.

Monthly income was also found to have a negative and statistically significant relationship with fuel-wood energy consumption at (-1.005) and (p=.039) significant level. This fact has been established in the literature, some of the authors specify income as a measure of household earnings (Hosier and Dowd, 1987, Abebaw, 2007), while others use household expenditure as a proxy for income (An et al, 2002, Akpalu et al, 2012). All these studies seem to corroborate the energy ladder hypothesis that emphasized income as the major driver of fuel transition from inferior (traditional fuels) to normal (modern fuels) (Muller and Yan, 2016:8). Furthermore, Kuunibe et al. (2013) work in the west region of Ghana shows that as household's monthly income increases, the probability that they will choose traditional fuel also decreases.

Additionally, e***mployment status*** was found to have a negative statistically significant relationship with the probability of consuming fuel-wood energy at (-1.594) and (p=.015) level of significance. This relationship means that households with employment are more likely to consume modern energy due to the flow of income which gives them the ability to decide on their energy needs, while the unemployed household is expected to consume more fuel-wood because due to lack of income.

Finally, the Exp (B) column are odd ratio (OR) values that determine the relative odds of occurrence of an outcome. In this case (OR) values greater than 1 are observed for all the variables in table 6.64. This shows that the more the independent variable the more likely the dependent variables (High or low fuel-wood energy). To estimate the precision of the (OR), 95% confidence column was analyzed which gives lower and upper confidence interval ranging from 0.515 to 22.215. Since the value range contains less than or equals to 1, therefore the result is not statistically significant at $p<0.05$. This also indicates an equal probability of the two responses.

6.5 Implication of Findings on Domestic Energy Supply in Nigeria and South Africa

According to Naibbi and Healey (2013:160), the supply of fossil fuels and electricity is precarious in Nigeria that the majority of people have to depend on fuel-wood for their domestic activities. The results presented in this study confirmed the above assertion. 95.9% of the Nigerian respondents are high fuel-wood consumers and it may likely to remain so. A correlation analysis conducted revealed a highly

positive relationship between fuel-wood energy consumption with age and household size on one hand and on the other hand, the analysis indicated a negative relationship between fuel-wood consumption with education level, household structure, and employment status. Concerning this, the most difficult challenge facing Nigeria as per high fuel-wood consumption can be seen from two perspectives, first, the unsustainable production and use of fuel-wood for energy pose economic, environmental, and health threats to both rural and urban population. The second is the inadequate supply of modern energy sources (kerosene, liquefied or compressed natural gas, and electricity) made many households unable to access energy making households fuel-wood consumption to continue unabated. This situation should be a source of concern for the Nigerian government. There must be a serious environmental and socioeconomic consequence if deliberate policies are not put in place it could lead to environmental collapse since results in the study have identified an increase in education level, household structure and employment among households will decrease the level of fuel-wood consumption. Conversely, in South Africa, 94.1% of respondents are low fuel-wood energy consumers. The result confirmed the Report of Western Cape Government (2013) that the consumption of fuel-wood is low among households in Western Cape Province. It could also be attributed to giant stride in electrification projects undertaken since 1994. A correlation analysis conducted in South Africa showed a highly negative relationship between fuel-wood energy consumption and marital status, household size, monthly income, and employment status. Based on these results, more policy emphasis in the two countries should be on developing education curricula that promote information to households on the benefits of adopting clean fuels as well as the need for greater incorporation of these factors into national domestic energy policy to break the prevailing energy poverty cycles linking high fuelwood use rates to localized environmental degradation, at ever-increasing cost to the well-being of the households.

It is important to note that the role of the economic environment in affecting fuel-wood energy consumption is evident in this study. For example, the result just presented showed an increase in income reduces the consumption of fuel-wood. Also, the level of employment influences income and household decision making on energy expenditure. The result shows a strong connection between household economy and fuel-wood consumption. This implies that one way to ensuring environmental sustainability is to work at increasing household income and employment to help them move towards cleaner energy sources and reduce their dependence on the environment for domestic energy.

6.6 Findings and Discussion (objective 2): Analyze the Contribution of Fuel-wood Business to Trader's Livelihood in South Africa and Nigeria as per Income, Food Security, Health Security, and Children Education.

This section presents results generated from fuel-wood energy traders in South Africa and Nigeria that analyzes the contribution of fuel-wood business to their livelihood using frequency tables. The result captured the livelihood indicators namely; turnover, profit use, food security, health care, children schooling, and house improvement and many more.

6.6.1 Household Size and Weekly Turnover

Table 6.65: Weekly turnover SA * HH Size SA

			HHSizeSA					Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Weekly Turnover SA	Less than R666	19	68	6	5		2	100
	Between R1222 to R2000	30	53	13	3		1	100

Total		49	121	19	8		3	200

Non-farming activities like fuel-wood trading remain a dominant sector that contributes to the livelihood of many households. Table 6.65 on trader's dynamic about weekly turnover on fuel-wood business and household size showed 68 participants in a household of 3 to 5 persons have a weekly turnover of less than R666 while 53 of the participants have a weekly turnover between R1222 to R2000. The household with the highest weekly turnover is the household with 3 to 5 persons and the household with less weekly turnover is the household with 11 persons and above. Out of 200 participants, 100 participants said their weekly turnover is less than R666 and 100 participants said their weekly turnover is between R1222 and R2000.

Table 6.66: Weekly Turnover NG * HH Size NG

				HHSizeNG			Total
			2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
Weekly Turnover NG		Less than R666	0	33	70	38	141
		Between R666 to R1333	2	10	18	21	51
		Between R1333 to R2000	0	1	2	5	8
		Between R2000 to R2333	0	2	1	6	9
Total			2	46	91	70	209

As per Nigeria's trader dynamic on weekly turnover and household size, the result in table 6.66 showed 70 participants in a household of 6 to 10 persons have a weekly turnover less than R666 (N19,980). 21 participants in a household of 11 and above have a weekly turnover between R666 to R1333 (N19.980 to N39, 990), 5 participants have a weekly turnover between R1333 to R2000 (N39, 990 to N60, 000) and 6 participants have a weekly turnover between R2000 to R2333 (N60, 000 to N69, 990). Out of 209 participants, 141 participants said their weekly turnover is less than R666 (N19, 980) and while 51 participants said their weekly turnover is between R666 and R1333 (N19, 980 and N39, 990).

Comparing South Africa and Nigeria in terms of weekly turnover on fuel-wood business. The result showed Nigeria has more households that were involved in fuel-wood business than South Africa. This confirmed the earlier assertion in the study that Nigeria has a cultural and religious belief of having many wives and children leading to larger family size. Furthermore, the turnover in South Africa (between R666-R2000) is higher than that of Nigeria (between R666 and R1333 (N19, 980 and N39, 990).

6.6.2 Household Size and Weekly Profit

Table 6.67: Weekly profit SA * HH Size SA

			HHSizeSA					Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Weekly Profit SA	Less than R166	25	56	9	4		2	96
	Between R166 to R333							
	Between R333 to R499	18	32	5	2		1	58
	Between R499 to R666	2	18	3	0		0	23

		4 49	15	2	2		0	23
Total			121	19	8		3	200

On trader's dynamic about weekly profit and household size, the result in table 6.67 showed 56 participants in a household of 3 to 5 persons have a weekly profit less than R166, 32 participants have a weekly profit between R166 to R333, 18 participants have weekly profit between R333 to R499 and 15 of the participants have weekly profit between R499 to R666. The household with the highest weekly profit is the household with 3 to 5 persons and the household with less weekly profit is the household with 11 persons above. Out of 200 participants, 96 participants said their weekly profit is less than R166.

Table 6.68: Weekly profit NG * HH Size NG

			HH Size NG			Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
Weekly Profit NG	Less than R166	1	33	70	39	143
	Between R166 to R333	0	7	9	16	32
	Between R333 to R499	1	5	7	9	22
	Between R499 to R666	0	1	5	6	12
Total		2	46	91	70	209

Similarly, Nigeria's trader's dynamic on weekly profit and household size, the result in table 6.68 showed 70 participants in a household of 6 to 10 persons have a weekly profit less than R166 (N 4,980). 16 participants in a household of 11 persons and above have a weekly profit between R166 to R333 (N4, 980 to N9, 900), 9 participants have weekly profit between R333 to R499 (N9, 900 to N14, 970) and 6 of the participants have weekly profit between R499 to R666 (N14, 970 to N19, 980). Out of 209 participants, 143 participants said their weekly profit is less than R166 (N4, 980).

Comparing the results in table 6.67 and 6.68, we can conclude that weekly profit generated by traders in the two countries is the same. The possible explanation to this outcome is the fact that the fuel-wood business is perceived as a business of poor hence low profit.

6.7.3 Household Size and Profit Use

Table 6.69: Profit use SA * HH Size SA

			HHSizeSA					Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Profit Use SA	Food for the household members	19	68	6	5		2	100
	Health and medical	30	53	13	3		1	100
Total		49	121	19	8		3	200

The choice of the Household Economic Portfolio Model (HEPM) in our conceptual framework in (Chapter4) to explain the nexus between household resources and household activity and the outcome of the interaction is justified. The profit generated from the interaction is very significant in the livelihood effort of the household. Therefore, Table 6.69 above is showing trader's dynamic about profit use and

household size, the result shows that 68 participants in a household of 3 to 5 persons use their profit for food for the household members while 53 of the participants use their profit for health and medicals. Out of 200 participants, 100 participants said they use their profit for food for the household members and 100 participants said they use their profit for health and medicals.

Table 6.70: Profit Use NG * HH Size NG

			HH SizeNG			Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
Profit Use NG	Food for the household members	2	28	52	45	127
	Education	0	11	24	14	49
	Health and medical	0	7	15	11	33
Total		2	46	91	70	209

In Nigeria, table 6.70 results showed 52 participants in a household of 6 to 10 persons use their profit for food for the household members 24 of the participants use their profit on education and 15 of the participants use their profit for health and medicals. Out of 209 participants, 127 participants said they use their profit for food for the household members, 49 participants said they use their profit on education and 33 participants said they use their profit for health and medicals.

In comparing the results between South Africa and Nigeria in terms of profit usage, as we can see, traders in South Africa use their profit to provide food and health care to their households. In Nigeria, profit is used to provide education, food, and health care. The difference is that Nigerian traders provide education with their profit while South Africans don't.

6.7.4 Household Sleeping Hungry

Table 6. 71: HH Sleeping hungry SA * HH Size SA

		HH Size SA						Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
HH Sleeping Hungry SA	Never	19	68	6	5		2	100
	Sometimes	30	53	13	38		1	100
Total		49	121	19			3	200

Access to sufficient food by households enables them to live a healthy and active life. Respondents were asked how often they sleep hungry. Result in table 6.71 on trader's dynamic about household sleeping hungry and household size showed 68 participants in a household of 3 to 5 persons never sleep hungry while 53 of the participants sometimes sleep hungry. Out of 200 participants, 100 participants said they never sleep hungry and 100 participants said they sometimes sleep hungry. This shows that households utilize earnings from fuel-wood business to provide food.

Table 6.72: HH Sleeping hungry NG * HH Size NG

			HH Size NG			Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
HH Sleeping Hungry NG	Never	1	36	71	50	158

	Seldom	0	6	4	8	18
	Sometime	1	4	14	12	31
	4	0	0	2	0	2
Total		2	46	91	70	209

In the case of Nigeria, when respondents were asked how often they sleep hungry. Table 6.72 on trader's dynamic about households sleeping hungry and household size, the result showed 71 participants in a household of 6 to 10 persons never sleep hungry, 4 seldom sleep hungry while 14 of the participants sometimes sleep hungry. Out of 209 participants, 158 participants said they never sleep hungry. This shows that a substantial number of respondents use earnings from fuel-wood business to provide food.

On a comparative scale, South African and Nigerian households utilize money generated from fuel-wood business to provide food for their families. Most of the respondents in the two countries sleep with their stomachs full. Equally some households in South Africa and Nigeria said they sometimes sleep hungry. From the result, it is apparent that the fuel-wood business contributes to the livelihood of the households in the study areas. The results show more than 50% of the respondents in the two countries spend their income on food to be food secure.

6.7.5 Availability of Water in Last 1 Year

Table 6.73: Water availability in last 1Yr SA * HH Size SA

		HHSizeSA						Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Water Avail last 1YrSA	Available	25	56	9	4		2	96
	Once in a while							58
	Not available	18	32	5	2		1	
	Other							
		2	18	3	0		0	23
		4	15	2	2		0	23
Total		49	121	19	8		3	200

The availability of infrastructural facilities like water at the household level will invariably affect the household activities. Accessibility to clean water directly affects the health of households. This study tries to link the availability of water and household livelihood because access to clean water improves household health and welfare. Result in table 6.73 on trader's dynamic on water availability and household size showed 56 participants in a household of 3 to 5 persons said water is available to them, 32 participants indicated that water is available once in a while, 18 participants said water is not available to them and 15 of the participants gave other reasons of water availability. The household with the highest water availability is the household with 3 to 5 persons and the household with less water availability is the household with 11 persons above. Out of 200 participants, 96 participants said that water is available to them.

Table 6.74: Water Availability last 1YrNG * HH Size NG

		HHSizeNG				Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	

Water Availability last 1Yr NG	Available	1	32	59	38	130
	Once in a while	1	2	3	3	9
	Not available	0	12	29	29	70
Total		2	46	91	70	209

Similarly in Nigeria, results in table 6.74 on trader's dynamic on water availability and household size showed 59 participants in a household of 6 to 10 persons said water is available to them, 3 participants in a household of 6 to 10 persons as well as in a household of 11 persons above said water is available once in a while. Also, 29 participants in a household of 6 to 10 persons as well as in a household of 11 persons above, said water is not available to them. The household with the highest water availability is the household with 6 to 10 persons and the household with less water availability is the household with 2 persons. Out of 209 participants, 130 participants said that water is available to them.

Generally, the results in both countries showed households do not have available water. The possible explanation could be because fuel-wood business activities take place mostly in both urban and rural areas as the business is domiciled to the poor household due to lack of recognition by governments and elites.

6.7.6 Health Care in Last 1 Year

Table 6.75: HH Health in 1Yr SA * HH Size SA

				HHSizeSA			
			2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5
HH Health in 1YrSA		Adequate taking care of	22	64	7	5	
		Not taking care of	27	57	12	3	
Total			49	121	19	8	

According to table 6.75 showing traders dynamic on household health in 1 year and household size. The result showed 64 participants in a household of 3 to 5 persons said they adequately take care of their health while 57 of the participants said they do not take care of their health. Out of 200 participants, 99 participants said they adequately take care of their health and 101 participants said they do not take care of their health.

Table 6.76: HH Health in 1YrNG * HH Size NG

			HHSizeNG			Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
HHHealth in 1YrNG	Adequate taking care of	1	34	74	44	153
	Mildly taking care of	1	9	16	51	51
	Not taking care of	0	3	1	1	5
Total		2	46	91	70	209

Conversely, the Nigerian result in table 6.76 on trader's dynamic about household health in 1 year and household size showed 74 participants in a household of 6 to 10 persons said they adequately take care of their health while 51 participants in a household of 11 persons and above said they mildly take care of

their health. 1 participant in a household of 6 to 10 persons as well as in a household of 11 persons above 6 to 10 persons said they do not take care of their health. Out of 209 participants, 153 participants said they adequately take care of their health and 51 participants said they mildly take care of their health.

Results on traders' dynamics on household health and household size are an outcome of interest on the contribution of fuel-wood business to livelihood. Respondents in South Africa have indicated their inability to provide their households with health care. Less than 50% of the participants were able to provide health care from the business. On the contrary, the respondents in Nigeria have indicated that the fuel-wood business takes care of their health care. More than 70% of the participants showed that their health care was adequately taken care of.

6.7.7 House Improvement in Last 1 Year

Table 6.77: House improvement in 1Yr SA * HH Size SA

		HHSizeSA						Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Household Improvement last 1YrSA	Repairs of the roof, wall and paintings	25	56	9	4		2	96
	Housing maintenance	18	32	5	2	1		58
	Additional installation	6	33	5	2	0		46
Total		49	121	19	8	3		200

Table 6.77 on trader's dynamic about house improvement and household size, the result showed 56 participants in a household of 3 to 5 persons said their house improvement has been on repairs of the roof, wall, and paintings, 32 participants said the improvement in their house was on painting, and 33 of the participants said the improvement in their house was on additional installation. The household with the highest house improvement is the household with 3 to 5 persons and the household with less household improvement is the household with 11 persons above. Out of 200 participants, 96 participants said that their household improvement was on repairs of the roof, wall, and paintings.

Table 6.78: House improvement last 1YrNG * HH Size NG

		HHSizeNG				Total
		2 persons	3 to 5 persons	6 to 10 persons	11persons and	
House Improvement last 1YrNG	Repairs of the roof, wall and paintings	2	36	67	54	159
	Housing maintenance	0	8	20	15	43
	Additional installation	0	2	4	1	7
Total		2	46	91	70	209

Table 6.78 on trader's dynamic about house improvement and household size, the results showed 67 participants in a household of 6 to 10 persons said their house improvement has been on repairs of the roof, wall and paintings, 20 participants said the improvement in their house was on painting, and 4 of the participants said the improvement in their house was on additional installation. The household with the highest house improvement is the household with 6 to 10 persons and the household with less household improvement is the household with 2 persons. Out of 209 participants, 159 participants said that their household improvement was on repairs of the roof, wall, and paintings.

Comparing South Africa and Nigeria in terms of dynamics on house improvement and household size. The results showed respondents from Nigeria have achieved 79% of house improvement due to fuel-wood business while in South Africa 48% of house improvement was achieved. The result goes to show that Nigerian households have more house improvement than their South African counterpart.

6.7.8 Household Size and Dwelling Access/Bus Station

Table 6.79: Dwelling access to road/bus station SA * HH Size SA

			HHSizeSA					Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Dwelling Access to Road/Bus station SA	Hours	25	56	9	4		2	96
	Less than an hour	18	32	5	2		1	58
	Minutes	2	18	3	0		0	23
	Other	4	15	2	2		0	23
Total		49	121	19	8		3	200

Dwelling conditions and access to the road/bus station to obtain essential social services such as transportation, basic health and education services is a determinant of living conditions and livelihood of many people. Respondents were asked the time taken to access the road/bus station. Results in table 6.79 on trader's dynamic about dwelling access to road/bus station and household size showed 56 participants in a household of 3 to 5 said that their dwelling access to road/bus station is in hours, 32 participants said that their dwelling access to road/bus station is less than an hour, 18 participants and said that their dwelling access to road/bus station is in minutes and 15 of the participants gave other reasons about their dwelling access to road/bus station. The household with the highest dwelling access to road/bus station is the household with 3 to 5 persons and the household with less dwelling access to road/bus station is the household with 11 persons above. Out of 200 participants, 96 participants said that their dwelling access to road/bus station is in hours.

Table 6.80: Dwelling access to road/bus station NG * HH Size NG

		HH Size NG				Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
Dwelling Access to Road/Bus station NG	Hours	1	9	26	15	51
	Less than an hour	0	19	43	29	91
	Minutes	1	18	20	26	65
	5	0	0	2	0	2
Total		2	46	91	70	209

Similarly, Nigerian respondents were also asked the taken to access road/bus station. The result in table 6.80 on trader's dynamic about dwelling access to road/bus station and household size showed 26 participants in a household of 6 to 10 said that their dwelling access to road/bus station is in hours, 43 participants said that their dwelling access to road/bus station is less than an hour, 20 participants and said that their dwelling access to road/bus station is in minutes and 2 of the participants gave other reasons

about their dwelling access to road/bus station. The household with the highest dwelling access to road/bus station is the household with 6 to 10 persons and the household with less dwelling access to road/bus station is the household with 2 persons. Out of 209 participants, 91 participants said that their dwelling access to road/bus station is less than an hour.

The results show that both South African and Nigerian respondents have less than 50% access to the road/bus station. The reason could that fuel-wood business activities take place in the rural and forested areas.

6.7.9 Children Schooling

Table 6.81: Children schooling * HH Size SA

		HHSizeSA						Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5		
Children Schooling	Adequately taking care of	25	53	8	5		2	93
	Less adequate	18	43	8	2		1	72
	More than adequate	6	25	3	1		0	35
Total		49	121	19	8		3	200

Non-food activities like children's schooling are one of the livelihood outcomes. To establish whether respondents take care of their children's education or not. Result in table 6.81 on trader's dynamic about children schooling and household size shows that 53 participants in a household of 3 to 5 persons said their children schooling has been adequately taken care of, 43 participants said their children schooling has been less adequate, and 25 of the participants said their children schooling has been more than adequate. Out of 200 participants, 93 participants said their children's schooling has been adequately taken care of.

Table 6.82: Children schooling NG * HH Size NG

		HH Size NG				Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
Children Schooling NG	Adequately taking care of	2	31	64	50	147
	Less adequate	0	10	21	17	48
	More than adequately	0	5	6	3	14
Total		2	46	91	70	209

In Nigeria, table 6.82 on the trader's dynamic about children's schooling and household size. The results showed 64 participants in a household of 6 to 10 persons said their children's schooling has been adequately taken care of, 21 participants said their children's schooling has been less adequate, and 6 of the participants said their children's schooling has been more than adequate. Out of 209 participants, 147 participants said their children's' schooling has been adequately taken care of.

Comparing South Africa and Nigeria on children's schooling and household size, the result shows that 46.5% of respondents in South Africa said they have adequately taken care of their children's school fees. While in Nigeria 70% of the respondents indicated that they have adequately taken care of their children's

school fees. It is clear from the result that Nigerian households were taking care of their children's education more than South African respondents.

6.7.10 Communication Facility

Table 6.83: HH Communication facility SA * HH Size SA

		HH Size SA					Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	5	
HH Com Facility SA	Mobile telephone	48	120	19	8	3	198
Total		48	120	19	8	3	198

On the communication facility to households, respondents were asked about their communication facility. The result in table 6.83 on the trader's dynamic about household communication facility and household size shows that all the participants in different household sizes said that their household communication facility is the mobile telephone.

Table 6.84: HH Communication facility NG * HH Size NG

		HH Size NG				Total
		2 persons	3 to 5 persons	6 to 10 persons	11 persons and	
HH Com Facility NG	Mobile telephone	2	30	66	47	145
	None	0	16	24	23	63
Total		2	46	90	70	208

Nigerian respondents were also asked about their communication facilities. Result in table 6.84 on the trader's dynamic about household communication facility and household size showed 66 participants in a household of 6 to 10 persons said that their household communication facility is mobile telephone while 24 said that they do not have household communication facility. Out of 208 participants, 145 participants said that their household communication facility is a mobile telephone and 63 said that they do not have a household communication facility.

From the results, all the respondents in South Africa have indicated that they use a mobile telephone. But 30% of Nigerian respondents have indicated that they have no communication facility. Meaning that 70% of Nigerian respondents use mobile telephone, unlike South African respondents that showed 100% ownership of mobile telephone.

6.7.11 Weekly Turnover and How Long in Business

Table 6.85: Weekly turnover SA * How long in business SA

		How Long n Business SA		Total
		Less than 1 year	1 to 5 years	
Weekly Turnover SA	Less than R666	16	84	100
	Between R1222 to R2000	13	87	100
Total		29	171	200

On the trader's dynamic about weekly turnover and how long in business, the result in table 6.85 showed 84 participants in the business of 1 to 5 years have a weekly turnover less than R666 while 87 of the participants have a weekly turnover between R1222 to R2000. The business with the highest weekly turnover is the business of 1 to 5 years and the business with less weekly turnover is the business of less than 1 year. Out of 200 participants, 100 participants said their weekly turnover is less than R666 and 100 participants said their weekly turnover is between R1222 and R2000.

Table 6.86: Weekly turnover NG * How long in business NG

		How Long in Business NG					Total
		Less than 1 year	1 to 5 years	6 to 10 years	4		
Weekly Turnover NG	Less than R666 Between R666 to R1333 Between R1333 to R2000 Between R2000 to R2333	3	48	46		44	141
		0	10	13		28	51
		0	12	3		4	8
		0		2		5	9
Total		3	61	64		81	209

On trader's dynamic about weekly turnover and how long in business, the result in table 6.86 showed 46 participants in business of 1 to 5 years have a weekly turnover less than R666. 13 participants in business of 6 to 10 years have a weekly turnover between R666 to R1333, 3 participants have a weekly turnover between R1333 to R2000 and 2 participants have a weekly turnover between R2000 to R2333. Out of 209 participants, 141 participants said their weekly turnover is less than R666 and while 51 participants said their weekly turnover is between R666 and R1333.

Comparing the results between South Africa and Nigeria, 50% of the respondents in South Africa have weekly turnover less than R666 and 50% have weekly turnover between R1222 and R2000. In Nigeria, the result shows that 70% of the respondents have weekly turnover less than R666 (N19, 980) and 25.5% of the respondents have weekly turnover between R666 (N19, 980) and R1333 (N39, 990). Furthermore, respondents in South Africa with 6-10 years have more weekly turnover than respondents that have 1-5 years and this also applies to Nigeria.

6.7.12 Weekly Profit and How Long in Business

Table 6.87: Weekly profit SA * How long in business SA

		How Long n Business SA		Total
		Less than 1 year	1 to 5 years	
Weekly Profit SA	Less than R166 Between R166 to R333 Between R333 to R499 Between R499 to R666	14	82	96
		8	50	58
		4	19	23
		3	20	23
Total		29	171	200

On trader's dynamic about weekly profit and how long in business, the result in table 6.87 showed 82 participants in a business of 1 to 5 years have a weekly profit less than R166, 50 participants have a weekly profit between R166 to R333, 19 participants have weekly profit between R333 to R499 and 15 of

the participants have weekly profit between R499 to R666. The business with the highest weekly profit is the business of 1 to 5 years and the business with less weekly profit is the business of less than 1 year. Out of 200 participants, 96 participants said their weekly profit is less than R166.

Table 6.88: Weekly profit NG * How long in business NG

			How Long in Business NG			Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	
Weekly Profit NG	Less than R166	2	47	50	44	143
	Between R166 to R333	0	10	5	17	32
	Between R333 to R499	1	3	6	12	22
	Between R499 to R666	0	1	3	8	12
Total		3	61	64	81	209

On trader's dynamic about weekly profit and how long in business, the result in table 6.88 showed 50 participants in business of 6 to 10 years have a weekly profit less than R166 (N4, 980), 5 participants have a weekly profit between R166 to R333 (N4, 980 TO N9, 990), 6 participants have weekly profit between R333 to R499 (N9, 990 to N14, 970) and 3 of the participants have weekly profit between R499 to R666 (N14,970 to N19,980). Out of 209 participants, 143 participants said their weekly profit is less than R166 (N4, 980).

Comparing South African respondents and Nigerian respondents, the results show that the business with the highest weekly profit in South Africa is the business of 1 to 5 years and the business with less weekly profit is the business of less than 1 year. While in Nigeria, the business with the highest profit in the business with 6-10 years. Also, 71.5% of the respondents in Nigeria showed that their weekly profit is less than R166 (N4, 980) contrary to South Africa which showed 48% with less than R166.

6.7.13 Profit Use and How Long in Business

Table 6.89: Profit use SA * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
Profit Use SA	Food for the household members	16	84	100
	Health and medical	13	87	100
Total		29	171	200

On the trader's dynamic about profit use and how long in business, the result in table 6.89 showed 84 participants in a business of 1 to 5 years use their profit for food for the household members while 87 of the participants use their profit for health and medicals. Out of 200 participants, 100 participants said they use their profit for food for the household members and 100 participants said they use their profit for health and medicals.

Table 6.90: Profit use NG * How long in business NG

			How Long in Business NG			Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	

Profit Use NG	Food for the household members	1	41	35	50	127
	Education	2	11	21	15	49
	Health and medical	0	9	8	16	33
Total		3	61	64	81	209

On trader's dynamic about profit use and how long in business, the result in table 6.90 showed 35 participants in the business of 6 to 10 persons use their profit for food for the household members 21 of the participants use their profit on education and 8 of the participants use their profit for health and medicals. Out of 209 participants, 127 participants said they use their profit for food for the household members, 49 participants said they use their profit on education and 33 participants said they use their profit for health and medicals.

Comparing South Africa and Nigeria on profit use, the results indicated that 42% of the respondents in a business of 1 to 5 years use their profit for food for the household members while 43% use their profit for health and medicals. 16.7% of the Nigerian respondents in the business of 6 to 10 years use their profit for food for the household members 10.5% use their profit on education and 3.8% of the participants use their profit for health and medicals. Additionally, 1 to 5 years use 20.5% for food and 5.2% for education in Nigeria.

6.7.14 Household Sleeping Hungry and How Long in Business

Table 6.91: HH Sleeping hungry SA * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
HH Sleeping Hungry SA	Never	16	84	100
	Sometimes	13	87	100
Total		29	171	200

On the trader's dynamic about household sleeping hungry and how long in business, the result in table 6.91 showed 84 participants in the business of 1 to 5 years never sleep hungry while 87 of the participants sometimes sleep hungry. Out of 200 participants, 100 participants said they never sleep hungry and 100 participants said they sometimes sleep.

Table 6.92: HH Sleeping hungry NG * How long in business NG

			How Long in Business NG			Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	
HH Sleeping Hungry NG	Never	2	48	45	63	158
	Seldom	0	7	5	6	18
	Sometime	1	6	12	12	31
	4	0	0	2	0	2
Total		3	61	64	81	209

On the trader's dynamic about household sleeping hungry and how long in business, the result in table 6.92 showed 45 participants in the business of 6 to 10 persons never sleep hungry, 5 seldom sleep hungry

while 12 of the participants sometimes sleep hungry. Out of 209 participants, 158 participants said they never sleep hungry.

Comparatively, 42% of the respondents 84 in the business of 1 to 5 years never sleep hungry while 43.5% of them sometimes sleep hungry. In Nigeria 25% of the respondents in the business of 6 to 10 persons never sleep hungry, 2.3% seldom sleep hungry while 5.7% of them sometimes sleep hungry. Also, 22.5% of 1to 5 years in business in Nigeria said they never sleep hungry.

6.7.15 Water Availability in Last 1 year and How Long in Business

Table 6.93: Water availability last 1YrSA * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
Water Avail last 1YrSA	Available	14	82	96
	Once in a while	8	50	58
	Not available	4	19	23
	Other	3	20	23
Total		29	171	200

On trader's dynamic about water availability and how long in business, the result in table 6.93 showed 82 participants in business of 1 to 5 years said water is available to them, 50 participants said water is available once in a while, 19 participants said water is not available to them and 20 of the participants gave other reasons of water availability. Out of 200 participants, 96 participants said that water is available to them.

Table 6.94: Water availability last 1YrNG * How long in business NG

		How Long in Business NG				Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	
Water Avail last 1Yr NG	Available	2	41	43	44	130
	Once in a while	1	2	2	4	9
	Not available	0	18	19	33	70
Total		3	61	64	81	209

On trader's dynamic about water availability and how long in business, the result in table 6.94 showed 43 participants in business of 6 to 10 years said water is available to them, 2 participants in a business of 6 to 10 years as well as in business of 1 to 5 years said water is available once in a while. 19 participants in the business of 6 to 10 years said water is not available to them. Out of 209 participants, 130 participants said that water is available to them.

Comparing South Africa and Nigeria, 41% of the respondents in South Africa in business of 1 to 5 years said water is available to them, 20% said water is available once in a while, while only 20% of Nigerian respondents in business of 6 to 10 years said water is available to them and in category 1 to 5, 19.6% said water is available.

6.7.16 Health Care in Last 1 year and How Long in Business

Table 6.95: HH Health in 1YrSA * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
HH Health in 1YrSA	Adequate taking care of	14	85	99
	Not taking care of	15	86	101
Total		29	171	200

On the trader's dynamic about household health in 1 year and how long in business, the result in table 6.95 showed 85 participants in the business of 1 to 5 years said they adequately take care of their health while 86 of the participants said they do not take care of their health. Out of 200 participants, 99 participants said they adequately take care of their health and 101 participants said they do not take care of their health.

Table 6.96: HH Health in 1YrNG * How long in business NG

			How Long in Business NG				Total
			Less than 1 year	1 to 5 years	6 to 10 years	4	
HH Health in 1YrNG	Adequate taking care of		3	47	47	56	153
	Mildly taking care of		0	11	16	24	51
	Not taking care of		0	3	1	1	5
Total			3	61	64	81	209

On traders dynamic about household health in 1 year and how long in business, the result in table 6.96 showed 47 participants in business of 6 to 10 years said they adequately take care of their health while 16 participants said they mildly take care of their health and 1 participant said they do not take care of their health. Out of 209 participants, 153 participants said they adequately take care of their health and 51 participants said they mildly take care of their health.

42% of the South African respondents in the business of 1 to 5 years said they adequately take care of their health while 43% said they do not take care of their health. In Nigeria, 22% in business of 6 to 10 years said they adequately take care of their health and 22% in business of 1 to 5 years said they adequately take care of their health.

6.7.17 House Improvement in Last 1 year and How Long in Business

Table 6.97 House improvement last 1YrSA * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
House Improvement last 1YrSA	Repairs of the roof, wall and paintings	14	82	96
	Housing maintenance	8	50	58
	Additional installation	7	39	46
Total		29	171	200

On trader's dynamic about house improvement and how long in business, the result in table 6.97 showed 82 participants in business of 1 to 5 years said their house improvement has been on repairs of the roof, wall, and paintings, 50 participants said the improvement in their house was on painting, and 39 of the participants said the improvement in their house was on additional installation. Out of 200 participants, 96 participants said that their household improvement was on repairs of the roof, wall, and paintings.

Table 6.98: House Improvement last 1YrNG * How Long in Business NG

		How Long in Business NG				Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	
HouseImprov last 1YrNG	Repairs of the roof, wall and paintings Housing maintance	2	52	45	60	159
	Additional installation	1	7	14	21	43
		0	2	5	0	7
Total		3	61	64	81	209

On trader's dynamic about house improvement and how long in business, the result in table 6.98 showed 45 participants in business of 6 to 10 years said their house improvement has been on repairs of the roof, wall, and paintings, 14 participants said the improvement in their house was on painting, and 5 of the participants said the improvement in their house was on additional installation. Out of 209 participants, 159 participants said that their household improvement was on repairs of the roof, wall, and paintings.

Comparing South Africa and Nigeria, 41% of respondents in business of 1 to 5 years in South Africa said their house improvement has been on repairs of the roof, wall, and paintings, 25% said the improvement in their house was on painting, and 19.5% said the improvement in their house was on additional installation. In Nigeria, 21.5% of respondents in the business of 6 to 10 years said their house improvement has been on repairs of the roof, wall and paintings, 6.6% said the improvement in their house was on painting, and 2.3% said the improvement in their house was on additional installation. Also, 24.8% of the respondents in business of 1 to 5 years in Nigeria said their house improvement has been on repairs of the roof, wall and paintings,

6.7.18 Dwelling Access to Road/Bus Station and How Long in Business

Table 6.99: Dwelling Access to Road/Bus station SA * How Long in Business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
Dwelling Access to Road/Bus station SA	Hours	14	82	96
	Less than an hour	8	50	58
	Minutes	4	19	23
	Other	3	20	23
Total		29	171	200

On trader's dynamic about dwelling access to road/bus station and how long in business, the result in table 6.99 showed 82 participants in business of 1 to 5 said that their dwelling access to road/bus station is in hours, 50 participants said that their dwelling access to road/bus station is less than an hour, 19 participants and said that their dwelling access to road/bus station is in minutes and 20 of the participants gave other reasons about their dwelling access to road/bus station. The participants with the highest dwelling access to road/bus station are those in business 1 to 5 years and the participants with less

dwelling access to road/bus stations are those in business for less than 1 year. Out of 200 participants, 96 participants said that their dwelling access to road/bus station is in hours.

Table 6.100: Dwelling Access to Road/Bus station NG * How Long in Business NG

		How Long in Business NG				Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	
Dwelling Access to Road/Bus station NG	Hours	2	15	19	15	51
	Less than an hour	0	27	29	35	91
	Minutes	1	19	16	29	65
	5	0	0	0	2	2
Total		3	61	64	81	209

On trader's dynamic about dwelling access to road/bus station and how long in business, the result in table 6.100 showed 19 participants in business of 6 to 10 years said that their dwelling access to road/bus station is in hours, 29 participants said that their dwelling access to road/bus station is less than an hour, 16 participants and said that their dwelling access to road/bus station is in minutes, Out of 209 participants, 51 participants said that their dwelling access to road/bus station is less than an hour.

In South Africa, 41% of respondents in the business of 1 to 5 years said that their dwelling access to road/bus station is in hours, 25% said that their dwelling access to road/bus station is less than an hour. 9% of respondents in Nigeria in the business of 6 to 10 years said that their dwelling access to road/bus station is in hours and 13% said that their dwelling access to road/bus station is less than an hour. Also, respondents in the business of 1 to 5 years in Nigeria, 7.1% said their dwelling access to road/bus station is in hours and 12.8% said their dwelling access to road/bus station is less than an hour.

6.7.19 Children Schooling and How Long in Business

Table 6.101: Children schooling * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
Children Schooling	Adequately taking care of	15	78	93
	Less adequate	9	63	72
	More than adequate	5	30	35
Total		29	171	200

On trader's dynamic about children schooling and how long in business, the result in table 6.101 showed 78 participants in business of 1 to 5 years said their children schooling has been adequately taken care of, 63 participants said their children schooling has been less adequate, and 30 of the participants said their children schooling has been more than adequate. Out of 200 participants, 93 participants said their children's schooling has been adequately taken care of.

Table 6.102: Children schooling NG * How long in business NG

			How Long in Business NG				
			Less than 1 year	1 to 5 years	6 to 10 years	4	
Children Schooling NG		Adequately taking care of	1	40	49	57	
		Less adequate	0	15	14	19	
		More than adequately	2	6	1	5	

Total			3	61	64	81	

On trader's dynamic about children schooling and how long in business, the result in table 6.102 showed 49 participants in business of 6 to 10 years said their children schooling has been adequately taken care of, 14 participants said their children schooling has been less adequate, and 1 of the participant said their children schooling has been more than adequate. Out of 209 participants, 147 participants said their children's schooling has been adequately taken care of.

Comparing South Africa and Nigeria, 39% of the respondents in South Africa in the business of 1 to 5 years said their children schooling has been adequately taken care of, 31.5 participants said their children schooling has been less adequate, and 15% said their children's schooling has been more than adequate. In Nigeria, 23.4% of the respondents in the business of 6 to 10 years said their children's schooling has been adequately taken care of, 6.6% said their children's schooling has been less adequate. In the business of 1 to 5 years, 19.1% of the Nigerian respondents said their children's schooling has been adequately taken care of and 7.1% of their children's schooling has been less adequate.

6.7.20 Communication Facility and How Long in Business

Table 6.103: HH Communication facility SA * How long in business SA

		How Long in Business SA		Total
		Less than 1 year	1 to 5 years	
HH Com Facility SA	Mobile telephone	29	169	198
Total		29	169	198

On the trader's dynamic about household communication facility and how long in business, the result in table 6.103 showed all the participants in who are in the business said that their household communication facility is a mobile telephone.

Table 6.104: HH Communication facility NG * How long in business NG

		How Long in Business NG				Total
		Less than 1 year	1 to 5 years	6 to 10 years	4	
HH Com Facility NG	Mobile telephone	3	42	45	55	145
	None	0	19	18	26	63
Total		3	61	63	81	208

On the trader's dynamic about household communication facility and how long in business, the result in table 6.104 showed 45 participants in the business of 6 to 10 years said that their household communication facility is mobile telephone while 18 said that they do not have household communication facility. Out of 208 participants, 145 participants said that their household communication facility is a mobile telephone and 63 said that they do not have a household communication facility.

Comparing South Africa and Nigeria, in South Africa the result shows that all the respondents who are in the business said that their household communication facility is a mobile telephone. Contrary to Nigeria where 22.5% of the respondents in the business of 6 to 10 years said that their household communication facility is a mobile telephone, while 8.6% said that they do not have a household communication facility.

Those respondents in business 1 to 5 years, 20% of them said they have a mobile telephone and 9% said they do not have a household communication facility.

6.7 Policy Implications of the Findings for both South Africa and Nigeria

Wood-based biomass can create value- addition through poverty alleviation as many poor people are involved in the sector (World Bank, 2011:9). This is a contrast to what is obtained in the fossil fuels-based energy sector that is often imported energy (kerosene and LPG) and negatively affects the countries balance sheet. The above findings confirmed this statement. The results revealed that fuel-wood traders in both South Africa and Nigeria used fuel-wood business as one of the means of their livelihood as per food security, health security, children's education, and income. This is in line with the assertion of Chambwera (2004:4) that fuel-wood energy sector there is the involvement of many people (i.e consumers and traders) in the market economy acting as economic agents, with consumers seeking to maximize utility from energy consumption and traders seeking to maximize profit through selling fuel-wood. The result of this interaction led to livelihood outcomes. The outcome of this study confirms the results of many studies conducted in African countries. The recent include, Jamal and Anthony (2016) in Northern Ghana and Geoffrey (2010) in Kenya and Rwanda. Furthermore, the results show fuel-wood business has contributed to food security as measured by the number of years respondents spent in fuel-wood business and household size as well as non-food consumption such as health and children schooling. The evidence suggests that the fuel-wood business not only improved household livelihood but also transformed households in terms of entrepreneurial skills. This attests that households' involvement in the fuel-wood business has smoothened their consumption, their incomes were utilized to reduce vulnerabilities, poverty, and other shocks.

Empirical evidence from the developing countries, particularly Sub-Saharan African countries believed that poverty has been a challenge to many households. The findings of this study imply that the fuel-wood business can create diverse opportunities that can enable urban and rural poor to make the best use of their available natural and human resources to initiate self-employment activities and develop a sense of self-reliance. The natural resource management can be achieved through development of Small-scale plantations and woodlots that can increase fuel-wood production and trigger economic opportunities and land-use planning. Although natural forests are expected to continue supplying much of the fuel-wood. However, in the long run, they will be unable to meet demand sustainably since the demand is expected to increase substantially due to population growth. Thus, private or group-based woodlots/plantations could, in the long term, complement fuel-wood supplies through encouraging local-level investments in establishing planted woodlots. The recently acquired green bond can substantially assist in this manner. South Africa and Nigeria can also leap Senegal where World Bank's PROGEDE initiative established sustainable community-based forest management systems over an area of 378,161 hectares with a capacity to supply more than 370,596 tons per year of sustainable fuel-wood. It was reported that the results greatly exceeded the goals at the time of appraisal (with an average 215 achievement index figure compared to the appraisal report) (World Bank, 2005). Finally, the result has a welfare implication in the sense that it presented poor infrastructure in terms of portable water supply, transportation and communication facilities that explains the living condition of fuel-wood traders.

6.8 Finding and Discussion (objective 3): Determination of Factors Affecting Fuel-wood Energy Sector Funding from the Perspective of Stakeholders (a case study of Nigeria)

This section presents a case study result of focus group discussion (FGD) with the stakeholders in the fuel-wood energy sector (traders) to determine factors affecting fuel-wood energy sector funding (Nigeria as a case study) _. Three themes have emerged from the FGD, namely; lack of access to finance, Lack of awareness of the available financial services and Lack of government support.

6.8.1 Lack of Access to Finance

Participants viewed access to finance as critical to the development of fuel-wood business unfortunately they expressed their inability to access funding from financial institutions hindering the growth of the fuel-wood energy sector in Nigeria. Their only source of finance is through their savings and loan from friends and family. One of the respondents has this to say:

"I started as a laborer and then venture into selling fuel-wood with some little money from my family. I also added with the little I saved. I got no financing from any financial institution". (Nigerian, interview, July 2017).

This outcome is consistent with the findings of Okpara (2011:156) revealing that lack of access to finance as the commonest constraint hindering the growth and survival of small businesses in Nigeria. Evidence of small business difficulty in accessing financing was further revealed in recent banking sector report by the Nigerian National Bureau of Statistics (NBS) for the Q1 of 2018 where credit allocation to private sector by banks hits N15.60 trillion but small scale businesses still haven't felt the impact of the huge allocation by the banks, noting that the banks preferred to finance the sector that gives them quick and fast gains (Daily Trust, 2018:32). Commercial bank loans to Micro Small and Medium Enterprises MSMEs decreased from 48.79% in 1992 to 0.15% in 2010 (Luper, 2012).

Relatedly, Taiwo and Falohun, (2016) argued that the financial system in Nigeria is not in short supply of liquidity, but the formal financial institutions have been very reluctant to grant loans to MSMEs, which they regard as a high-risk sector. Most of the banks would rather pay the penalty imposed for not meeting the minimum exposure to preferred sectors of the economy than run the risk of being exposed to them
One respondent narrated that:

"Financial institutions are not interested in dealing with us because we are not rich, we fund our business through the little savings we have". (Nigerian, interview, July 2017).

One of the best ways to prevent deforestation is to encourage fuel-wood traders to own and develop woodlots. Studies have shown that sustainable fuel-wood production can be possible through woodlots development. Participants dissatisfied with the way financial institutions treat the development of woodlots. According to them, if funds were available, they can grow enough wood without destroying the natural vegetation. In respond, one respondent said:

"Financial institutions don't value us nor our business that is why they are reluctant to give us a loan to develop woodlots. My capital comes through the help of Allah (God in Muslims faith). I managed a very small woodlot which is too little to serve my customers fuel-wood needs. You see, I have very small capital" (Nigerian, interview, July 2017).

This confirmed the assertion made by Adedayo and Toluwalupe (2014:107) on the bank's inability to grant credit to small businesses. The reason banks don't give funds to small businesses is because of the general perception of Nigeria's bankers that banks are not a charity, hence there is no reason why they should take risks with small businesses and SMEs when they can make good money elsewhere. For instance, most banks rather seek low-risk investments and short duration instead of extending credit to small businesses.

6.8.2 Lack of Awareness of the Available Financial Services

Respondents noted that their level of awareness of available financial products is a problem but still no effort is being made to educate them on funding opportunities provided by financial institutions. Most of them were the product of Almajiri system (a traditional system of Islamic education being practice in Northern Nigeria). They have agreed that the system has disallowed them western education from childhood. They venture into petty businesses to sustain their families when they reach adulthood.
One respondent said:

"Am aware of all the external financing institutions but I don't know about the financial products available". (Nigerian, interview, August 2017).

However, this contradicts a recent study conducted by Small and Medium Enterprise Development Agency (SMEDAN) in conjunction with NBS (NBS, 2013:69) reporting some level of improvement in the awareness of financial products available to MSMEs. For example, Kwara State was rated the highest (92.09%) followed by Bayelsa State (86.48%), Sokoto State (79.88%) and Katsina State (75.63%). To confirm the low level of awareness of available financial products despite the rating,

One of the respondents have this to say:

"*How do you know them and their services (referring to financial institutions and their products) while they don't have anything to do with you?" (Nigerian, interview, August 2017).*

6.8.3 Lack of Government Support

Respondents believe that they have not been getting any financial support from the government. World over, governments create various departments, agencies, and institutions to support small businesses. The Nigerian government has created various agencies and institutions like CBN, SMEDAN, BOI and MFB's to support small businesses. Respondents claimed that financial support for small businesses in the country has been politicized. They lamented that money that was to be disbursed to small business owners ended of being shared with the supporters and cronies of politicians.

One respondent narrated:

"Recently micro-enterprises funding is given to many people in this state (referring to Katsina state) but nobody came here to give us. They are only sharing money to their political friends, not us". (Nigerian, interview, September 2017).

This is in agreement with the recent happening in Katsina State when 2billion Naira small business loan was given to Katsina state government through the CBN but instead of disbursing the loan to small traders it was distributed to political cronies. Even the Trader's Money initiative being championed by Vice President of Nigeria is under serious criticism of being politicized.

One respondent said:

"I used to hear that government is giving money to small traders, but they never gave me". (Nigerian, interview, September 2017).

6.9 Implication of the Findings

Modernizing the wood-based biomass sector can significantly the revenue base of many Sub-Saharan African countries and sustainable economic development (World Bank, 2011:9). There is an urgent need for investment in natural resources. However, our findings from FGD in Nigeria show that stakeholders in the fuel-wood energy sector depend on internal financing or retained earnings, friends and family and to finance their businesses. There has not been external funding for the fuel-wood energy sector. The findings also confirmed a lack of access to finance, lack of awareness of financial services and assistance from the government to have a significant negative effect on the fuel-wood energy sector. To enhance the fuel-wood sector, the government can play an important role by removing restrictions imposed on small businesses by financial institutions in accessing financial resources thereby creating more penalties for banks that refuse to grant loans to small businesses. One way to achieve this is through the modernization of fuel-wood markets to create an opportunity for stakeholders to engage formally in the sector. The way to improve these markets is by investing massively in scaling-up the infrastructure, such as trading sites. The private sector can have an important role in establishing rural fuel-wood markets since their rewards are directly linked to the markets' success. For example, the domestic energy strategies for Mali and Niger have achieved this target through village organization and granting the exclusive right for communities to sell fuel-wood via rural markets (Jolie et. al, 2014:26). Financial institutions like bank of

industry (BON), National economic reconstruction fund (NERFUND), the community banks (CB) now microfinance banks, Nigerian export and import bank (NEXIM), Nigerian agricultural credit guarantee scheme, small and Medium equity investment scheme (SMEEIS) and small and medium enterprises credit guarantee scheme (SMECGS) and SMEDAN can provide financial mechanism that will support fuel-wood energy sector and forest management in Nigeria.

6.10 Hypotheses Testing

The study formulated hypotheses to investigate the similarities/differences between South Africa and Nigeria in terms of domestic fuel-wood energy consumption, the contribution of fuel-wood business to trader's livelihood and also determine factors affecting the fuel-wood energy sector funding in Nigeria. Hypothesis one investigates the differences between South Africa and Nigeria on the influence of socioeconomic and demographic variables on domestic fuel-wood energy consumption. To test hypothesis one, descriptive statistics and regression analysis were used. Hypothesis two investigates differences between South Africa and Nigeria on the contribution of fuel-wood energy business on trader's livelihood as per income, food security, health care, and children's education. To test the hypothesis, descriptive statistics were used. Hypothesis three investigates factors affecting the fuel-wood energy sector funding using FGD and constant comparison analysis.

6.10.1 Hypothesis One

Hypothesis one predicted that there is no significant difference between South Africa and Nigeria on the influence of socioeconomic and demographic factors namely (Gender, education level, monthly income, age, household size, employment status, marital status and structure of the house) on domestic fuel-wood energy consumption. The results in tables (5.7 to 5.12) show that gender is not a significant predictor of the frequency of using fuel-wood, reason fuel-wood is the major energy source and reason for combining fuel-wood with other energy types in South Africa and Nigeria. There is no significant difference between South Africa and Nigeria in this respect. Similarly, results in tables (5.13to 5.17) showed marital status is not a significant predictor of the frequency of using fuel-wood energy and reason for using fuel-wood as the major source of energy. However, tables (5.18-5.21) revealed that marital status is a predictor for the combination of fuel-wood with other energy types in South Africa and Nigeria at significant values of 21.252 and 0.047 for South Africa and 21.253 and 0.026 for Nigeria. Furthermore, the results in tables (5.22 to 5.30) have indicated the level of education is a significant predictor of the frequency of using fuel-wood, reason for using fuel-wood as a major energy source and reason for combining fuel-wood with other energy types in South Africa and Nigeria. Regression analysis supported these results revealing that education has a negative significant relationship with fuel-wood energy consumption. In terms of the influence of education on fuel-wood consumption, there is no significant difference between South Africa and Nigeria. Also, there are no significant differences between South Africa and Nigeria on the influence of age. Tables (5.31 to 5.36) shows age is not a significant predictor of fuel-wood energy consumption. Concerning household size, employment status, and monthly income, logit regression in tables 5.50 and 5.64 revealed that there is a negative and statistically significant relationship between fuel-wood energy consumption and socioeconomic and demographic variables in South Africa and Nigeria. Meaning that there is no significant difference between South Africa and Nigeria in terms of the influence of these variables. Based on this we can conclude that hypothesis one is rejected.

6.10.2 Hypothesis Two

Hypothesis two predicted that there is no significant difference between South Africa and Nigeria on the contribution of fuel-wood business on trader's livelihood as per income, health security, food security, and children's education. The results in tables (5.39 and 5.40) shows that weekly profit generated by traders in the two countries is the same, and in terms of profit usage, tables (5.41 and 5.42) indicated that traders in South Africa use their profit to provide food and health care to their families. In Nigeria, profit is used to provide education, food, and health care. The difference is that Nigerian traders provide education with their profit while South Africans don't. Results in tables (5.43 and 5.44) showed a

substantial number of the respondents in South Africa and Nigeria go to sleep with their stomachs full. Even though some households in South Africa and Nigeria said they sometimes sleep hungry, but the result shows that more than 50% of the respondents in the two countries spend their income on food to be food secure. In terms of health security, the result in the table (5.47) for South Africa has shown the trader's inability to provide their families with health care. Less than 50% of the participants were able to provide health care from the business. On the contrary, the result in the table (5.48) for Nigeria showed fuel-wood business takes care of the trader's health. Regarding children education, result in the table (5.53) shows that 46.5% of respondents in South Africa said they have adequately taken care of their children school fees. In Nigeria, result in the table (5.54) shows 70% of respondents have indicated they are adequately taken care of their children school fees. From these results, we can conclude that hypothesis two is partially rejected.

6.11.3 Hypothesis Three

Hypothesis three predicted that there is no significant influence of lack of access to finance, lack of awareness of the available financial services and lack of government support on the fuel-wood energy sector. In the contrary, results from FGD where three themes emerged showed that the financial constraints facing the fuel-wood energy sector faces were lack of access to finance, lack of awareness of the available financial services and lack of government support. Therefore, hypothesis three is also rejected.

CHAPTER SEVEN: SUMMARY, CONCLUSION AND RECOMMENDATION

7.1 Overview of the Study

In this chapter, a summary, conclusion, and recommendation of the entire study will be presented. The research problems raised in the study were adequately addressed using robust methods of data analysis namely descriptive and econometric methods of analysis. Also, Content Comparison Analysis was used to analyze data obtained from FGD. The findings of the study revealed that Nigerian households consume more fuel-wood than their South African counterpart. Education level, gender, monthly income, the structure of the house and employment have a negative significant relationship with fuel-wood consumption in both countries. Household size, marital status, and age have a positive significant relationship with fuel-wood consumption in the two countries. Furthermore, the results showed weekly profit is used by the fuel-woo traders in South Africa to provide food and health care to their families. While fuel-wood traders in Nigeria use the weekly profit to provide food, health care and education to their families. Finally, three themes emerged from FGD that revealed a lack of access to finance, lack of information on available financial services and lack of government support are factors that affect fuel-wood energy sector funding in Nigeria. This chapter has eight sections. Section 7.2 is an overview of the study. Section 7.3 is the reflection of the study theoretical paradigm. Section 7.4 presents the reflection of methodological approaches of study 7.5 outlines the summary of the study. Section 7.6 presents recommendations. Section 7.7 is the limitation of the study. Section 7.8 presents the contribution of the study.

The study empirically analyzed and compare domestic fuel-wood energy consumption between South Africa and Nigeria using Western Cape Province and Katsina State as a case study. Answers to the three research questions raised in the study were provided. The study provided answers to the following three main research questions; 1. What is the impact of socioeconomic and demographic variables on domestic fuel-wood energy consumption in South Africa and Nigeria?
2. Does the fuel-wood business improve the lives of the traders in South Africa and Nigeria?
3. What factors affect fuel-wood energy sector funding?

Analysis of domestic fuel-wood energy consumption is significant to public policy-makers, practitioners and other energy stakeholders. The global energy standard linked energy with the level of economic development, countries that have an adequate supply of clean energy are considered developed. Conversely, countries that use more of dirty or traditional energy are considered as less developed. Fuel-wood is a widely used traditional energy for household domestic tasks. Therefore, analyzing dynamics of household fuel-wood consumption and impact of socioeconomic variables, contribution of fuel-wood business to the livelihood of the traders as well as fuel-wood energy sector funding of the targeted population will provides evidence that can be used to bring about new policy direction and interventions on energy, entrepreneurship and livelihood development of the society.
The results revealed that South Africa and Nigeria are developing countries where the majority of people cannot afford the cost of commercial energy for domestic activities. This situation forced many dwelling households to embrace fuelwood as a substitute despite the availability of modern energy, ("descending") the energy ladder instead of ("ascending") as expected (even though consumption of fuel-wood is higher in Nigeria). According to the literature, there is a direct link between fuel-wood consumption and development at macro and micro levels. For example, the use of fuel-wood in South Africa is only dominant in the rural areas and urban informal settlements where the concentration of poor people is high. Large gaps created by inequality between rich and poor, urban and rural persist in South Africa. The income distribution shows that the majority of South African households are poor. Report on poverty in South Africa has indicated an increase of 0.1% in national poverty which includes people getting R50 1 or less per day and striking inequality (World Bank, 2016). Therefore, socioeconomic variables play a significant role on modern versus traditional energy intake in South Africa. Nigeria on the other hand,

apart from the influence of socioeconomic and demographic factors in modern and traditional energy consumption, there exists a huge energy infrastructural gap. Residential consumption is higher than in the other sectors. Most of the energy is consumed in the residents, and it is mostly for domestic activities. In terms of poverty and fuel-wood consumption in Nigeria, almost 100 million people live in less than $1 a day. In 2010, 69 percent of Nigerian citizens were leaving below the poverty line (World Bank, 2016). Furthermore, results have indicated that fuel-wood traders in both countries have been deriving their livelihood from the fuel-wood business but despite that, the fuel-wood energy sector is deprived of external financing. Therefore, the present study is needed for possible future economic analysis of energy consumption for both South Africa and Nigeria.

7.2 Reflection of the Study: Theoretical Paradigm

The study adopted four theoretical frameworks namely, The Energy Ladder Model, Fuel Stacking Model, Household Economic Portfolio Model, and pecking order theory to explain dynamics and socioeconomic variables of fuel-wood energy consumption, the contribution of fuel-wood business to trader's livelihood and fuel-wood energy sector funding. The four theories have the merit of focusing households as a unit of analysis with regards to fuel-wood use, livelihood and fuel-wood funding. The Energy ladder model expounds on the significance of income on household energy uptake. According to the theory, as income increase household will move to more efficient and cleaner energy. Meaning that as family gain additional income and socioeconomic status they abandoned fuels that is local, less costly and inefficient. Families desire to move up the energy ladder not just to achieve greater fuel efficiency or less direct pollution exposure, but to demonstrate an increase in socioeconomic status.

The Fuel Stacking Model or multiple fuel model is a model that explains energy transition which the energy ladder model failed to offer. Fuel stacking model is an improvement of the energy ladder model because the model had incorporated the idea of stacking different fuel instead of abandoning inefficient fuel due to low income. According to the model, it is unusual for the households to completely switch from one fuel to another. Instead, they will continue to use the additional fuel with abandoning the old one. Also, the model explained that energy demand is driven by services energy provides, at the household level there will be reliance on biomass fuel for cooking and heating which form the main energy need at that stage of development. With increasing income, the household can afford to purchase a variety of appliances, each of which requires a specific energy source. This led to more diversified energy demand including modern energy sources. For basic energy needs, households will continue to use biomass fuels and add fuel to accommodate the needs of their changing lifestyle.

The Household Economic Portfolio Model (HEPM) is anchored on the premise that household being the unit owns resources namely human, natural, physical, social and financial. Households also are engaged in a certain activity that is geared toward livelihood outcomes. Therefore, the combination of resources and activity will give household livelihood outcomes.

The Pecking Order theory assumes that small businesses prefer internal financing like retain earnings to finance their businesses instead of external financing like debt and equity due to the fear of agency cost and domination by the bigger creditors. According to the theory, management prefers to finance first from retained earnings, then with debts, followed by a hybrid form of financing and lastly by using externally issued equity. This theory enables us to comprehend how the fuel-wood energy sector is to be funded.

7.2 Reflection of Methodological Approaches in the Study

The study collected two sets of questionnaires for objectives 1 and 2. The first was for the household fuel-wood energy consumers. A total of 1199 households fuel-wood consumers in Western Cape Province and 992 households fuel-wood consumers in Katsina State were received through two-stage stratified random sampling procedures using EAs that were used in the 2011 Census for South Africa and EAs established by Nigerian National Bureau of Statistics in 2015. Information was collected on the socio-demographic variable of the household fuel-wood consumers namely; household income, household size, educational level, age, the structure of the house, household employment, marital status, and gender. The second

questionnaire was for the fuel-wood traders in both South Africa and Nigeria. A total of 200 fuel-wood traders in the Western Cape Province and 209 fuel-wood traders in Katsina State were received. Information was collected bordering the following aspects; household size, socio-demographic information, business level information, income, food consumption, spending on household health, spending on children's education, household-level assets, social services, etc. For objective 3, a qualitative survey design involving a focused group discussion was conducted with 10 groups of fuel-wood traders in Nigeria using EAs in the sampling.

The study made use of Descriptive statistics and econometric models to analyze the data collected. For objective 1, frequency tables were used to analyze the dynamics of fuel-wood energy consumption. While Chi-Square Testing and Logit Regression were used to analyze socio-economic and demographic variables in fuel-wood energy consumption. Similarly, frequency tables were used to analyze data for objective 2, the contribution of fuel-wood energy business as per food security, health security, children's education, and income. To analyze objective 3, three themes from the FGD were identified and analyzed. They are; lack of access to finance, Lack of awareness of the available financial services and Lack of government support.

7.3 Summary of the Key Findings

7.3.1 Dynamics of fuel-wood energy consumption in South Africa and Nigeria

Comparing the findings on the frequency of using fuel-wood energy between South African and Nigerian households revealed that Nigerians use fuelwood more than South Africans. The study found South African households use 24.4% of fuel-wood once in a day, 60.8% use it twice in a day, while Nigerian households use 1.1% once in a day, 7.3% twice in a day and 72.2% trice in a day.

In comparing the reason fuel-wood is the major source of energy between South Africa and Nigeria. The results showed fuelwood is the main energy used and Nigerian households use more fuel-wood as energy than South Africans because it is affordable. The findings in South Africa indicated that 68.1% said because it is relatively affordable, 8.7% said it is very affordable and 11.3% responded that it is a bit affordable. On the contrary, 62.4% of Nigerian households said because it is affordable, 2.5% responded that it is a bit affordable and 4% said it is very affordable.

With regards to comparing the reasons for combining fuel-wood with other energy types (fuel stacking) between South Africa and Nigeria. The findings also revealed family size and price are the major drivers of fuel stacking behavior among households in Nigeria. While culture and price are the major drivers for fuel stacking in South Africa. 48.6% of Nigerian respondents indicated family size, 43.6% said it is due to price, while in South Africa, 68.1% said it is because of culture and 11.9% indicated price as the reason for the combination.

These findings supported the argument of Muller and Yan (2016) that beyond income (energy ladder hypothesis) there are other closely interrelated social-economic factors driving the household fuel transition. However, the extent of the influence of these factors varies widely within or across countries.

7.3.2 The Impact of Socioeconomic and Demographic Variables on Level of Fuel-wood Energy Consumption in South Africa and Nigeria

In exploring the impact of socioeconomic and demographic variables on the level of fuel-wood energy consumption in South Africa and Nigeria, the Chi-Square test and Logit regression was used. The Chi-Square test findings showed females frequently use fuel-wood than men in both South Africa and Nigeria. Also, the study found no significant difference between the frequencies of using fuel-wood energy, the reason for using fuel-wood as a major energy source, reason for combining fuel-wood with other energy

types and gender in the two study areas. This result corroborated the finding of Link et al. (2012) that show a high proportion of female members induced households to use fuelwood in Nepal. The general explanation that could be drawn from the result is the role of gender in explaining fuel-wood consumption stems from the influence and bargaining position of women in household domestic activities.

The study also found no significant difference between marital status and frequency of using fuel-wood and reason for using fuel-wood as a major source of energy in the study areas. However, the results show a significant difference between marital status and reasons for combining fuel-wood with other energy types at Chi-Square values of 21.253 (0.047) and 21.253 (0.026). The regression analysis also confirmed this in South Africa, as marital status has a negative and statistically significant relationship with the probability of consuming fuel-wood energy at (. -444) and (p=.016) significant level.

In terms of educational level and fuel-wood energy consumption, the findings revealed a significant difference between frequencies of using fuel-wood energy at (4673.14, p=0.000), reason for using fuel-wood as a major energy source at (32.736, p=0.047) and reason for combining fuel-wood with other energy types at (32.736, p=0.001) for both South Africa and Nigeria respectively. From the result, education has a significant negative influence on the level of fuel-wood consumption. The regression analysis for Nigerian respondents shows a significant relationship between education level and level of fuel-wood consumption at (p=.0047) and a negative B value of (-691). Meaning that as education level increases, the level of fuel-wood consumption will decrease. This is following Farsi et al., (2007) argument that a higher level of education gives household higher awareness of the negative impact of dirty fuel consumption and increases their knowledge about the efficiency and convenience of modern fuels.

The study examined whether the employment status of the household has any impact on fuel-wood energy consumption. The result showed employment status was found to have a negative and significant relationship with the probability of consuming fuel-wood in Nigeria at (-1.276) and (p=.002) significant level. Similarly, result in South Africa revealed the employment status of the households was found to have a negative and significant relationship with the probability of consuming fuel-wood at (-1.594) and (p=.015).

Another equally important variable examined was the impact of household size on fuel-wood energy consumption in South Africa and Nigeria. The findings in Nigeria showed the size of the household was found to have a positive value at (.531) and a highly statistically significant relationship with the probability of consuming fuel-wood energy at (p=.033). Conversely, in South Africa, household size was found to have less probability of consuming fuel-wood. The negative relationship is statistically significant at (-135) and (p=.025) level. However, some evidences show a positive relationship exists between household size with fuel-wood consumption (Reddy 1995, Ouedraogo, 2006, Rao and Reddy, 2007, Pandey and Chaubal, 2011 and Özcan et al. (2013). While other studies revealed a negative relationship between household size with fuel-wood consumption (Israel, 2002, Abebaw, 2007 and Zhang and Koji, 2012).

7.3.3 Contribution of Fuel-wood Business to Trader's livelihood in South Africa and Nigeria as per Food Security, Health Security, Children's Education and Income.

The contribution of fuel-wood business to trader's livelihood has been analyzed by the study using frequency tables. The results showed Nigeria has more households involved in fuel-wood business than their South African counterpart. This confirmed the earlier assertion in the study that Nigeria has a cultural and religious belief of having many wives and children leading to larger family size. However, the turnover gained by the traders is higher in South Africa (between R666-R2000) than Nigeria (between R666 and R1333 (N19, 980 and N39, 990).

On weekly profit, the results show that the weekly profit generated by traders in the two countries is the same. The possible explanation could be because the fuel-wood business is perceived as a poor man business, hence low-profit margin. The results also revealed traders in South Africa use their profit to provide food and health care for their households. In Nigeria, traders use their profit to provide education, food and health care to their families. The difference is that Nigerian traders use their profit to provide education for their children, while South African traders don't.

The study also showed Nigerian and South African households utilize money generated from fuel-wood business to provide food for their families. Similarly, the results in both countries showed the majority of the respondents sleep with their stomach full. Even though some number of households in South Africa and Nigeria were reported to sometimes sleep hungry. From the results, it is apparent that the fuel-wood business contributed to the livelihood of the household traders.

The study examines the contribution of the fuel-wood business on the trader's health security. Respondents in South Africa have indicated their inability to adequately provide their households with health care. Less than 50% of the participants were able to provide health care from the business. On the contrary, the respondents in Nigeria have indicated that the fuel-wood business has taken care of their health security. More than 70% of the participants showed that their health care was adequately taken care of.

In Comparing South Africa and Nigeria on children's education, the result showed 46.5% of respondents in South Africa said they have adequately taken care of their children's school fees. In Nigeria, 70% of the respondents indicated they have adequately taken care of their children's school fees. It is clear from the result that Nigerian respondents were taken care of their children's education more than South African respondents.

7.3.4 Funding of Fuel-wood Energy Sector in South Africa and Nigeria.

The study used Focus Group Discussion (FGD) to analyze factors affecting funding of the fuel-wood energy sector in Nigeria (being our case study). The result showed all the respondents rely on friends, family, retained earnings and personal equity to fund their business. Mixing family or friends, own equity with other sources of finance is supported by pecking order theory. The findings in the study also showed a lack of access to finance, lack of awareness of financial services available and lack of government support are the major constraints to the fuel-wood energy sector in Nigeria. This finding supports the position of Hussaini et al. (2006) who argues that lack of access to finance is one of the challenges facing small and medium business growth and expansion. Also lack awareness of financial services constraints the ability of small businesses to access financial markets (Guiso and Jappelli, 2005).

7.4 Recommendations

From the onset, the study aimed to make a comparative analysis of domestic fuel-wood energy consumption between South Africa and Nigeria. The study made the following recommendations;

1. The need to include fuel-wood energy into energy policies of South Africa and Nigeria.

Electrification in the developing countries may reduce fuel-wood energy consumption, but cannot eliminate it. The study acknowledged that more than 60% of the household's fuel-wood consumption in both South Africa and Nigeria were accounted for by electrified households due to socioeconomic reasons. Therefore, it is clear, if the socioeconomic drivers propelling households to consume fuel-wood persist, consumption of fuel-wood will invariably increase. The study recommends the need for policymakers in South Africa and Nigeria to look beyond the provision of modern energy and incorporate traditional energy (fuel-wood energy) in their energy policies.

2. Development of a virile and vibrant fuel-wood energy sector

The study acknowledged the significance of the fuel-wood energy sector in the provision of energy and as a source of livelihood to many households. There is a need for the creation of a fuel-wood energy sector that could help in achieving energy security and livelihood.

3. Development of specific education curricula that promote fuel-wood energy

Concerning how the fuel-wood energy sector is viewed and managed, there is the need for a policy shift that promotes and better informs people about the significance of the informal fuel-wood energy sector. Currently, the sector is viewed almost entirely negatively as a result, policies, and laws tend to focus on how to stop fuel-wood consumption through a "command and control" type regulation, enforcement, and restriction. This perception needs to change to allow for responsible, sustainable, and profitable enterprises to develop from within the sector.

4. Creation of funding opportunities and information for the sector

Finally, lack of access to finance, information and government support has emerged as a constraint on the growth and existence of the fuel-wood energy sector. Policies to address these constraints should be introduced, including providing loans to the fuel-wood traders. Educational initiatives such as setting up workshops, developing the existing local markets, providing adequate and updated information on funding opportunities.

7.5 Limitations and Future Research

Firstly, the study was based in the Western Cape Province and Katsina State, on one hand, South Africa's economy is known to be two-tiered. The Western Cape Province is perceived to be more developed than most of the provinces. On the other hand, Katsina State is the second poorest state in Nigeria. There is a need to conduct studies in other provinces and states to have adequate information on domestic fuel-wood consumption. Secondly, primary data was collected only once, the study provides only a measurement at one moment at a time. The study does not represent the longitudinal and causal effect of fuel-wood energy consumption with seasonal change.

Thirdly, the study only analyzed the impact of eight socioeconomic and demographic variables out of many variables that can drive households' fuel-wood energy consumption. There is an ongoing debate on the applicability of the energy ladder and fuels tacking hypotheses based on the impact of socioeconomic and demographic variables in the developing countries. Empirical research is needed to investigate how these variables determine these hypotheses. Fourthly, the study argues that the fuel-wood energy business has impacted positively the livelihood of traders as per livelihood indicators such as income, food security, health security, and children's education. Further research should be conducted to analyze the contribution of fuel-wood business using other livelihood indicators. Fifthly, only three factors affecting fuel-wood energy sector funding were analyzed (lack of access to finance, lack of awareness of financial services available and lack of government support), more research should be conducted to explore more factors and constraints.

7.6 Contribution to Knowledge

1. Given the limited number of comparative studies that specifically analyze domestic fuel-wood energy consumption between South Africa and Nigeria, this study fills an existing knowledge gap. The findings in this study provide an inside view of how fuel-wood is consumed in the two countries. Given the large sample of 1199 and 992 respondents in each country, the study can provide a benchmark for possible future economic analysis on energy consumption for both South Africa and Nigeria.
2. The study provided the current status of domestic fuel-wood energy consumption. Measuring the level of consumption on the ground could help in energy policy implementation.
3. The study provided current views on domestic fuel-wood energy consumption that can be used in transforming the fuel-wood energy sector into a market-oriented sector that can achieve sustainable energy production like the modern energy sector.
4. This study has contributed to the debate on fuel-wood consumption-environment nexus where welfare issues were raised with environmental protection.

5. Fuel-wood consumption analysis methods are limited. The present study will add to the existing body of literature.

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Consent Form for questionnaire for learners University of the Western Cape

Title: Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Researcher: Naseer Babangida, Muazu

Student Number: 3689039

Programme: PhD Management

Please initial box

1. I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. (If I wish to withdraw I may contact the lead researcher at any time) ☐

3. I understand my responses and personal data will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the reports or publications that result for the research. ☐

4. I agree for the data collected from me to be used in future research. ☐

5. I agree for to take part in the above research project. ☐

Name of Participant (*or legal representative*)	Date	Signature
Name of person taking consent *(If different from lead researcher)*	Date	Signature
Lead Researcher (*To be signed and dated in presence of the participant*)	Date	Signature

Copies: All participants will receive a copy of the signed and dated version of the consent form and information sheet for themselves. A copy of this will be filed and kept in a secure location for research purposes only.

Researcher: Naseer Babangida Muazu
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UNIVERSITYOF THE WESTERN CAPE (UWC)
FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

School of Business and Finance

INFORMATION SHEET FOR RESEARCH PARTICIPANTS

Dear participant

Naseer Babangida Muazu

Student Number: 3689039

Programme: PhD Management

The title of my thesis is:

Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Please take time to read through this information sheet carefully in order for you to be knowledgeable about what is required of you as a research participant in this study.

As a participant who gave consent of your participation in this study, you will be required to **(list all the data gathering techniques/data collection methods that will be used here), for example:**

1. ***Complete a questionnaire in which you will be asked different questions with the aim of understanding the factors that determine fuel-wood energy consumption of your household.***

Your participation in this research project is voluntary and your responses will be treated as confidential. It will assist me to achieve the objective of the study which is to determine the domestic energy consumption, estimate the contribution of fuel wood business to household livelihood as well as estimate the level of SMMEs (fuel wood business) funding.

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact me at**:** nmbabangida69@gmail.com **+2348065030000, Ricardo M. Peters** rmpeters@uwc.ac.za**, Kanayo Ogujiuba** kannyog@gmail.com**.**

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

_____ _____

Name of Participant **Date**

Thank you for participating in my study.

HOUSEHOLD FUELWOOD CONSUMPTION **SOUTH AFRICA**

PROJECT LEADER:NASEER BABANGIDA MU'AZU

FOR FUELWOOD CONSUMER

Name……..

Position…….

Telephone……..

Fax……..

Email……..

Confidential

Questionnaire number……

(Q. 1) PLEASE INDICATE WHETHER YOU ARE	**male**	**female**
Tick one box		

(Q. 2) WHAT IS YOUR AGE	**17 - 29**	**30 - 45**	**45 - 60**	**Above 60**
Tick one box				

(Q. 3) MARITAL STATUS?	Single	Married	divorced	separated		
Tick one box						
(Q. 4) PLEASE INDICATE HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT	**Primary**	**secondary**	**certificated**	**diploma**	**first Degree**	**postgraduate**
Tick one box						
(Q. 5) PLEASE INDICATE YOUR HOUSEHOLD SIZE	**2 Persons**	**3-5 Persons**	**6-10 persons**	**11 person & Above**		
Tick one box						
(Q. 6) AGE BRACKET OF HOUSEHOLD MEMBERS	**0 - 9.99 years**	**10 - 19.99 years**	**20 - 39.99 years**	**40 - 49.99 years**	**50 - 59.99 years**	**60 years & above**
Enter the number of household members whose age fall in the bracket of:						
(Q. 7) PLEASE INDICATE YOUR HOUSEHOLD TYPE	**Nuclear**	**Extended**	**Bachelor**	**Others (Specify)**		
Tick one box						
(Q. 8) PLEASE INDICATE THE HOUSING TYPE	**made of cement,tailed**	**house made of cement**	**house made of wood,mud,thatching**	**Other,specify…..**		
Tick one box						

(Q. 9) WHAT IS YOUR PRIMARY OCCUPATION?	Public servant	Civil servant	self employed	Others (specify)
Tick one box				

(Q.10) ESTIMATE YOUR MONTHLY INCOME FROM YOUR :	Less than R333	R333-R666	R666-999	R999-R1333	R1333-1666	above R1666 specify….
Primary occupation						
second occupation						
Other occupation						

(Q. 11) PLEASE INDICATE EMPLOYMENT STATUS OF HOUSEHOLD MEMBERS	household members are	Not all are employed	None is employed	Looking for employment
Enter the number of household members that fall among the category				

(Q. 12) EDUCATIONAL LEVEL OF THE HOUSEHOLD MEMBERS	primary	secondary	certificate	diploma	first degree	Postgraduate
Enter the number of household members whose qualification fall in the bracket						

(Q. 13) A MAJOR ENERGY SOURCE	Electricity	Gas	Kerosene	Fuelwood
Which is the major source of energy for your household cooking?				

Which is the major source of energy for your household boiling?				
Which is the major source of energy for your household heating?				

(Q. 14) FREQUENCY OF USING A MAJOR ENERGY SOURCE	**Once a day**	**Twice a day**	**Thrice a day**	**Others (Specify)**
The major of source of energy for your household cooking is used:				

(Q. 15) REASONS FOR ADOPTING A MAJOR ENERGY SOURCE	**A bit affordable**	**Relatively affordable**	**Affordable**	**Very affordable**
The major of source of energy for your household cooking is used because:				

(Q. 16) REASON FOR ADOPTING A MAJOR ENERGY SOURCE FOR YOUR HOUSEHOLD FOR:	**A bit affordable**	**Relatively affordable**	**Affordable**	**Very affordable**
Cooking:				
Boiling:				
Heating:				

(Q. 17) MONTHLY EXPENDITURE ON THE MAJOR SOURCE OF ENERGY FOR:	**Cooking**	**Boiling**	**Heating**
Less than R66			
R66-R133			
R133-R199			
R199-R266			
R266-R300			
R333 & above.			

(Q. 18) HOW LONG HAVE YOU BEEN USING THIS MAJOR ENERGY SOURCE	Electricity	Gas	Kerosene	Fuelwood
Less than 1 year				
1 - 5.99 Years				
6 - 10 years				
Above 10 years				

(Q. 19) HOW DOES YOUR HOUSEHOLD COMBINE THE USE OF THE SOURCES OF ENERGY?	Electricity	Gas	Kerosene	Fuelwood	Others (Specify)
Electricity					
Gas					
Kerosene					
Fuelwood					
Others					

(Q. 20) REASON(S) FOR THE ABOVE COMBINATION (Tick more than one option if necessary)	Tick
Price	
Culture	
Family size	
Others (Specify:_____)	

(Q. 21) HOW OFTEN DO YOU USE FUELWOOD FOR?	Once a day	Twice a day	Three times a day	Others (Specify)
cooking				

boiling					
heating					
(Q. 22) WHAT AMOUNT OF MONEY DO YOU SPEND ON FUELWOOD PER MONTH?	**Less than R66**	**R66-R133**	**R133-R166**	**R200-R266**	**R333 & above**
Tick one box					
(Q. 23) FOR HOW LONG HAVE YOU BEEN USING FUELWOOD?	**Less than 1 year**	**1-5years**	**5-10years**	**Above 10years**	
Tick one box					
(Q. 24) DO YOU COMBINE FUELWOOD WITH ANY OF THE FOLLOWING ENERGY?	**Electricity**	**Kerosene**	**Gas**	**Other (Specify)**	
Tick one box					
(Q. 25) IF YES, WHAT IS YOUR RESONS FOR COMBINING THEM?	**Price**	**Culture**	**Family size**	**Other (Specify)**	
Tick one box					

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Please initial box

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6. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. (If I wish to withdraw I may contact the lead researcher at any time) ☐

7. I understand my responses and personal data will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the reports or publications that result for the research. ☐

8. I agree for the data collected from me to be used in future research. ☐

9. I agree for to take part in the above research project. ☐

_____	_____	_____
Name of Participant (*or legal representative*)	Date	Signature
_____	_____	_____
Name of person taking consent *(If different from lead researcher)*	Date	Signature
_____	_____	_____
Lead Researcher (*To be signed and dated in presence of the participant*)	Date	Signature

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Supervisor: Prof. Ricardo M. Peters
CONTACT ADDRESS: School of Business and Finance University of the Western Cape. CONTACT NUMBER:: (w) 021 959 769/2595
(c) 083 9566014
EMAIL:rmpeters@uwc.ac.za
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UNIVERSITYOF THE WESTERN CAPE (UWC)
FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

School of Business and Finance

INFORMATION SHEET FOR RESEARCH PARTICIPANTS

Dear participant

Naseer Babangida Muazu

Student Number: 3689039

Programme: PhD Management

The title of my thesis is:

Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Please take time to read through this information sheet carefully in order for you to be knowledgeable about what is required of you as a research participant in this study.

As a participant who gave consent of your participation in this study, you will be required to (**list all the data gathering techniques/data collection methods that will be used here), for example:**

2. ***Complete a questionnaire in which you will be asked different questions with the aim of understanding the factors that determine fuel-wood energy consumption of your household.***

Your participation in this research project is voluntary and your responses will be treated as confidential. It will assist me to achieve the objective of the study which is to determine the domestic energy consumption, estimate the contribution of fuel wood business to household livelihood as well as estimate the level of SMMEs (fuel wood business) funding.

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact me at**:** nmbabangida69@gmail.com **+2348065030000, Ricardo M. Peters** rmpeters@uwc.ac.za**, Kanayo Ogujiuba** kannyog@gmail.com**.**

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

_____ _____

Name of Participant Date

Thank you for participating in my study.

HOUSEHOLD FUELWOOD CONSUMPTION NIGERIA

PROJECT LEADER:NASEER BABANGIDA MU'AZU

FOR FUELWOOD CONSUMER

Name……..

Position…….

Telephone……..

Fax……..

Email……..

Confidential

Questionaire number……

(Q. 1) PLEASE INDICATE WHETHER YOU ARE	MALE	FEMALE
Tick one box		

(Q. 2) WHAT IS YOUR AGE	17 - 29	30 - 45	45 - 60	Above 60
Tick one box				

(Q. 3) MARITAL STATUS?	Single	Married	divorced	separated
Tick one box				

(Q. 4) PLEASE INDICATE HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT	Primary	secondary	certificated	diplma	first Degree	postgraduate
Tick one box						

(Q. 5) PLEASE INDICATE YOUR HOUSEHOLD SIZE	2 Persons	3-5 Persons	6-10 persons	11 person & Above
Tick one box				

(Q. 6) AGE BRACKET OF HOUSEHOLD MEMBERS	0 - 9.99 years	10 - 19.99 years	20 - 39.99 years	40 - 49.99 years	50 - 59.99 years	60 years & above
Enter the number of household members whose age fall in the bracket of:						

(Q. 7) PLEASE INDICATE YOUR HOUSEHOLD TYPE	Nuclear	Extended	Bachelor	Others (Specify)		
Tick one box						

(Q. 8) PLEASE INDICATE THE HOUSING TYPE	modern house made of cement,tailed roof	house made of cement	traditional house made of wood,mud,thatching	Other,specify…..
Tick one box				

(Q. 9) WHAT IS YOUR PRIMARY OCCUPATION?	Public servant	Civil servant	self employed	Others (specify)
Tick one box				

(Q.10) ESTIMATE YOUR MONTHLY INCOME FROM YOUR :	Less than N10,000	N10,000-N19,999	N19,999-N29,999	N29,999-N39,999	N39,999-49,999	above N49,999, specify….
Primary occupation						
second occupation						
Other occupation						

(Q. 11) PLEASE INDICATE EMPLOYMENT STATUS OF HOUSEHOLD MEMBERS	All the household members are employed	Not all are employed	None is employed	Looking for employment
Enter the number of household members that fall among the category				

(Q. 12) EDUCATIONAL LEVEL OF THE HOUSEHOLD MEMBERS	primary	secondary	certificate	diploma	first degree	Postgraduate
Enter the number of household members whose qualification fall in the bracket						

(Q. 13) A MAJOR ENERGY SOURCE	Electricity	Gas	Kerosene	Fuelwood
Which is the major source of energy for your household cooking?				
Which is the major source of energy for your household boiling?				
Which is the major source of energy for your household heating?				

(Q. 14) FREQUENCY OF USING A MAJOR ENERGY SOURCE	Once a day	Twice a day	Thrice a day	Others (Specify)
The major of source of energy for your household cooking is used:				

(Q. 15) REASONS FOR ADOPTING A MAJOR ENERGY SOURCE	A bit affordable	Relatively affordable	Affordable	Very affordable
The major of source of energy for your household cooking is used because:				

(Q. 16) REASON FOR ADOPTING A MAJOR ENERGY SOURCE FOR YOUR HOUSEHOLD FOR:	A bit affordable	Relatively affordable	Affordable	Very affordable
Cooking:				
Boiling:				
Heating:				

(Q. 17) MONTHLY EXPENDITURE ON THE MAJOR SOURCE OF ENERGY FOR:	Cooking	Boiling	Heating
Less than ₦2000			
₦2,000 – ₦3,999			
₦4,000 – ₦5,999			
₦6,000 – ₦7,999			
₦8,000 – ₦9,000			
₦10,000 & above.			

(Q. 18) HOW LONG HAVE YOU BEEN USING THIS MAJOR ENERGY SOURCE	Electricity	Gas	Kerosene	Fuelwood
Less than 1 year				
1 - 5.99 Years				
6 - 10 years				
Above 10 years				

(Q. 19) HOW DOES YOUR HOUSEHOLD COMBINE THE USE OF THE SOURCES OF ENERGY?	Electricity	Gas	Kerosene	Fuelwood	Others (Specify)
Electricity					
Gas					
Kerosene					
Fuelwood					
Others					

(Q. 20) REASON(S) FOR THE ABOVE COMBINATION (Tick more than one option if necessary)	Tick
Price	
Culture	
Family size	
Others (Specify:_____)	

(Q. 21) HOW OFTEN DO YOU USE FUELWOOD FOR?	Once a day	Twice a day	Three times a day	Others (Specify)
cooking				
boiling				
heating				

(Q. 22) WHAT AMOUNT OF MONEY DO YOU SPEND ON FUELWOOD PER MONTH?	Less than #2000	#2,000-#3.999	#4,000-#4.999	#6,000-#7.999	#10,000 & above
Tick one box					

(Q. 23) FOR HOW LONG HAVE YOU BEEN USING FUELWOOD?	Less than 1 year	1-5years	5-10years	Above 10years
Tick one box				

(Q. 24) DO YOU COMBINE FUELWOOD WITH ANY OF THE FOLLOWING ENERGY?	Electricity	Kerosene	Gas	Other (Specify)
Tick one box				

(Q. 25) IF YES, WHAT IS YOUR RESONS FOR COMBINING THEM?	Price	Culture	Family size	Other (Specify)
Tick one box				

Title: Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Researcher: Naseer Babangida, Muazu

Student Number: 3689039

Programme: PhD Management

Please initial box

I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project. ☐

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_____ _____ _____

Name of Participant Date Signature

(*or legal representative*)

_____ _____ _____

Name of person taking consent Date Signature

(If different from lead researcher)

_____ _____ _____

Lead Researcher Date Signature

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Complete a questionnaire that estimates the contribution of fuel- wood business to the livelihood of your household.

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I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

_____ _____

Name of Participant Date

Thank you for participating in my study.

CONTRIBUTION OF FUELWOOD BUSINESS TO HOUSEHOLD LIVELIHOOD SOUTH AFRICA

PROJECT LEADER:NASEER BABANGIDA MU'AZU

FOR FUELWOOTRADERS

Name…….

Position……..

Telephone……

Fax……..

E-mail ……

Confidential

Questionnaire number……...

(Q. 1) PLEASE INDICATE WHETHER YOU ARE	male	female
Tick one box		

(Q. 2) WHAT IS YOUR AGE BRACKET	17 - 29	30 - 45	45 - 60	Above 60
Tick one box				

(Q. 3) MARITAL STATUS?	Single	Married	divorced	separated
Tick one box				

(Q. 4) PLEASE INDICATE HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT	Primary	secondary	certificate	diploma	
Tick one box					

(Q. 5) PLEASE INDICATE YOUR HOUSEHOLD SIZE	2 Persons	3-5 Persons	6-10 persons	11 person and above
Tick one box				

(Q. 6) FOR HOW LONG DID YOU START SELLING FUELWOOD	Less than 1 year	1-5years	6-10years	Above 10years	
Enter the number of household members whose age fall in the bracket of:					
(Q. 7) WHAT MAKES YOU TO VENTURE INTO FUELWOOD BUSINESS?	Lack of job	Because the business is profitable	Convenience	Other (Specify)	
Tick one box					
(Q. 8) ARE YOU EMPLOYED IN OTHER JOB APART FROM SELLING FEULWOOD??	Yes	No			
Tick one box					
(Q. 9) IF YES, WHICH ONE IS YOUR MAIN JOB?	farming	handcraft	services	Other (Specify)	
Tick one box					

(Q. 10) HOW FREQUENT DO YOU SELL FUELWOOD?	daily	Weekly	Monthly	Others explain
Tick one box				

(Q. 11) INDICATE THE MODE OF SELLING?	Wholesales only	retail only	more of a wholesale	more of retail	
Tick one box					

(Q. 12) WHAT WAS YOUR ESTIMATED TURN-OVER WEEKLY?	Less than R666	between R666-R1333	between R1333-R2,000	between R2,000-R2,333	
Tick one box					

(Q. 13) WHAT WERE YOUR ESTIMATED COST WEEKLY?	Less than R333	Between R333-R666	Between R666-R1,000	Btween R1,000-R1,333	
Tick one box					

(Q. 14) WHAT WERE YOUR ESTIMATED WEEKLY PROFIT AFTER DEDUCTING YOUR EXPENSES?	less than R166	R166-R333	R333-R499	R499-R666	
Tick one box					
(Q. 15) PURPOSE WHICH THE PROFIT IS BEEN USED FOR?	food for the household members	education expenditure for the household members	health and medical expenditure for the household members	water supply	
Tick more than one box					
(Q. 16) FOOD ITEMS EATING BY THE HOUSEHOLD MEMBERS IN THE LAST 30 DAYS	rice	cereals	flour(bread)	pasta	
Tick more than one box					
(Q. 17) HOW OFTEN DID ANY ADULT OR CHILD GO TO BED HUNGRY IN THE HOUSEHOLD?	never	seldom	sometimes	often	
Tick one box					

(Q. 18) ILLNESS OR INJURY OF THE HOUSEHOLD MEMBERS IN THE LAST 12 MONTH	adequately taking care of	mildly taking care of	not able to take care of	relying on assistance	other,
Tick one box					
(Q. 19) IMPROVEMENT,REPAIRS OR ADDITION IN THE HOUSING IN THE LAST 12 MONTHS	repairs of roof,wall and painting	housing expansion	additional installation	other,specify……	
Tick one box					
(Q. 20) WATER AVAILABILITY IN THE HOUSEHOLD IN THE LAST 12 MONTHS	available	once in a while	not available	Others,Specify ……	
Tick one box					
(Q. 21) COMMUNICATION FACILITIES IN THE HOUSEHOLD	mobile telephone	teelphone	fax	email	
Tick more than one box					
(Q. 22) DWELLING MOVEMENT TO THE ROAD OR BUS STATION?	hours	less than an hour	minutes	other,specify ……	
Tick one box					

(Q. 23) OWNERSHIP OF ASSETS IN THE LAST 12 MONTHS	car	motorcycle	bicycle	television	
Tick more than one box					
(Q. 24) SCHOOLING OF CHILDREN	adquately taking care of	less adquate	more than adquate	not at all	
Tick one box					

Consent Form for the questionnaire for learners University of the Western Cape

Title: Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Researcher: Naseer Babangida, Muazu

Student Number: 3689039

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Name of Participant (*or legal representative*)	Date	Signature
_____	_____	_____
Name of person taking consent *(If different from lead researcher)*	Date	Signature
_____	_____	_____
Lead Researcher	Date	Signature

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School of Business and Finance

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Programme: PhD Management

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I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

_____ _____

Name of Participant Date

Thank you for participating in my study.

CONTRIBUTION OF FUELWOOD BUSINESS TO HOUSEHOLD LIVELIHOOD **NIGER IA**

PROJECT LEADER:NASEER BABANGIDA MU'AZU

FOR FUELWOOD TRADERS

Name…….

Position……..

Telephone……

Fax

E-mail

Confidential

Questionaire number……...

Fax……
……
E-mail
……..

(Q. 1) PLEASE INDICATE WHETHER YOU ARE	**male**	**female**
Tick one box		

(Q. 2) WHAT IS YOUR AGE BRACKET	**17 - 29**	**30 - 45**	**45 - 60**	**Above 60**
Tick one box				

(Q. 3) MARITAL STATUS?	**Single**	**Married**	**divorced**	**separated**
Tick one box				

(Q. 4) PLEASE INDICATE HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT	Primary	secondary	certifacate	diploma	first degree	postgraduate
Tick one box						

(Q. 5) PLEASE INDICATE YOUR HOUSEHOLD SIZE	2 Persons	3-5 Persons	6-10 persons	11 person and above
Tick one box				

(Q. 6) FOR HOW LONG DID YOU START SELLING FUELWOOD	Less than 1 year	1-5years	6-10years	Above 10years		
Enter the number of household members whose age fall in the bracket of:						

(Q. 7) WHAT MAKES YOU TO VENTURE INTO FUELWOOD BUSINESS?	Lack of job	Because the business is profitable	Convenience	Other (Specify)		
Tick one box						

(Q. 8) ARE YOU EMPLOYED IN OTHER JOB APART FROM SELLING FEULWOOD??	Yes	No		
Tick one box				

(Q. 9) IF YES, WHICH ONE IS YOUR MAIN JOB?	farming	handcraft	services	Other (Specify)
Tick one box				

(Q. 10) HOW FREQUENT DO YOU SELL FUELWOOD?	daily	Weekly	Monthly	Others explain
Tick one box				

(Q. 11) INDICATE THE MODE OF SELLING?	Wholeseles only	retail only	more of a wholesale	more of retail	less of wholesale
Tick one box					

(Q. 12) WHAT WAS YOUR ESTIMATED TURN-OVER WEEKLY?	Less than N20,000	between N20,000-N40,000	between N40,000-N60,000	between N60,000-N100,000	Above N100,000	
Tick one box						

(Q. 13) WHAT WERE YOUR ESTIMATED COST WEEKLY?	Less than N10,000	Between N20,000-N30,000	Between N30,000-N40,000	Btween N40,000-N50,000	Above N50,000
Tick one box					

(Q. 14)WHAT WERE YOUR ESTIMATED WEEKLY PROFIT AFTER DEDUCTING YOUR EXPENSES?	less than N5,000	N5,000-N9,999	N9,999-N14,999	N14,999-N19,999	above N19,999	
Tick one box						

(Q. 15) PURPOSE WHICH THE PROFIT IS BEEN USED FOR?	food for the household members	education expenditure for the household members	health and medical expenditure for the household members	water supply	transportation	toilet facility	rent	electricity	other(specify)……
Tick morethan one box									

(Q. 16) FOOD ITEMS EATING BY THE HOUSEHOLD MEMBERS IN THE LAST 30 DAYS	rice	cereals	flour(bread)	pasta	meat	vegetable	milk	beans	potatoes
Tick more than one box									

(Q. 17) HOW OFTEN DID ANY ADULT OR CHILD GO TO BED HUNGRY IN THE HOUSEHOLD ?	never	seldom	sometimes	often	always
Tick one box					

(Q. 18) ILLNESS OR INJURY OF THE HOUSEHOLD MEMBERS IN THE LAST 12 MONTH	adquately taking care of	mildly taking care of	not able to take care of	relying on assistance	other,specify……..
Tick one box					

(Q. 19) IMPROVEMENT,REPAIRS OR ADDITION IN THE HOUSING IN THE LAST 12 MONTHS	repairs of roof,wall and painting	housing expansion	additional installation	other,specify……
Tick one box				

(Q. 20) WATER AVAILABILITY IN THE HOUSEHOLD IN THE LAST 12 MONTHS	available	once in a while	not available	Others,Specify……
Tick one box				

(Q. 21) COMMUNICATION FACILITIES IN THE HOUSEHOLD	mobile telephone	teelphone	fax	email	none	to be connected soon
Tick more than one box						

(Q. 22) DWELLING MOVEMENT TO THE ROAD OR BUS STATION?	hours	less than an hour	minutes	other,specify ……..
Tick one box				

(Q. 23) OWNERSHIP OF ASSETS IN THE LAST 12 MONTHS	car	motorcycle	bicycle	television	house	redio/tape recorder	shares	farm land	cash in the bank
Tick more than one box									

(Q. 24) SCHOOLING OF CHILDREN	adquately taking care of	less adquate	more than adquate	not at all	
Tick one box					

FUELWOOD BUSINESS FINANCING IN NIGERIA

Focus group interview for fuelwood traders

Selection criteria: Fuelwood traders aged between 18-60 years who have been in the business for more than one year.

Before we start, I would like to remind you that there are no right or wrong answer in this discussion. We are interested in knowing what each of you think, so please feel free to be frank and to share your point of view, regardless of whether you agree or disagree with what you hear. It is very important that we hear all your opinions. Also, be assured that your identity would be kept confidential and you have the full personal right to refuse or withdraw at any point during the discussion.

Q1. What do you think about the topic that has brought us here today (financing of fuelwood business)?

Q2. With respect to the financing structure of your business do you use both internal funds and external financing?

Q3. For the external financing, has your need for the funds increased over the past one year?

Q4. Which of the following types of external financing do you know?

. Bank loan

.Grants

.Subsidized bank loan

.Government SMMEs support initiatives

.Trade credit

Q5. For each of the following financing facilities, would you say that they have increased, decreased or had no impact on your business need over the past one year?

Q6. Please, I would like to hear whether you have applied for any of the external financing facilities over the past one year.

Q7. If you have applied, did you receive all the financing you requested and were the terms and conditions acceptable?

Q8. Which of the following institutions did you source your external financing?

. Bank of Industry (BOI)

. Micro finance Bank

. National Enterprise Development Programme (NEDEP)

. Commercial Banks

Q9. Looking ahead, for the above financing institutions that may be available to your business, could you kindly indicate whether you think their availability will improve or deteriorate your business over the past one year?

Q10. What is the type and size of the last loan your business has obtained in the last two years?

Q11. Who provided you this last loan?

. Bank

. Family or friend

. Government SMMEs support initiatives

Q12. What did you use this last loan for?

. Working capital

. Starting new business

. Family expenditure

. Land/building/equipment/ vehicle

Q13. As you know, the availability of external finance depends on various factors such as business specific situation, lenders attitudes and general economic condition, for each of these factors, would you say that they have improved or deteriorated your business in the past one year?

Q14. In your opinion, how would you rate the government SMMEs financing institutions initiatives?

Q15. During the last one year, what funding support do you enjoy from government?

Q16. What would be biggest constraints which may prevent you from achieving financing of your business?

Q17. If you need external financing to realize your business growth ambitions, what type of external financing would you prefer?

Q18. Let us summarize some of the key points from our discussion.

Q19. Do you have any question?

Thank you for taking the time to talk to us.

Title: Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Researcher: Naseer Babangida, Muazu

Student Number: 3689039

Programme: PhD Management

Please initial box

1. I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. (If I wish to withdraw I may contact the lead researcher at any time) ☐

3. I understand my responses and personal data will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the reports or publications that result for the research. ☐

4. I agree for the data collected from me to be used in future research. ☐

5. I agree for to take part in the above research project. ☐

_____	_____	_____
Name of Participant (*or legal representative*)	Date	Signature
_____	_____	_____
Name of person taking consent *(If different from lead researcher)*	Date	Signature
_____	_____	_____
Lead Researcher (*To be signed and dated in presence of the participant*)	Date	Signature

Copies: All participants will receive a copy of the signed and dated version of the consent form and information sheet for themselves. A copy of this will be filed and kept in a secure location for research purposes only.

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FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

School of Business and Finance
INFORMATION SHEET FOR RESEARCH PARTICIPANTS

Dear participant

Naseer Babangida Muazu

Student Number: 3689039

Programme: PhD Management

The title of my thesis is:

Comparative Analysis of Domestic Fuel-wood Energy Consumption between South Africa and Nigeria: A Mixed Method Approach.

Please take time to read through this information sheet carefully in order for you to be knowledgeable about what is required of you as a research participant in this study.

As a participant who gave consent of your participation in this study, you will be required to (**list all the data gathering techniques/data collection methods that will be used here), for example:**

4. ***Participate in a short focus group interview (20 minutes) in which it will reflect on the understanding of funding of fuel wood business.***

Your participation in this research project is voluntary and your responses will be treated as confidential. It will assist me to achieve the objective of the study which is to determine the domestic energy consumption, estimate the contribution of fuel wood business to household livelihood as well as estimate the level of SMMEs (fuel wood business) funding.

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact me at**: nmbabangida69@gmail.com +2348065030000, Ricardo M. Peters rmpeters@uwc.ac.za, Kanayo Ogujiuba kannyog@gmail.com.**

I hereby consent voluntarily to participate in this study. I have been given a copy of this form.

_____ _____

Name of Participant **Date**

Thank you for participating in my study.