GENDER AND ENERGY SERVICES IN THE RURAL NON-FARM ECONOMY OF EJISU-JUABEN MUNICIPALITY

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DECLARATION

I hereby declare that this submission is my own work towards a Master of Philosophy in Planning and that, to the best of my knowledge, it contains neither materials previously published by another person or materials which have been accepted for the award of any other degree by this or any other university except where due acknowledgement has been made in the text.

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ABSTRACT

Energy is central to the issues of development of rural non-farm economy (RNFE), global security, gender equity, environmental protection and sustainable development. Developing the RNFE, sustaining its growth and improving the living standards of the rural poor require adequate and reliable supply of energy. There exists the absence of 'gender' disaggregated data on the specific energy needs for productive services at the RNFE. The study thus sought to examine the gendered usage of energy at the RNFE, identify the factors influencing decisions to use particular energy forms and the implications of the supply and utilisation of the energy fuel on in the RNFE. One hundred and fifty four (154) operators within the RNFE in four communities in the Ejisu-Juaben Municipality were interviewed: Bonkra, Adadientm, Hwereso and Kubease. Relevant institutions such as the Energy Commission, Municipal Planning Office and the Electricity Company of Ghana (ECG); were also interviewed for primary data to supplement secondary data from literature. The study employed the mixed research design to collect relevant primary data from the units of enquiry. The operators ran 15 categories of enterprises. Approximately 48% and 52% of the enterprise operators were females and males respectively. Activities at the RNFE were found to be informal and similar to those of the urban informal economy. The type of activities at the RNFE were found to be gendered where women were involved in the food preparation activities.

The enterprises made use of varied energy fuels ranging from traditional solid fuels to cleaner energy ones. The study revealed that reasons for the preference for energy fuels were not very gendered at the RNFE. This was further confirmed by a Chi square test which revealed no significant association between gender and the type and preference for an energy service for productive purpose. The preference for an energy service was thus influenced by type of activity one was engaged in at the RNFE. Despite the health risks associated with solid fuels, they still remained central to activities of the food based enterprises, because they were readily available, reliable and affordable. Based on the findings, the study recommended efforts by health institutions to intensify public health care programmes to educate operators on the short and long-term implications of utilising the solid fuels. The study further recommended efforts by the government to encourage PPPs to promote investments into R&D and the deployment of alternative cleaner energy forms. Lastly, the study recommended for encouraging gender participation in energy intervention initiatives, due to the differing energy needs of men and women in the RNFE.

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LIST OF ABBREVIATIONS AND ACRONYMS

AGECC	Advisory Group on Energy and Climate Change
AusAID	Australian Agency for International Development
CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
DFID	Department for International Development
EIA	Energy Information Administration
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agricultural Organisation
GLSS	Ghana Living Standards Survey
GSS	Ghana Statistical Service
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
MDG	Millennium Development Goals
NBSSI	National Board for Small Scale Industries
NDPC	National Development Planning Commission
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
UNDP	United Nations Development Programme
WHO	World Health Organization

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background of the Study

"Energy is at the forefront of the global agenda. It is central to the issues of development, global security, environmental protection and socio-economic growth (Advisory Group on Energy and Climate Change, AGECC, 2010: ix)". Access to cleaner and affordable energy options is essential for improving the livelihoods of the poor in developing countries (World Bank, 2009).

This is reflected in the United Nations General Secretary's statement that, "Energy lies at the heart of both of these efforts. The decisions we take today on how we produce, consume and distribute energy will profoundly influence our ability to eradicate poverty and respond effectively to climate change" (AGECC, 2010:2).

Access to more efficient, cleaner and affordable energy options is an effective tool for combating extreme hunger by increasing food productivity and promoting enterprise development (International Energy Agency (IEA), 2009; Food and Agricultural Organisation (FAO), 2006; UNDP et al, 2000). This thus indicates that, without access to cleaner, safer and affordable energy services, the poor have very limited opportunities for economic and social advancement. Global studies indicate that a higher percentage of women live in poverty than men (United Nations Economic Commission for Africa (UNECA), 2010). Gender-related studies of the poor in sub-Saharan Africa, parts of South Asia, and Latin America and the Caribbean demonstrate that poverty affects women and men differently, with women often experiencing the most severe levels of deprivation, in part, demonstrated by inadequate access to cleaner energy options for both domestic and productive service (Karekezi et al., 2002). It is documented that poor women, particularly in rural areas of developing countries comparatively have a more difficult time, due to their traditional socio-cultural roles (Clancy et al, 2003; UNDP, 2001).

According to the UN (2010), productive use of energy can be a significant driver of economic growth and social progress in developing countries. Haggblade et al (2009) indicate that earnings from non-farm activities accounted for 35% to 50% of rural household income across the developing world. Thus, households that are landless or near-landless depend largely on non-farm income for survival, whiles agricultural households depend on non-farm income to

diversify risk and seasonal income swings (World Bank, 2004). Reardon et al., (2007) further indicate the rural non-farm economy (RNFE) has over time grown rapidly, and contributed significantly to both employment and rural income growth. Activities in the RNFE are dominated by agro-processing and other activities that require varied energy fuels for productive purposes. Furthermore, Kartha and Leach (2001) assert that productive use of energy is pivotal to the economic development/income generation of rural folks. In rural contexts and RNFE in developing countries, typical productive uses can be found in agroprocessing, various manufacturing industries such as carpentry, tailoring, welding and looming, and in the service sector. Generally, the preference for energy is revealed to be influenced by many factors: social-cultural (perception, traditions, norms/values), economic (income, expenditure on the types, availability, prices of services: Leach, 1992; Barnes, Krutilla, and Hyde, 2002; Barnes and Floor, 1999) and political.

Promoting enterprise development as well as promoting development and 'equality' of men and women is an agreed national and global priority and is reflected in major global conferences and inter-governmental agreements on the need to enhance the socio-economic status of women, including in economic and political life (Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), 2011). It has become clearer among energy and development practitioners that tackling gender issues as part of energy access programmes and projects improves project delivery and can enhance the quality of life of rural dwellers (see Clancy et al, 2003; International Energy Council, 2013, Farinelli, 2000). Hence,

"greater attention to the energy needs and concerns of the economic activities run by men and women in the RNFE in developing countries can improve the effectiveness of energy policies and projects, … and promote overall development goals, such as poverty alleviation, increased employment, and improved health and education levels" (UNDP, 2000:3).

Underpinned by these discussions, this research was geared towards examining the energy fuels used by men and women in the RNFE for productive purposes.

1.2 Problem Statement

Division of roles by men and women in rural Ghana and Africa show that women are mainly responsible for fetching water, collecting fuel wood and cooking (WaterAid, 2009). This role transcends to the RNFE where women are confined to the food preparation businesses. At the heart of Ghana's energy sector is the need to ensure that all segments of society benefit from

the sustainable management of the nation's energy resources. Though, there has been evidence from studies on how communities, enterprises and households make use of and benefit from the available energy resources (GSS, 2000, 2008; Miller et. al. 2011, and Energy Commission 2010, 2011c), the analyses are usually on national or regional basis where broader attempts were made on extensive comparative analyses across regions or countries.

Research works have revealed that the energy-poverty divide is still skewed towards women in less developed countries (LDCs) (UNIDO, 2013; UNECA, 2010; Karekezi et al., 2002). Energy service interventions (policies, programmes and plans) in Ghana, namely; Ghana Poverty Reduction Strategy (GPRS I), the Growth and Poverty Reduction Strategy (GPRS II) and the Ghana Shared Growth and Development Agenda (GSGDA, Volume One), the National Energy Policy (NEP), Energy for Poverty Reduction Action Plan (EPRAP) and the Strategic National Energy Policy (SNEP); indicate that men and women have equal access to energy resources. The interventions further indicate that the factors influencing the preference for the energy are equal among men and women. However, the International Energy Council (2013) and Ghana Energy Audit Committee (2010) clearly indicate that there still exist energy poverty among men and women at the rural enterprise level (energy access interventions have not been successful and well appreciated) because of the limited attention paid to the specific energy needs particularly for productive services since they provide sources of livelihood support for rural dwellers. There exists the absence of 'gender' disaggregated data on the productive activities of men and women in the RNFE and specific energy needs for productive services.

This according to the Ministry of Energy (MoE) (2010a) makes it very challenging to understand the specific energy services required by men and women in undertaking their productive activities. According to the MoE (2010a:7), "energy issues are of concern to all. However, women are one of the most important actors in the energy sector, in terms of their contact, use and management of energy resources… The goal is to mainstream these gender concerns in the energy sector and align them with proper health, safety and environmental standards". However this goal, according to the FAO (2006), can only be effectively achieved if the energy needs of men and women are identified and the implications associated with the supply and the utilisation of the fuels. Once these have been identified, the necessary interventions can be put in place to meet the energy needs, and effectively mainstream gender issues into energy provision (Ministry of Energy, 2010b).

Therefore, issues of who has access to what energy service, who is doing what with what energy service, who benefits or suffers, and what factors influence such decisions on the energy fuel are all relevant questions to be addressed at the very early stages of energy planning processes by policy makers. However, little is known about these, the enterprises operated by men and women and how they become engaged in these rural non-farm activities. This study aimed at drawing out and synthesising findings from the primary and secondary data sources regarding the energy needs of gender n the RNFE. Beyond simply disaggregating the findings, the study sought to investigate the gender implications of differing occupational, and energy needs with a view to highlighting relevant policy implications.

1.3 Research Questions

The research sought to provide answers to the following questions:

1. What factors influence enterprise operators' preference for specific energy services?
2. What are the types of productive enterprises and their gendered usage of various energy services in the RNFE?
3. What implications are associated with the supply and utilisation of the available energy services?
4. What recommendations can be made to address the gendered energy in the RNFE and improve quality of rural life?

1.4 Research Objectives

The general objective of the research was to examine energy services of men and women for productive purposes in the RNFE, identify the factors that affect the decision to use specific energy services, and make recommendation to improve upon access to cleaner energy services of enterprises in RNFE. This objective will be achieved through the following specific objectives:

1. To examine factors influencing enterprise operators' preference for specific energy services;
2. To examine the types of productive enterprises and their gendered usage of various energy services in the RNFE;
3. To examine the implications associated with the supply and utilisation of the available energy services; and

4. To make recommendations to address the gendered energy in the RNFE and improve quality of rural life

1.5 Hypothesis

For the purposes of achieving the research objectives, the hypothesis tested by the researcher was: "There is no significant association between the gender and the type and preference of energy service for productive usage in the RNFE". This was the null hypothesis with the alternate hypothesis formulated in the course of testing it.

1.5.1 Propositions

i. The factors influencing preference for energy services for productive purposes are the same for men and women in the RNFE

ii. The implications of the supply and utilisation of energy services available are the same for men and women in the RNFE

1.6 Relevance of the Research

Access to cleaner and affordable energy options is essential for improving the livelihoods of the poor in developing countries by engaging in productive activities. Women and men have different roles in the energy system. Enterprises require modern and more efficient energy sources to improve their work and quality of life. Women and men also have different kinds of knowledge and experience of energy, either through their traditional roles, their new nontraditional roles (especially in female-headed households), or increasingly as professionals in the energy sector.

This study's findings and recommendations would thus help identify disaggregated data on the gendered energy services for productive purposes in the RNFE, address the challenges in meeting energy needs for productive uses. This will thus help address the implications associated with this activity. The study will further assist in examining the energy consumption patterns of men and women at the enterprises level so as to inform interventions to sustain the energy services of the enterprises and improve upon the livelihood and living conditions of rural dwellers. Furthermore, this survey will feed into the options for the way forward, both on a global and regional level- to inform policymakers, business and investment sectors, and society at large, on the key opportunities and challenges facing the global energy system in its quest for sustainable development. The study's findings will further reveal the potential for developing strategies of improving the RNFE and the general quality of rural life.

Also, this study will be used as a point of reference for future studies to assist in effective and feasible policies, plans and programmes to incorporate or mainstream gender into energy service provision to alleviate rural energy problems and improve living conditions. The study's finding and recommendation will also reveal more efficient means on incorporating the concept of ''gender and development'' in alternative energy strategies to achieve the objectives of sustainable rural development. In sum, this study has empirical information having policy significance on the formulation of better policies and strategies that will better respond to the contemporary needs of Ghana amidst increasing demand for energy.

1.7 Scope of the Study

The scope of the study was categorised into two sections; contextual and geographic scopes.

1.7.1 Contextual Scope

The study sought to examine issues of energy for productive use at the RNFE and gender linkages that can help countries ensure rural development. It revealed issues on energy services used, and examine the factors that influence preference for energy services used for productive purposes by both men and women in the RNFE to inform policy formulation and implementation on energy service provision. The survey results would be used to validate the findings of the earlier surveys for the identification of generic and peculiar findings. The output of the survey will facilitate the provision of a strong technical and scientific basis for energy decision-making and service provision.

1.7.2 Geographical Scope

The Ejisu–Juaben Municipality lies within latitudes 1º 15'N and 1º 45'N and longitudes 6º 15'W and 7º 00 W. Occupying a land area of 637.2 km^2, the Municipality lies in the central part of the Ashanti Region sharing boundaries with six Districts in the Region; Sekyere East and Afigya Kwabre to the Northeast and North-West respectively; the Bosomtwi and Asante Akim South Districts to the South; the Asante Akim North to the East and the Kumasi Metropolitan Assembly to the West.

1.8 Limitations of the Study

The major challenge of the study was the unavailability of the number and various kinds or types of energy-dependent productive enterprises in the Municipality. To address this challenge, the researcher undertook a head count of the all enterprises within the selected communities in the Ejisu-Juaben Municipality, based upon which a set of criteria were

developed to select suitable enterprises for the study. Another challenge had to do with the selection of suitable communities for the study which was to be rural communities and meet a list of indicators as described in section 3.4.1.1. This challenge was addressed through an extensive discussion with relevant institutions and stakeholders specifically, the Municipal

Planning Officer; and also by applying the Ghana Statistical Service's criteria of a rural community; where a rural community should have a threshold population of less than 5,000 people and where the dominant economic activity is primary production.

1.9 Organisation of Report

The research was organised into seven chapters. The first chapter dealt with the introductory phase of the research. It laid emphasis on the background to the research, specifically, overview of energy options and their significant role to improving the livelihood of rural dwellers, and productive enterprises at rural areas. It further presented the objectives to be achieved through the research, the scope of the research and the relevance of the research.

The second chapter of the study presented the theories and concepts related to the objectives of the research. It thus presented the concepts of energy, productive use of energy to improving the livelihood of rural dwellers (men and women), gender, rural development, sustainability and sustainable development, to enhance understanding of all other succeeding discussions. The chapter among other discussions laid emphasis on the conceptual and theoretical frameworks for productive use of energy by men and women and its implications on improving livelihoods and sustainable development. The third chapter presented the methodological framework for the research. It details the research design adopted, the methods used in sampling and collection of relevant data and how the collected data were analysed. The fourth chapter presented on the profile of the study area; Ejisu-Juaben Municipality, taking into consideration the scope, the available energy options, the types of enterprises within the area, among others.

Chapter five and six presented the analysis of the collated data from the field concerning the energy needs and use by enterprises in the RNFE in the study area. Among other issues, the chapter presented data on the types of productive enterprises at the RNFE, the energy services utilised and required by the enterprises, the factors that influence operators' preference for specific energy services, the implications associated with the supply and utilisation of the energy services among others. Chapter seven presented the discussion of the study's findings based on the specific research objectives. The section aimed at theorising the findings of the

study by relating it to similar findings in literature across the globe. Based on the findings, recommendations for promoting sustainable energy services as a component of strategies to improve the quality of rural life as well as ensuring effective mainstreaming of gender issues in energy access interventions; policies, programmes and plans were made. The chapter ends with the conclusion of the research and areas for further research.

CHAPTER TWO

CONCEPTUAL AND THEORETICAL PERSPECTIVES ON GENDER AND ENERGY SERVICES IN THE RURAL NON-FARM ECONOMY

2.1 Introduction

The chapter discusses issues related to the concept of energy needs of men and women for productive purposes in the rural non-farm economy (RNFE) from varied perspectives. It thus presents concepts on rural productive enterprises, 'gender', rural areas, energy, RNFE, and productive uses of energy to enhance understanding of all other succeeding discussions. It further elaborates on the forms of energy resources used by men and women in Ghana and across the globe. The chapter also lays emphasis on the policy issues and theoretical frameworks that exist to address the gender-energy gap as means of improving the activities of rural productive enterprises and living standards of rural dwellers. The chapter, among other discussions concludes with the conceptual framework on the energy services for productive use by men and women in the rural non-farm economy in order to improve the livelihoods and living conditions of rural dwellers.

2.2 Operationalisation of Concepts

This sub-section of the chapter explains concepts such as gender and other related concepts like gender analysis, energy and energy fuels, energy access and productive uses, energy and development, and sustainable rural development. Analyses of these concepts help in developing an appropriate conceptual framework for the study.

2.2.1 The Concept of Gender and Gender Analysis

Gender has been widely contested in literature. Gender issues are of concern especially to many development agencies. There is the need to understand the concept of gender as a cross-cutting socio-cultural variable, in the sense that gender encompasses other variables such as race, class, age, ethnic group, among others (Raab, 2013).. Gender according to UNESCO (2003) is regarded as the roles and responsibilities of men and women that are created in our families, societies and cultures. Furthermore, UNESCO (2000) regards it as the social differences and

relations between men and women, which are learned, vary widely among societies and cultures, and change over time. Promotion of gender equality should concern and engage men as well as women. Studies on gender have however focused much on women.

Furthermore, gender analysis according to UNESCO (2003) is the collection and analysis of sex-disaggregated information. It is important to highlight that, men and women both perform different roles. This leads to women and men having different experiences, knowledge, talents and needs (UNESCO, 2003; Miller and Razavi, 1998; Baden, 2000). Gender analysis thus explores these differences so policies, programmes and projects can identify and meet the different needs of men and women. The study is thus aimed at understanding the energy needs of men and women at the enterprise or productive level at the RNFE.

2.2.2 The Concept of "Rural" Settlements

Strategies and measures to combat poverty in rural areas need to be central in the expansion of economic activities**,** specifically non-farm activities. In doing this, access to affordable energy fuels and services is a vital prerequisite. The concept of "rural" just as "gender" has also been widely discussed and contested in literature. This has come about as result of the absence of clear-cut and well–defined criteria for defining what "rural" is. The United States Census Bureau (2000 census) defines rural areas as comprising open country and settlements with fewer than 2,500 residents (population/administrative-based); areas designated as rural can have population densities as high as 999 per square mile or as low as 1person per square mile (population/land-use-based)..

In most rural communities of Sub-Saharan Africa, it is revealed that majority of the adults are farmers and live in villages where poverty persist as a result of low farming technologies, poor access to modern energy services and low economic activities. Anokye-Mensah (2001) asserts that in the West African sub-region, a greater number of food crop farmers are women, who contribute the most to rural poverty because of their low occupational opportunities and limited productivity due to lack of modern energy supplies. This buttresses the findings of most research works that improving access to cleaner and modern energy supplies has the potential to improving the socio-economic conditions of particularly women in rural areas.

The Ghana Statistical Service's definition of a rural area as localities with less than 5,000 persons (Ghana Statistical Service, GSS 2012) has been widely used and somehow accepted as the definition of "rural areas" in Ghana, notwithstanding the criticisms that what constitute

rural today will most likely change as Ghana moves on into the new millennium with changing demographics (IFAD, 2010). Adarkwa (2014) is of the view that social and economic factors are also significant in classifying areas. Thus, the livelihood of rural settlements are derived from land-based primary economic activities. In Ghana, there are strong social and economic ties within rural communities for some activities between the various individuals and groups. Furthermore, rural communities willingly and easily embark upon other forms of cooperative activities, especially if these are of a commercial nature. Premised on the definition by GSS (2012), the rural population constitutes approximately 49 percent of Ghana's population, and their activities are primary in nature (GSS, 2012).

The study therefore adopts a combination of the definition by GSS (2012) and Adarkwa (2014) where, a rural area is regarded as an area with a population threshold of less than 5,000 people and where the predominant economic activity is agriculture.

2.2.3 The Rural Non-Farm Economy (RNFE)

According to Csaki and Lerman (2000), there has been an increasing recognition that the rural economy is not confined to the agricultural sector alone. This according to Davis and Bezemer (2004) is largely due to the fact that, the number of poor people in rural areas far exceeds the capacity of agriculture to provide sustainable livelihood opportunities in many parts of the world. Bacho (2004) indicates that, in Ghana, the capacity of the agricultural sector alone cannot sustain the livelihoods of farm households in some parts of the rural north. This is a result of the environmental degradation, rapid population growth, slow spread of technology and low public investment in agriculture account for the increasing inability of the farm sector to sustain rural livelihoods (Laird, 2006).

Rural households in developing countries are increasingly earning their livelihoods from activities other than farming: the rural non-farm economy (RNFE) is growing (Wiggins and Hazell, 2011; Reardon et al., 2007). Earnings from non-farm activities accounted for 35% to 50% of rural household income across the developing world (Haggblade et al., 2009). Thus, households who are landless or near-landless depend largely on non-farm income for survival, whiles agricultural households depend on non-farm income to diversify risk, seasonal income swings and finance their agricultural input purchases (World Bank, 2004; Smith, 2001). Activities in the RNFE are dominated by agro-processing and other activities that require varied

energy services for productive purposes. The World Bank (2015) indicates that activities within the RNFE are significant part of the rural poor households' complex income strategies.

Analyses of survey data in Ghana have identified the important role that these varied sources of income play in the rural household economy. Individual rural non-farm businesses vary enormously from part time self- employment in household-based enterprises/cottage industries to large scale agro-processing operated by large firms. Highly seasonal, the RNFE fluctuates with the availability of required energy forms and agricultural raw materials and in rhythm with household labour and financial flows between farm and non-farm activities (Wiggins and Hazell, 2011:12). The composition of non-farm activity varies spatially; whereas home-based cottage industries predominate in rural areas, the towns and urban areas support the increasing concentration of factory manufacturing, services and trade. Renkow (2007) further indicates that rural areas house small retailers, basic farm equipment repair services and input supply firms, barber shops, and milling activities.

The World Bank (2015) asserts that the main income-generating activity of women is farming, and that their participation in the non-farm activities is concentrated in the trade and manufacturing sectors. Women within the manufacturing sector are engaged in the food and beverages, and cottage industries - including wood, textiles, leather and handicrafts (Newman and Canagarajah, 1999; Kwagala, 1999 in Kampala). Zwick and Smith (2001) further indicates that activities of women in the rural non-farm economy is often gender-defined, focusing on the brewing and sale of alcohol, handicrafts, market trading and the sale of cooked food. Activities of men in the RNFE are often differentiated from female activities. This pattern according to Newman and Canagarajah, (1999) are explained by women's culturally-defined role in agriculture and home (i.e. both productive and reproductive), "but also through unequal access to non-farm occupations, whether as a consequence of male-dominated social networks, education or other determinants of entry into this sector of the economy".

The foregoing discussion indicates that the RNFE plays important role in rural livelihood diversification. Developing the RNFE, sustaining its growth and improving the living standards of the rural poor require adequate and reliable supply of energy (IEC, 2013; World Bank, 2015) and raw materials (Wiggins and Hazell, 2011; Smith 2001). However, little is known about the specific energy needs of enterprises operated by men and women and how they become engaged in these rural non-farm activities, who can gain access to them, who cannot and why. This study is aimed at drawing out and synthesising findings from the primary and secondary

data sources regarding the energy needs of enterprises within the non-farm economy differentiated by sex. Beyond simply the disaggregation of findings, the study sought to investigate the gender implications of differing occupational, energy needs, and income with a view to highlighting relevant policy implications.

2.3 The Concept of Energy

Energy like most words or concepts has different meanings; depending on the field of study. In a mechanical point of view, "energy" is often viewed as the capacity of a physical system to perform work. Energy thus exists in several forms such as heat, kinetic or mechanical energy, light, potential energy, electrical, or other forms (Bloom and Zaidi, 1999). In a mechanical stand of view, "energy" is the capacity of a physical system to perform work.

The concept of "energy" is operationalised on the sources and its conversion to other fuels or products; primary, secondary, final or useful energy product. According to Akinbami (1997), energy is the central cross-sectoral issue which affects all human activities either directly or indirectly. It is a vital input to economic growth and development of any economy, developing or developed. The quality of energy is important to the development process (Cleveland et al., 1984; Brookes, 2000; Kaufmann, 2004). To maintain both a sustainable economy that is capable of providing essential goods and services to the citizens of both developed and developing countries, and to maintain a supportive global climate system, requires a major shift in how energy is produced and utilised (Nfah et al., 2007; Kankam and Boon, 2009).

The working definition of energy for the study is operationalised based on the "energy fuel or type; be it solid of non-solid for direct use in the production or running of an enterprise. It considers firewood, charcoal, biomass residue, grid electricity, solar panels to generate electricity and petroleum products at the RNFE. It further goes to include the services that the energy fuel renders to users at the RNFE. For instance, firewood as a fuel was used in cooking or heating". Thus, in this study, energy, energy fuel/type and energy service would use interchangeable depending on the context in which each was used to mean the energy used by actors at the RNFE for various productive purposes.

2.3.1 Energy Fuels

Fuel is a substance which, when burnt, i.e. on coming in contact and reacting with oxygen or air, produces heat. To utilise the energy of fuel in most usable form, it is often required to transform the fuel from its one state to another, i.e. either from solid to liquid or gaseous state,

liquid to gaseous state, or from its chemical energy to some other form of energy. In this way, the energy of fuels can be utilised more effectively and efficiently for various purposes (IEC, 2013). Generally, fuels may broadly be classified in two ways; according to the physical state in which they exist in nature–solid, liquid and gaseous, and according to the mode of their procurement – natural and manufactured. Solid fuels are further mainly classified into two categories, i.e. natural fuels, such as wood, coal, etc. and manufactured fuels, such as charcoal, coke, briquettes, etc. which are obtained from the natural fuels.

Non-solid fuels are further classified into liquid and gaseous fuels. The liquid fuels generally consist of natural or crude oil, and artificial or manufactured oils like gasoline, diesel oil, kerosene, heavy oil, naptha, lubricating oils, etc. Gaseous fuels mostly occur in nature, besides being manufactured from solid and liquid fuels. Some of the important manufactured gaseous fuels are coal gas, blast furnace gas, water gas, producer gas and oil gas. The forms of energy and fuels are discussed in the context of their presence or existence and usage in Ghana. The Energy Commission (2013) addresses issues of energy from five distinct sources; electricity (from hydro and thermal), petroleum products (from oil and consists of gasoline, kerosene, LPG and diesel), natural gas to run thermal plants and traditional biomass (including firewood and charcoal) for household activities and other enterprise activities. The five relevant energy sources in Ghana are briefly discussed below.

2.3.1.1 Biomass

Traditional biomass is the term for energy obtained from plants. Energy in this form is very commonly used throughout the world. Unfortunately the most popular is the burning of trees for cooking and warmth. This process releases ample amounts of carbon dioxide gases into the atmosphere and is a major contributor to unhealthy air in many areas (Keller, 2000). Some of the more modern forms of biomass energy are methane generation and production of alcohol for automobile fuel and fuelling electric power plants. Apart from firewood and charcoal, energy derived from biomass is very unpopular (Energy Commission, 2013). The lack of an adequate framework for the pricing and use of the technology as an alternative to fossil fuel, however, did not encourage the private sector to participate.

2.3.1.2 Electricity from hydro-power energy

Hydro-power energy makes use of the gravitational potential of elevated water lifted from the oceans to generate electricity. It is not strictly renewable since all reservoirs eventually fill up and require very expensive excavation to become useful again. At this time, most of the

available locations for hydroelectric dams are already used in the developed world. Furthermore, water power is developed by allowing water to fall under the force of gravity. It is used almost exclusively for electric power generation. Potential energy of water is converted into mechanical energy by using prime moves known as hydraulic turbines. Although capital cost of hydro-electric power plants is higher as compared to other types of power plants their operating costs are quite low, as no fuel is required in this case. Hydro-energy is the most tangible RE technology that has been deployed in Ghana. The main hydroelectric plants are the Akosombo and Kpong dams which supply electricity to most parts of Ghana, and recently the Bui dam.

2.3.1.3 Electricity generation from solar

Solar energy is a form of energy which relies on the nuclear fusion power from the core of the sun. This energy is collected and converted in a few different ways. The range is from solar water heating with solar collectors or attic cooling with solar attic fans for domestic use to the complex technologies of direct conversion of sunlight to electrical energy using mirrors and boilers or photovoltaic cells (Foster, 1994). Unfortunately these are currently insufficient to fully power our modern society (EIA, 1998). According the Energy Commission (2011a), the main solar technology applications on the Ghanaian market are rural solar home systems (especially lanterns and torch lights), urban solar home systems (household appliances, lanterns), solar systems for schools, systems for lighting health centers, vaccine refrigeration, solar water heaters, solar water pumps, telecommunication, battery charging stations and solar streetlights. Solar technology spans the urban, peri-urban and rural Ghana.

2.3.1.4 Electricity generation from wind

Wind as a source of energy is plentiful, inexhaustible and pollution free but it has the disadvantage that the degree and period of its availability are uncertain. Also, movement of large volumes of air is required, to produce even a moderate amount of power. Recently, however, the Energy Commission has identified the coastal belt, particularly the Volta and Central Regions, as viable places for harvesting enough wind for energy generation. The discovery has encouraged very little private participation so far, and major wind farms have been constructed yet in Keta. A few individuals have installed wind turbines to back-up the intermittent power supply in some parts of the country. Industrial use of wind farms is under 1% of the range of renewable energy (RE) technologies in Ghana. The coastal belt and the Volta and Central Regions in particular have wind speeds of 3 to 5 miles per second which is

enough to drive turbines to generate wind energy. The technology, however, has been virtually untapped by the private and public sectors.

2.3.1.5 Oil

Like coal, (crude) oil was formed 300 to 500 million years ago from the remains of tiny aquatic animals and plants called micro-organisms (World Energy Council, 2013). Under high pressure and temperature these micro-organisms were transformed into oil and gas. Oil represents 40 % of the Energy used in the world today (World Energy Council, 2013). Its refining leads to various fuels ranging from gases like propane and butane to liquid such as petrol, kerosene, diesel oil, fuel oil and to bitumen. Ghana's petroleum products marketed are premium gasoline; kerosene; gas oil; residual fuel oil; LPG; and premix. Even though its share of world production has declined, OPEC still controlled over 40% of world exports of crude and petroleum products in 2009 (OPEC, 2009). Since the discovery of oil in commercial quantities in Ghana in 2008, both the government and the public at large have had heightened expectations about how the exploitation of the oil resources will propel Ghana to the path of accelerated economic growth and development and the achievement of international middle-income status (Center for Policy Analysis, 2010).

2.3.2 The Productive Use of Energy

There is vast literature on the uses of energy; most of which are concerned with household use and energy for community services. Energy access, which includes electricity, modern fuels for cooking and heating, adequate power for industrial and non-industrial productive applications, and for transportation, looks beyond the consumption of energy at the household level and thus extends to its use for both public services and commercial enterprises. Energy access according to Thiyagarajan et al (2014:393) is "a function of how the availability, affordability and reliability of energy allow for a variety of uses of energy and how they impact the lifestyle of users". Linking renewable energy to productive uses can facilitate increases in rural access to modern energy services. Productive use of a resource most often is measured by productivity, and according to the OECD (2001:11), "productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker". OECD (2001) thus operationalise productivity as the ratio between the output volume and the volume of inputs. Productive use of energy can be a significant driver of economic growth and social progress in developing countries (UN, 2010; Brüderle et al, 2011; Kartha and Leach, 2001).

Brüderle et al (2011:10) posit that productive uses of energy "are those that directly increase income or productivity (that is, they add value which is taxable in the form of VAT if part of the formal economy). In rural contexts in developing countries, typical productive uses can be found in agro-processing, various manufacturing industries such as carpentry, tailoring, welding and looming, and in the service sector. There is significant overlap between productive and household uses of energy, since many small commercial income-generating activities are run as home businesses and thus benefit from the typical domestic uses like lighting and small household ICT appliances. Access to modern fuels is essential for providing great benefits to development through the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunication services and enterprises (OECD and IEA, 2010). Furthermore, according to Kartha and Leach (2001) productive use of energy is pivotal to the economic development/income generation of rural folks, as depicted in Table 2.1.

Table 2.1: Energy Service and Income Generating Value to Rural Enterprises

Energy Service	**Income Generating value to rural households and enterprises**	**Energy Services**
Irrigation	Better yields, higher value crops, greater reliability, growing during periods when market prices are high	Wind, biomass, solar, hydropower, oil products
Illumination	Reading, many types of manual production during evening hours	Wind, biomass, solar, hydro power, oil products
Grinding, milling	Create value-added product from raw agricultural commodity	Wind, biomass, solar, hydro power, oil products
Drying, smoking (preserving with process heat)	Create-value added product. Preserve produce to enable selling to highervalue markets	Biomass, Solar
Refrigeration, ice-making (preserving with electricity)	Preserve produce to enable selling to highervalue markets	Wind, PV, Biomass, Hydropower
Transport	Reaching markets and other facilities	Biomass (e.g biodiesel), oil products
Expelling	Produce refined oils from seeds	Biomass, Solar Heat

Source: Adapted from Kartha and Leach (2001)

Table 2.1 gives an indication that, energy plays significant role in local economic development, particularly of rural areas. Kooijman-van Dijk (2008) in his report, "The Theory: Steps from Electricity Supply to Poverty Reduction" shares a similar view to Kartha and Leach (2001) on the significance of energy service to poverty reduction as shown in Figure 2.1.

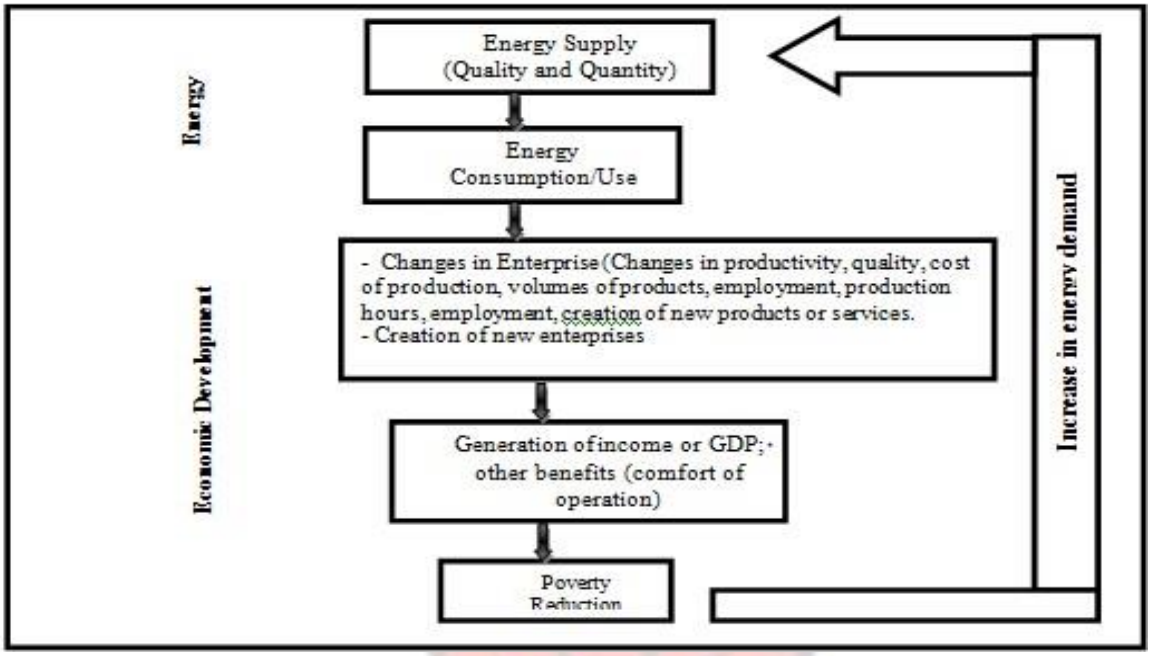


Figure 2.1: The Theory: Steps from Electricity Supply to Poverty Reduction

Source: Adopted from Kooijman-van Dijk (2008)

Kooijman-van Dijk (2008) in Figure 2.1 indicates that the supply and consumption of energy in the required quantity and quality has direct impact on enterprise development, and general economic development; increase in volume products, job creation, generation of income and contribution to GDP and the overall poverty reduction target. Thiyagarajan et al (2014:394) further assert that the various ways that productive use of energy can improve income generation and contribute to poverty reduction and human development can be divided into five primary categories-which are areas within both economic and social dimensions. These include: Using energy to improve efficiency or productivity of existing economic activities, for example increasing agricultural productivity through mechanized irrigation; expanding operation of existing enterprises beyond daylight hours or into new services; establishing new energy-based enterprises and creating employment opportunities; improving operation of schools, health facilities, and other public services and employing local people in the delivery of energy services-for example local masons building biogas digesters, local technicians servicing solar home systems- and in other productive activities.

These categories emphasise that productive use of energy does not only shape the way existing business and activities function, but also makes possible new opportunities and forms economic interaction. The research upon reviewing the concept of productive use of energy resources however adopts Brüderle et al's (2011) concept and definition of productive uses of energy.

2.4 Theoretical Underpinnings

The study does not make reference to classical theories such as the gender, feminism, queer and feminist theories because these to a larger extent discuss issues on promoting or ensuring equal right for all; men and women. They however place emphasis to the fact that women are 'always' marginalized: do not have equal access to resources in society; and thus ought to be brought on the same pedestal with men. The focus of this study was however to examine the typology of enterprises at the RNFE and gendered usage of energy services available, the factors influencing the gendered usage of the energy and the implications of the supply and usage of the available energy at the RNFE.

According to Sameti et al. (2012), there are largely two schools of thought when it comes to understanding why individuals make certain preferences and remain as they are (remain poor); thus in this study, why men and women prefer and use of some energy services over others. These two are the Cultural and Neighbourhood and the Structural schools of thought. Other theories that relate to the preference for energy services available were briefly reviewed: cultural belief, rational choice, political, social and economic distortion, and geographical disparity theories. The theories largely emphasise why people remain poor. These theories were however related to the study to better understand why actors at the RNFE may be economically and energy poor: absence or lack of energy services and inadequate amount of energy for usage. Furthermore, relevant models on energy utilisation were reviewed; the energy ladder, energy stacking and the energy rebound effect theory.

2.4.1 Cultural and Neighbourhood School of Thought

Oscar Lewis came out with this when he carried out a study on poverty in Mexico and Puerto Rico in 1961 and 1966 (Lewis, 1961 cited in Mandell and Schram, 2003). The theory is based on the premise that everyone has different pattern of values and beliefs and behavioural norms. Hence, an individual takes decisions and becomes what he/she is because they learn certain psychological behaviours associated with what they do. McIntyre (2002) citing Lewis (1961) points out that the decision to do something is transmitted from generation to generation because children are socialised with values and goals. The theory further posits that the current trend/situation is created by the transmission over generations of a set of beliefs, values, and skills that are socially constructed but are individually held (Sameti et al., 2012). Some researchers however argued that the present condition of individuals; the decisions they take are not necessarily based on culture (Merton, 1957; Gans, 1971; Rank, 2004; Mandell and Schram, 2003). Merton (1957) indicates by his opportunity theory that people maybe be poor or not have access to certain resources to take decisions because they have limited human

capital, as well as limited access to opportunities. Hence, by inference, the use of energy services are transmitted, though there could be transition in terms of energy services available. Studies have revealed that females mostly prefer using solid fuels due to the practice or habit they have developed for them (WHO, 2006, Clancy et al, 2003). It will therefore be a challenging task of such users moving away from the use of such energy services despite the harm they may pose on them. But then, just as Merton (1957) indicated, there should also be the need to take into consideration factors that limit individuals' preference for some energy services.

2.4.2 Structural School of Thought

Advocates of this school of thought argue that larger economic and social structures account for the present condition and decisions individuals make. Beeghley (2000) note that capitalism creates conditions that promote or defines what presently exist. Specifically, the Davis and Moores' functionalist theory, labor market theories, and the social exclusion perspective threw more light on the structural causes that define people's presence state: access to resources to undertake economic activities, access and preference for energy services, among others (Davis and Moores, 1945). The functionalist theory of social stratification argues that decisions, access to resources and present condition of individuals is an important social, economic and political function for society in general (Davis and Moores, 1945). One major criticism of Davis and

Moore's functionalist theory is the problem of how to establish the functional necessity of a task for a society. By inference, the type of energy services for usage among gender is determined by economic and social disparities and structures. If there are no measures to develop the make them available, provide relevant infrastructural facilities and services, rural dwellers have limited access to resources to use to the energy services they require. They will thus make do with what they have. Also, if measures are not put in place to make varied energy services available at the RNFE, "typical rural areas" as known ill resort to the use of solid fuels since they are readily available.

Borne out of the two schools of thought, Bradshaw (2006) came out with four relevant theories: cultural belief; neo-classical/rational choice; economic, political and social distortion; and the geographical disparity theories. These are briefly explained.

2.4.2.1 Cultural Belief vs. Neo-classical/Rational Choice Theory

Very similar to the cultural factors school of thought, the cultural belief theory argues that the "culture" of preference for an energy service is passed on from generation to generation, which is based on beliefs, practices, values and norms. The neo-classical/rational choice theory, which is an economic theory by Marx (1932) however posits that individuals seek to maximize their own well-being by making choices and investments, and that (assuming that they have perfect information) they seek to maximize their well-being. When some people choose short term and low-payoff returns, economic theory holds the individual largely responsible for their individual choices. Hence, men or women at the RNFE all things being equal use energy services that yields maximum satisfaction (financial returns or output). With this the WHO (2006) argues that if females are found using solid fuels but yield the needed satisfaction, substituting the fuel for cleaner energy services that come at additional cost will not be fully accepted.

2.4.2.2 Economic, Political, and Social Distortions or Discrimination

The economic, political, and social distortions or discrimination theorists in this tradition look not to the individual as a source of limited access to resources or taking decisions, but to the economic, political, and social systems which cause people to have limited opportunities and resources with which to achieve income and well-being. Research works on this theory attempt to redress the problem noted by Rank (2004: 4): "Poverty researchers have in effect focused on who loses out at the economic game, rather than addressing the fact that the game produces losers in the first place". The theory suggests that the economic system is structured such that 'poor people fall behind regardless of how competent or forceful they may be. Thus, individuals may attempt several times to look for high-valued enterprises and cleaner energy services for their activities. However they may not have access to them due to the structure of the economic system. A parallel barrier exists with the political system in which the interests and participation of rural poor is either impossible or is deceptive. Thus by inference, the political arrangements (those who have power) that are in place to make economic infrastructure and energy services available to a large extent influence what type of energy service an operator at the RNFE should use. Thus, the rural poor, who happen to be energy poorer and have limited access to infrastructural services, will continue to remain economically and energy poor if the political arrangements are not well streamlined to promote their interests.

Lastly on the system flaws associated with 'poverty' relate to groups of people being given a social stigma because of race, gender disability, religion, or other groupings, leading them to have limited opportunities regardless of personal capabilities. No treatment of poverty can be complete without acknowledging that groups against which discrimination is practiced have

limited opportunities regardless of legal protections. The theory by inference suggests that individuals at the rural setting may have limited access to energy resources as a result of gender issues. As revealed by Jan et al. (2011), the decision making of the type of energy service particularly at the household is determined by the man of the household. This is as a result of the social construction where men are seen as the heads of households and thus should take decisions at the expense of the woman at the household level.

2.4.2.3 Geographical Disparity

Lastly, Bradshaw (2006), on the theory of geographical disparity argues that poverty at the global south represent a spatial characterisation of poverty that exists separate from other theories. While these geographically based theories of poverty build on the other theories, this theory calls attention to the fact that people, institutions, and cultures in certain areas lack the objective resources needed to generate well-being and income, and that they lack the power to claim redistribution. Shaw (1996:29) points out, "*Space is not a backdrop for capitalism, but rather is restructured by it and contributes to the system's survival. The geography of poverty is a spatial expression of the capitalist system."* Urban bias theory by Michal Lipton shows that investments are largely made in urban centers to the neglect of the rural areas (Lipton, 1977). Thus, the poor will stay poor due to the disparities in terms of the distribution of resources. Therefore, due to biases in the distribution of resources, actors at the RNFE will be trapped in energy-poverty, if there is no conscious attempt to redistribute resources to improve upon their access to required cleaner energy services.

2.4.3 The Energy Ladder

According to Pachauri and Spreng (2004:4), "what influences the preference for fuels has been the interest of most researchers. The traditional view on fuel switching in the household sector in developing countries has been that households gradually ascend an "energy ladder" and that there is a simple progression from relatively inefficient fuels and energy end-use equipment to more efficient fuels, electricity and equipment, with increasing income levels and urbanisation" (Leach 1992, Sathaye and Tyler 1991, Smith et al 1994, Reddy and

Reddy 1994). The emergence of the "energy ladder" by Leach (1988) and Hosier and Dowd (1987) raised the prospect of an alternative solution, particularly, to household energy usage; fuel-switching (Dickson & Baldwin, 1990; Chomitz and Griffiths, 1997). The model emphasised the importance of income as a determinant of energy choice. The "energy ladder" conceptualizes the fuel choice by users at the domestic level, which is applicable at the

productive level. It is mostly associated with the choices of fuel or energy services users demand for their activities. As indicated earlier, the model places heavy emphasis on income to be a major determinant of energy choice in explaining fuel choice and fuel switching.

According to the energy ladder, the model in explaining this relationship (between income and energy choice) envisions a three-stage fuel switching process. The model is premised on the basic assumption that users change energy forms when there are significant changes in their income levels. Thus, their ability to afford the fuel is premised on their income levels. The first stage is marked by universal reliance on solid fuels or traditional biomass such as firewood. Users at this stage rely greatly on (wild) firewood for their activities, which if not well used exposes them to numerous health risks (respiratory ailments) from indoor inhalation. In the second stage, the ladder depicts that users move to "transition fuels" such as kerosene, coal and charcoal in response to higher incomes and other factors such as deforestation and urbanization, which are deemed safer than the traditional biomass. The last phase of the ladder is when households switch to cleaner and more efficient fuel such as LPG, natural gas, or electricity. The main driver affecting the movement up the energy ladder according to the model is hypothesized to be income and relative fuel prices (Leach, 1992; Barnes et. al., 2002; Barnes and Floor, 1996, Kammen et. al., 2000, Gebreegziabher et al., (2011)). Farsi et al (2007) state that "modern fuels" are generally perceived to be superior to traditional or transitional fuels in efficiency, comfort and ease of use (Farsi et al., 2007). The model can be seen as an extension of the economic theory of the consumer, where increase in consumers' income leads to increase the quantity and quality of goods consumed, all things being equal. The ladder is conceptualized in Figure 2.2.

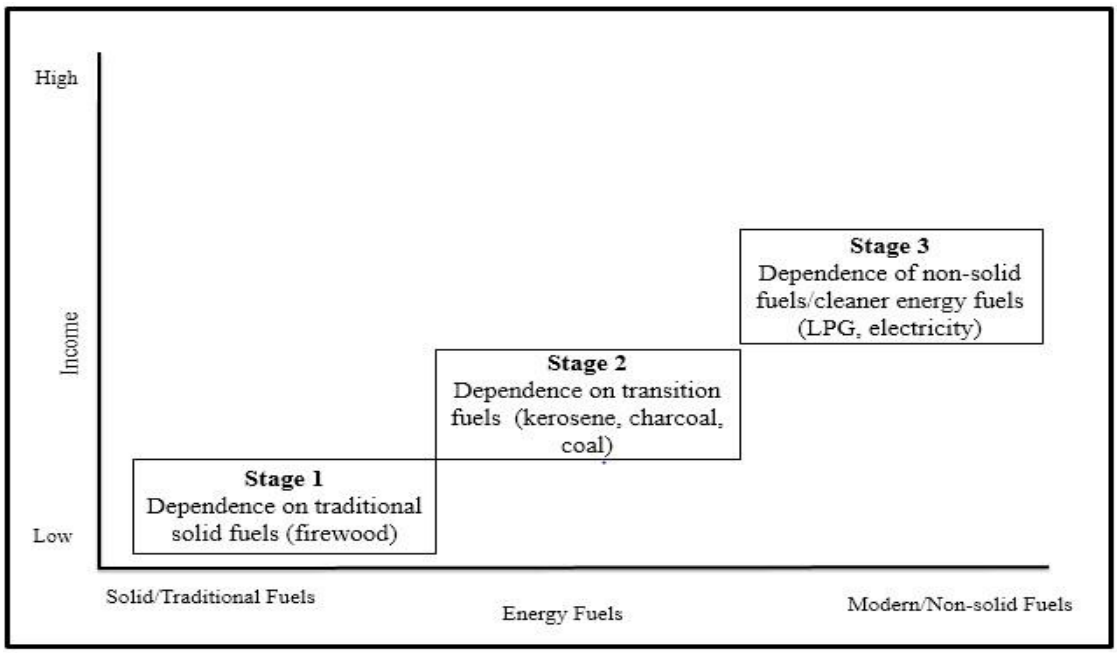


Figure 2.2: The Traditional Energy Ladder Model

Source: Author's Construct, January 2015

Herltberg (2003) iterates that households (headed by either a man or woman) that do not have access to modern energy services are undermined in undertaking their productive activities and their quest to raise their standards of living. Thus the energy service needs of both men and women have to be clearly identified to facilitate mainstreaming of gender needs into energy service provision. The usage of solid fuels; firewood, dung, and straw is regarded as strongly inferior, whose usage declines with income. Solid fuels are however revealed to be the dominant fuel used in rural areas for both household and economic activities by both gender; even seen in the top expenditure brackets in the rural areas and where the usage of all modern fuels increases with income (progressive). It could thus be inferred that in rural areas, economic development and income growth will not in themselves lead to displacement of dirty cooking fuels, or lead to fuel switch. Furthermore, other researchers have indicated that the model is a simplified version of the entire switching process, where multiple fuel patterns and switch back may occur (Leach, 1992; Kamen et. al, 2000).

The major achievement of this model from literature has been its ability to capture the strong income dependence of fuel choices. Yet the ladder image is perhaps unfortunate because it appears to imply that a move up to a new fuel is simultaneously a move away from fuels used hitherto. This implies that, the risk of confusing fuel choice (the form of energy fuel used) and fuel switching (shifting from one form of energy fuel to another) is embodied in the energy ladder model. The model however does not acknowledge that the rural areas are heterogeneous

in terms of culture and traditions; and so income does not necessarily affect the choice of resources, but the values, norms, traditions and culture to a large extent influence decision to use resources. The use and application of this model is more problematic in the rural areas, in the sense that it is very poorly understood (Kaul and Liu, 1992; Alberts et. al., 1997). Kamen et al. (2002) assert that using income to examine the model is difficult as usually large portion of rural dwellers incomes are often non-monetary. The implication is that the incomes of rural dwellers (women and men) are more uncertain, and so the regular consumption of modern fuels tends to be more difficult to estimate or identify.

It should however be stated that fuel switching as the model depicts is very difficult to explain and analyse. The model never raised issue as to whether there is the likelihood for users to move down the ladder; from the third stage to the second and to the first stage). If this should occur, what happens to the model, which is likely to happen especially in the rural setting?

Heltberg's (2003) elaborates on the model by considering the movement and choice between traditional (solid) fuels and modern non-solid fuels. He therefore considers:

- Stage 1: No switching, where actors consumes solid fuels;
- Stage 2: Semi-switching, where actors consume both solid and non-solid fuels; and
- Stage 3: Total Switching, where actors consume only non-solid fuels

One thing that is not also clear about Heltberg's (2003) conceptualisation of the ladder is whether one can conclude by saying that there is a total switch if findings from a survey reveals movement in the opposite direction; from Stage 3 to 2 and then to 1. These are all issues that need to be considered when adopting the model. The study will however adopt Heltberg's (2003) concept of the model with the expectation of a movement down the ladder. The model as discussed above, deals with energy fuels used by households for household activities. The study premised on the discussion; seeks to reveal the forms of energy services of both gender, identify whether income and relative fuel prices has influence on the energy fuels, and further reveal the extent to which the model applies to both gender for productive activities in the rural setting. Foregoing debates of the traditional energy ladder indicate that users of energy resources might not necessarily switch from one fuel to the other as the energy ladder model posits, thus the emergence of the "energy stacking/portfolio or multiple fuel model".

2.4.4 Energy Stacking or Portfolio

The major reason or factor underpinning this model is that households consume a multiplicity of energy sources. With fuel stacking or portfolio model, Heltberg (2004), Hosier and Dowd (1987), Farsi et al. (2007) and Njong and Johannes (2011) argue that households thus prefer to have more than one source of energy fuel for their activities; firewood, charcoal, kerosene or electricity, with the specific mix varying depending on the setting. Acker and Kammen (1996) further indicate that each household is confronted with a number of "mutually exclusive" options for energy fuels and thus uses the fuel that maximizes utility.

Unlike the ladder which dwells on fuel switching, the energy portfolio indicates that there is no switching and no movement up any "ladder", and therefore there are several forms of energy fuels available to households for their activities. Several research works have revealed that the reasons for using multiple fuels are varied, and are not necessarily dependent on economic factors, although the "affordability or cost of the energy service also has an important bearing on the household's choice" (e.g. Heltberg, 2004; Hosier and Dowd, 1987; Farsi et al., 2007; Njong and Johannes, 2011). According to Pachauri and Spreng (2004), some rural households prefer using more than one fuel because they would want to increase security of supply; whiles in some cases, their preference is dependent on social, cultural or taste preferences. There are thus other factors that influence choice of an energy service or fuel, other than income and relative fuel prices as the traditional energy ladder posits. There is evidence in some countries showing this pattern, and thus the manner people consume a portfolio of energy sources does not depict and fit with the energy ladder model (Davis, 1998; Hosier and Kipondya, 1993). This situation according to Masera et al. (2000) is termed fuel or energy stacking, and termed

"multiple fuel" model according to Kammen et al, (2000). This model has been often reported since the eighties (Leach and Mearns, 1988; Fitzgeraldet al., 1990). The description and further explanation of these patterns of fuel use has however received much less attention than the study of the fuel transition process itself. To the extent where multiple fuel usage for cooking is the norm, promotion of petroleum fuels may not induce the abandonment of traditional fuels and may therefore generate fewer benefits than sometimes hypothesized (Heltberg, 2003).

It is important to consider the exceptions to the general energy model. In many countries, one can find a substantial number of non-poor households who in principle could afford modern, clean and convenient fuels yet continue to rely fully or partly on traditional fuels. A number of plausible reasons have been advanced to account for this firewood puzzle. There is little indication that the smoke from solid fuels is perceived as a nuisance by large numbers of households; however, women's time savings from cooking with modern fuels seem to a major

factor in fuel switching decisions (Clarke, 2005; IEC, 2013). Other times, factors relating to the supply of modern fuels may curtail their full impact and household fuels may be rationed due to supply shortages in fuel markets; distances to retailers can be prohibitive, especially in rural areas; and waiting lists for access to government-distributed fuels, where this was a major issue in India until recently. Moreover, the affordability of modern fuels needs to be seen in light of the 'lumpiness' of modern fuel expenditures: whereas fuel wood costs are evenly spread out, modern fuel expenditures tend to come in spikes with particularly severe start-up costs. The current position on energy choice by households is seen as the portfolio more than a ladder. Heltberg (2004) asserts that "in this case, a single option can be a combination of different fuels. Fuel stacking is therefore addressed in some cases by using typical fuel combinations as choices" whiles Farsi et al (2007) posit that "the single option is ignored in other cases by considering only the main fuel used by the household". Ngui et al. 2011) position about fuel stacking is that dwellers utilise more than one energy fuel in their consumption of energy, without differentiating the purpose it is used for. However, this fact alone is not sufficient for fuel stacking in our context.

The discussion reveals that models on energy fuel choice have focused on household choice of fuel for domestic activities. These models (energy ladder and fuel stacking) can be applied at the productive level to ascertain the fuels used by enterprises and the factors that affect decisions of enterprises to utilise specific fuels for the respective productive purposes.

2.4.5 Energy Rebound Effect Model

There is no single proponent of this model in energy policy circles. There are however series of discussions and debates on this subject by energy economists and energy policy analysts. This study thus elaborates on the advent of this subject matter and the discussions made on it. After increases in the oil prices in the 1970s, there was a shift in focus of energy policies from supply-side to also include energy demand consideration. In order to ensure energy efficiency, technology standards and "home weatherisation campaigns" were introduced (Hertwich, 2005). However, Khazzoom (1980) criticised the notion that improving energy efficiency will necessarily lead to reduction in the demand for energy. However, Brookes (1978 and 2000) indicated that energy efficiency leads to increased demand for services. Brookes (1978; 2000) further argued that ensuring energy efficiency will lead to economic growth, and that will in turn lead to an increase in energy demand.

Hence, the energy rebound effect model unlike the traditional energy ladder which considers income of households and relative fuel prices; takes into consideration the fuel price elasticity of service demand and the efficiency elasticity of the service demand (which is the direct rebound effect). This relationship according to model thus underpins efforts to ascertain the direct rebound effect, which rely on variation in fuel prices and consumption. Gilligham and Chan (2014) indicates that economists have noted that improving energy efficiency could lead to a behavioural response reducing or even eliminating the energy savings from the efficiency improvement. This effect they claim, has come to be known as the rebound effect, which suggests an initial energy savings and a rebound in energy use from the response. Furthermore, other researchers suggest that the model has motivated empirical work, estimating the consumer response to specifically, changing energy prices (Gillingham et al.; 2013; Sorrell et al.; 2009; and IRGC; 2013).

The model comes with two effects; direct and indirect rebound effects. The direct rebound effect indicates the additional fuel use which is attributable to the increased energy service demand when the implicit price of the service declines due to an energy efficiency improvement. The indirect rebound effect however, identifies the increase in energy consumption from changes in the consumption of other goods and services due to improved energy efficiency in the product of interest. Azevedo (2014) for instance defines the indirect effect to include changes in the net embodied energy from the production of all products after the energy efficiency improvement. Borenstein (2015, forthcoming) however regard it as "*the effect of re-spending any increased income freed-up from the efficiency improvement (not including the compensated substitution effect)".* The model thus does not necessarily look at income but rather the changes to energy use due to price changes.

The model would however not be used in this study because it takes into consideration the fuel price elasticity of fuel or service demand and the efficiency elasticity of the service demand

(which is the direct rebound effect). The relationship thus underpins efforts to ascertain the direct rebound effect, which rely on variation in fuel prices and consumption. This study primary seeks not to determine these, but rather to identify the specific energy (fuel) needs of men and women at the productive level, the determinants of the specific energy fuels for productive activities and the implications associated with the supply and utilisation of the energy forms for policy formulation and implementation.

2.5 The Role of Energy in National Development

"Energy is seen as a resource that connects economic growth, social equity and sustainable environment" (WHO, 2013). Development is thus not possible without sustainable energy (UN,

2012).The UN-Energy (2005) and UNDP (2005) assert that no country times has substantially reduced poverty without a massive increase in its use of energy and/or a shift to more efficient energy sources that provide higher quality energy services. Most economic activities will thus not be possible without energy (UN-Energy, 2005, UNDP, 2005). Energy's significant role in sustainable development is also explained by its importance in promoting access to water, enhancing agricultural and industrial productivity, improving health care delivery, enhancing education, job creation and climate change impacts. The UNDP (2005) sums up the crucial role energy plays in national development by linking energy to the attainment of the MDGs. The UNDP argues that failure to include energy considerations in national strategies and development planning frameworks will severely limit the ability to achieve the MDGs (UNDP, 2005 cited in The Energy Center, 2011). Also, access to cleaner energy services is a critical enabler for economic and social development. The impact on human development is significant once communities have access to modern, cleaner and safer energy services.

For this study, sustainable energy access and use is interpreted to mean access to energy services that is lasting; available for current economic activities and also be available for future use, for similar activities. The energy services should not pose risks (economic, social or environmental) to enterprise operators; both men and women, and that, benefits should accrue to everyone. Furthermore the consumption of the resources or services should be more sustainable by leaving some to future generations. This is conceptualized in Figure 2.3.

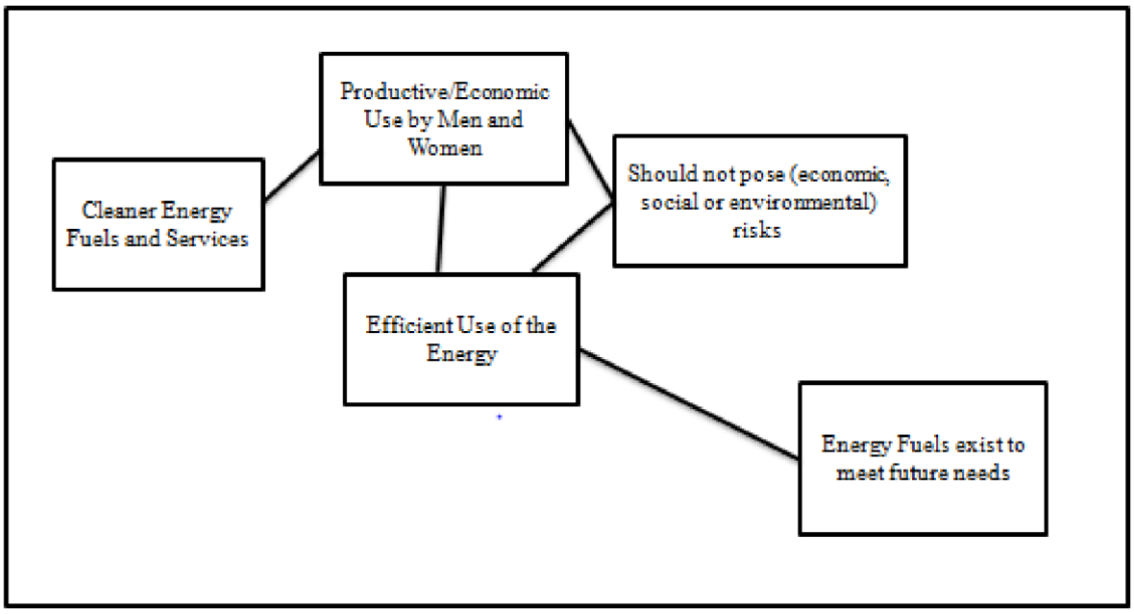


Figure 2.3: Sustainable Energy Access and Use

Source: Author's Construct, October, 2014

As shown in Figure 2.3, cleaner energy fuels and services are used by households and industries for domestic, productive and economic purposes. With the explanation of sustainable development, when these energy fuels are used efficiently (not wasting them and using them for the intended purpose), they (do not) pose less risks (economic, social and environmental), and at the same time are reserved or renewed to meet future energy needs.

2.6 Gender-Energy Nexus: Decision-making on Energy Services used in Rural Areas

Global warming, climate change and energy shortage are significant issues confronting governments and development agencies in meeting energy service demand. There is a shift in government policies to increase energy efficiency and to develop low-carbon economies (Jan, et. al. 2012). The gender dimension of energy thus appears in a number of ways. Several studies place much emphasis on women and the energy forms and technologies used in the kitchen primarily for cooking. Makan (1995) asserts that when there is the need for energy to be purchased, men enter the decision-making process. In South Africa for instance, it was found that the high expenditure on batteries was for young men to listen to taped music; in many cases, female members had no access to the equipment and no control over battery purchase. Thus, the decisions about what to buy and who owns it were mostly made by the males.

Survey data from Uganda in 1996 showed that 94% of rural dwellers not connected to the electricity grid were estimated to be spending about US$6/per household per month on batteries (Barnett, 2000). This trend is similar to the choice of fuels used for productive purposes, where productive enterprises are mostly family-based businesses. Male-headed households influence their spouse's demand for energy services if they (males) should end up paying for them (Clancy et al., 2003). It has been further researched that men also tend to influence the uptake of energy technologies in the women's domain. For instance in Zimbabwe, there have been reports that men have rejected the use of solar cookers by their wives, since technology and its development are seen traditionally as a male preserve (Nyoni, 1993). Tucker (1999) and Wilson and Green (2000) reveal that, men will also often decide on the energy fuel if it is to be purchased for both productive and domestic usage.

The evaluation of a rural electrification project by Rengasamy et al (2001) in Tamil Nadu showed that men benefited more than women since the electricity was used to run irrigation pumps substituting for oxen-drawn water. Furthermore, women and men have different perceptions about the benefits of energy; men see the benefits of electricity in terms of leisure, quality of life, and education for their children; while women see electricity as providing the

means for reducing their workload, improving health, and reducing expenditure (UNESCAP, 2003). Access to sources of energy is not only determined by their physical availability, but is also differentiated by power relations vested in a variety of social constructions, including gender. Between men and women, distribution of and power over energy services is not equal, but reflects the situation in respect of available resources (Reddy, 1996).

The foregoing discussions show that research works have focused on energy services used at the household level for household activities, primarily cooking, illumination, among others. Those that have focused on productive use of energy aligned itself largely to the welfare impact of electrification on rural dwellers, assuming that men and women both have equal access to it and benefits accrue equally to them (WHO, 2013; EIA, 2011; IEA 2011, 2015; Baffour, 2013). The study upon this discussion and revelation focuses on the specific energy needs of men and women for productive enterprises at the RNFE. Preference for energy services have most often being accessed based on the traditional "energy ladder" model and the emerged "energy stacking or portfolio.

2.7 Energy and National Development in Ghana

This section of the review identifies the forms of energy used in the country. It further identifies and analyses the energy access policies of the country to find out whether the policies had in focus the gender-energy nexus so as to provide a firm basis for mainstreaming gender into the development of energy interventions. Lastly, it identifies the forms and purposes of energy used in rural communities in Ghana, since the available forms of energy in the communities are used for productive purposes.

2.7.1 Energy Situation in Ghana

Ghana is well endowed with a variety of energy resources including biomass, hydrocarbons, hydropower, solar and wind as well as the capacity to produce bio-fuels and nuclear energy (Energy Commission, 2011; The Energy Centre, 2011). Access to energy in Ghana varies across gender, region, and enterprises. The main sources of energy in the country are solid fuels in the form of firewood and charcoal, petroleum products and electricity. For the year 2007, biomass energy consumption was 11.7 million tonnes while petroleum products and electricity consumption were 1.955 million tonnes and 6,269 GWh respectively. In terms of total energy equivalence, solid fuels constituted 59% with petroleum products and electricity accounting for 32.3% and 8.7% respectively (Ministry of Energy, 2009). According to the Ministry of

Energy (MoE, 2010a), solid fuel is Ghana's dominant energy resource in terms of endowment and consumption, which continues to be the major form of energy for consumption in Ghana, representing 46.8% in 2012, followed by petroleum products (42.9%) and electricity (10.3%). This compares favourably with the situation in 2011 when its consumption was estimated at 49.9%, followed by petroleum products (39.1%) and electricity (10.3%) (Energy Commission, 2011b; 2012). It could thus be inferred that solid fuels continues to be the dominant source of energy and is used significantly in the domestic sector for cooking and other heat applications in Ghana. The industrial and manufacturing sectors of the economy also make great use of grid electricity. The increasing dependence on fuel wood has implications for the food processing and micro businesses that women operate, as many of these businesses are based on processed heat and are energy intensive. The dependence on firewood has grown in recent years (ADF, 2008). The major challenge in biomass energy supply in Ghana is how to reverse the decline in the fuel wood resource base of the country and further sustain its production and use by improving the efficiency of production and use.

2.7.2 Public Institutions in the Energy Sector

There are generally six public institutions involved in the power sub-sector; the Ministry of Energy (MoE), Energy Commission (EC), Public Utility Regulatory Commission (PURC), Volta River Authority (VRA), Electricity Company of Ghana Limited (ECG) and the Northern Electricity Department (NED), a department of the VRA. Under an on-going Power Sector Reform however, ECG and NED are expected to be merged to form one distribution company. The transmission function is to be separated from the generation and other responsibilities of the VRA. Energy Foundation is a private-public sector partnership to promote energy efficiency and conservation countrywide.

Basically, the Ministry of Energy (MOE) is the government 'mouthpiece and responsible for energy policy formulation; the Energy Commission is in charge of Energy Policy Advisory, planning, technical regulation and monitoring; the PURC is the Electricity tariff regulation body of the country; VRA is responsible for electricity generation and transmission; Energy Foundation is also responsible for the promotion of energy efficiency and conservation; while ECG and NED are responsible for electricity distribution of the Southern (Greater Accra, Ashanti, Central, Eastern, Western and Volta Regions) and Northern (Brong Ahafo, Northern, Upper East and West Regions) Sector respectively.

2.7.4 Energy Access Policies in Ghana

This part of the study reviews the energy access policies in Ghana which are intended to enhance households' access to modern and safe energy services, premised on which this research is being carried out to address the gender energy gap. The review emphasises energy access policies in the national development frameworks; Ghana Poverty Reduction Strategy (GPRS I), the Growth and Poverty Reduction Strategy (GPRS II) and the Ghana Shared Growth and Development Agenda (GSGDA, Volume One). Energy policy documents such as the National Energy Policy (NEP), Energy for Poverty Reduction Action Plan (EPRAP) and the Strategic National Energy Policy (SNEP) are also reviewed to ascertain the objectives of these policies in addressing the gender-energy gap or challenge.

2.7.4.1 Energy Policies in the National Development Frameworks

Energy is regarded as a significant tool for developing local and regional markets and allowing for the extension of basic services such as telephone and for the development of supportive productive enterprises. The GPRS I was hence developed to provide reliable and affordable energy delivery systems to support economic activities, especially in the rural areas. The policy realised the need to improve access to energy for domestic purposes and had some strategies to achieve this: assist communities to develop woodlots; introduce renewable energy technologies such as solar PV and biogas; and introduce and promote energy efficiency technologies for domestic users (NDPC, 2003).

The GPRS II, succeeding the GPRS I was further developed to ensure and promote the supply of reliable and quality energy services by increasing access to alternative forms of energy by the poor and vulnerable; modernising and expanding power infrastructure; improving the regulatory environment in the power sector; and ensuring full cost recovery for power supply and delivery while protecting the poor. These interventions were intended to enhance users' access to adequate, reliable, high quality and safe energy services, especially in the rural areas (NDPC**,** 2006). The Ghana Shared Growth and Development Agenda –Volume one (NDPC, 2010) also paid attention to the energy sector of the economy. The energy sector session of it aims at improving industries and households' access to reliable energy supply. This policy is aimed at addressing identified issues such as: limited access to the national electricity grid especially in the rural areas; over-dependence on few sources of energy (HEP and thermal) and the neglect of potential indigenous sources; absence of renewable energy in the national energy mix; unreliable and inadequate supply of energy to households and industry, among others.

In the area of gender and energy, the policy aimed at increasing access to modern forms of energy, particularly women, in order to reduce the boredom in their activities; and ensure that concerns of women and children are taken into account in all aspects of energy production and utilisation. Subsequently, the development framework hopes to promote the use of modern forms of energy in households; support the capacity development of women in the energy sector; and ensure participation of women in the formulation and implementation of energy interventions. Holistically, the development frameworks recognise access to reliable, affordable, adequate and safe energy services as important national development tools. The strategies do not only hope to expand access to electricity but also to improve access to cooking fuels to all users in Ghana. The frameworks, with the exception of the GSGDA, failed to address the gender-energy gap. The GSGDA though attempted to address this, it however failed to realise the disaggregated and specific energy needs of men and women, which could have served as the foundation to address the gap and effectively mainstream gender into the sector.

2.7.4.2 Energy Policies in National Energy Policy Documents

The Government of Ghana in the SNEP, NEP and EPRAP hopes to achieve universal electricity coverage by 2020. In achieving universal access to electricity, the specific policy objectives under the NEP and SNEP include: securing long term fuel supplies for the thermal power plants; reducing technical and commercial losses in power supply; expanding energy infrastructure to meet growing demands and ensure reliability; increasing production and use of renewable energy and make energy delivery efficient; ensuring cost recovery for energy supply and delivery; and promoting and encouraging private sector participation in the energy sector (Energy Commission, 2006, Ministry of Energy 2009).

Strategic National Energy Policy (SNEP) aimed at "broadening the sources and types of energy supply and integrating them into high quality utility service for the total growth of the economy" (Energy Commission, 2006:10) between 2006 and 2020. The specific objectives of the plan are to: establish an effective national infrastructure for energy planning; and create a consensus reference framework for the development of the energy sector. The long-term nature of the SNEP provides the opportunities for the development of viable local industry for the production of components and systems locally, to meet future spare-parts requirements of future investments thereby making savings and ensuring sustainability.

The aim Energy for Poverty Reduction Action Plan (EPRAP) was to provide a roadmap for the targeted delivery of energy services to support productive activities to achieve national development poverty reduction goals and strategies outlined for the implementation of seven

key areas under the GPRS II (TEC/ESMAP, 2010). The seven sectors are agriculture, small and medium enterprises, health, education, water and sanitation, communication and technology and households. The main objective of EPRAP is to focus attention on the energy needs of the poor and the underserved during the implementation of the GPRS II and beyond; and explicitly recommends the promotion of LPG and improved cook stoves to rural, poor periurban and urban communities.

The summary of the review of the national development frameworks and national energy policy documents revealed that priority attention is given to the energy sector due to the significant role energy plays in the national poverty reduction agenda. The overall intent is to ensure sustainable access to environment-friendly sources of energy for use by households and enterprises. The development frameworks and policies however failed to largely recognize or consider the specific energy needs of men and women, for both productive and domestic purposes. The absence of disaggregated energy data would impede the successful aim of mainstreaming gender into energy policies and programmes, and ultimately address the genderenergy poverty gap.

2.8 The RNFE and Energy Situation in Rural Areas in Some Selected Countries Following the discussions, gender, particularly women, and energy issues have been given much attention in most studies. The quest and measures to address the most energy poor, women, have been given recognition in conferences and policies of countries. However, as this study seeks to do, there is absence of disaggregated data on the energy needs of both men and women for productive use in the RNFE, which would serve as the foundation to develop the RNFE, improve living conditions, promote gender mainstreaming into energy policies frameworks, plans and programmes.

2.8.1 Gender, RNFE and Energy Situation in Rural India

According to the International Electro-technical Commission (IEC, 2013), India is one of the fastest growing economies in the world today with a growth rate of around 6 to 8 per cent. However, electrification and access to sustainable quality electricity services remains a dream for more than half the populace in India, despite village electrification being around 90% (Ministry of Power, 2011). According to the DFID (2003), the RNFE in India has immense potential to generate new jobs with relatively low direct investments, by utilising local skills and resources or by meeting local demands by adoption of simple techniques. Developing the sector also has the potential of preventing migration of rural population to urban areas in quest

for employment (Radhakrishna 2002). The drift of the workforce from agricultural to nonagricultural activities has come about as a result of the diversified nature of the RNFE. Thus, increasing the dependence of the rural poor on non-farm incomes can be seen as a sign of a healthy economy (Praxis, 2001). The typical productive activities women are found in at the RNFE include bead making, milling, food preparation, cottage industries, and other services that relate to their gender-prescribed roles in the domestic sphere.

Energy services used by rural dwellers in India as in many other developing countries, is biomass (wood). Access to energy sources differs significantly between rural and urban areas, with rural areas often lacking access to more efficient sources of energy and wellfunctioning markets for energy and energy end-use equipment (Pachauri and Spreng, 2004;

Misra, 2007). A survey by Misra (2007) revealed that about 72% of India's population live in rural areas. Parikh (2007) revealed that about 52% of the people in India do not have access to modern cooking fuels; nearly 300 million do not have access to electricity; and of the energy used in poor Indian households, 70% comes from non-commercial fuels such as fuel wood, agricultural wastes and animal dung that are primarily managed by women.

According to the 2011 National Census (cited in IEC, 2013), about 67% of all households in India depended on solid fuels which were biomass-based. It further revealed that close to 85% of all rural dwellers continue to use biomass as it is easily accessible (relative to cleaner liquid fuels) and available free of charge. The IEC (2013) argues that these two factors in a way explain households even with access to LPG continue to use a combination of LPG and firewood. Energy policies, programmes and plans on "gender" in India as developed by countries focus primarily on only women, with the aim of improving the quality of life and productive activities of women (Ministry of New and Renewable Energy, 2006; Planning Commission, 2006; Clancy and Skutsch 2003; UNESCAP, 2003,). Focus of gender concerns into energy issues has been at the institutional level, where government seeks to bring on board "women" in the energy sector as a way of mainstreaming gender into energy concerns and policies. Parikh and Sangeeta (2008) indicate that gender-based empowerment, the needs of women and their access to and control over energy resources are seldom considered in India's energy development planning. They further state that the lack of attention to gender concerns in the national energy policies may be in part due to the lack of knowledge about the gender dimension in the energy sector and perhaps be due to uncertainties about how to incorporate gender in a sector that is primarily been technically driven.

2.8.2 Gender and Energy Situation in Rural Tanzania

The first National Energy Policy for Tanzania was formulated in April 1992 and was revised in 2003 taking into account structural changes in the economy. The national policy objective for the development of the energy sector remains to "provide an input in the development process by establishing an efficient energy production, procurement, transportation, distribution, and…with due regard to gender issues" (Ministry of Energy and Minerals, 2003:5). A specific objective among other objectives of the energy policy is to increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring. More than 80% of Tanzania's population is rural. Biomass is the dominant energy supply in the country contributing about 90% to energy supply, where more than 80% of energy delivered from biomass is consumed in rural areas (Msyani, 2013). In Tanzania, men are often the decision-makers when it comes to purchasing/changing domestic energy use and access (Uisso and Erneus, 2013). The Rural Energy Agency (REA) is an autonomous body whose activities are supervised by the Ministry of Energy and Minerals.

The Agency's scope is to promote and facilitate improved access to modern energy services in rural areas.

According to the MEM (2003), Inferior energy practices, particularly among poor households in rural and semi-urban areas, are mainly affecting women: the search, collection, and use of fuel-wood are associated with heavy and often low-productive time-consuming work, mainly performed by women. The energy policy, thus introduces "an institutional focus" on improvements of rural energy practices in order to reduce women workload and to involve them in the problem solving and decision-making processes on energy issues. Women are under represented on the supply side of commercial energy. Gender mainstreaming in Rural Energy Agency (REA) focuses on the 3E's: Equality, Equity and Empowerment. It however adopts a weak definition of gender (e.g. focuses on the number of women participating in energy activities). Gender issues just like India is more institutionalized (putting women in energy institutions). For instance, the Government of Tanzania has been trying to address the situation of women in the country by putting in place various policies to improve the standing of women in general (Example 30 women in Parliament through special seats, Ministry of Community Development, Women and Children, other Policies include some address to gender issues) (Mathew, 2013). The REA in an attempt to address gender issues and energy concerns seeks to undertake a "Gender Baseline Assessment, which is proposed in order to identify: Obstacles and opportunities for integration of gender issues into REA operations, currently –

including capacity issues, management and accountability issues and human resources issues; Specific opportunities for mainstreaming gender into specific projects being facilitated by REA; the gender dimensions of energy use and needs at the village level; and indicators for identifying success in mainstreaming gender into project activities.

The discussions reveal that gender whenever raised in development issues is narrowed to "empowering women to be better-off". Studies and measures on mainstreaming gender into energy have been to improve women representativeness at the decision making level (institutional level at the national, regional and community levels). It is however imperative to identify the specific energy needs by gender, not necessarily women; and the decisions that affect the choice of energy needs, taking into consideration the theoretical underpinnings; energy ladder and the energy stacking, to provide the foundation to effectively address gender poverty in rural areas of particularly, developing countries.

2.9 Gender and Energy in the RNFE: Conceptual Framework

Investments made in the provision of energy fuels and services are buttressed by their significant role in rural and national development (WHO, 2013; UN, 2012; UN-Energy, 2008**)**. Energy plays significant role in sustainable rural development as it is regarded as the key that unlocks all other resources and influences the living conditions of mankind (Youngquist,

2001:1). Lack of access to energy services constitutes a major obstacle to the world's access to water, sound economic conditions and activities, food production, health, and the environment (World Bank Group, 2009:2). The AusAID (2001:5) however indicates that access to energy will not automatically lead to poverty reduction. Thus, energy should be seen as a development issue rather than an energy issue.

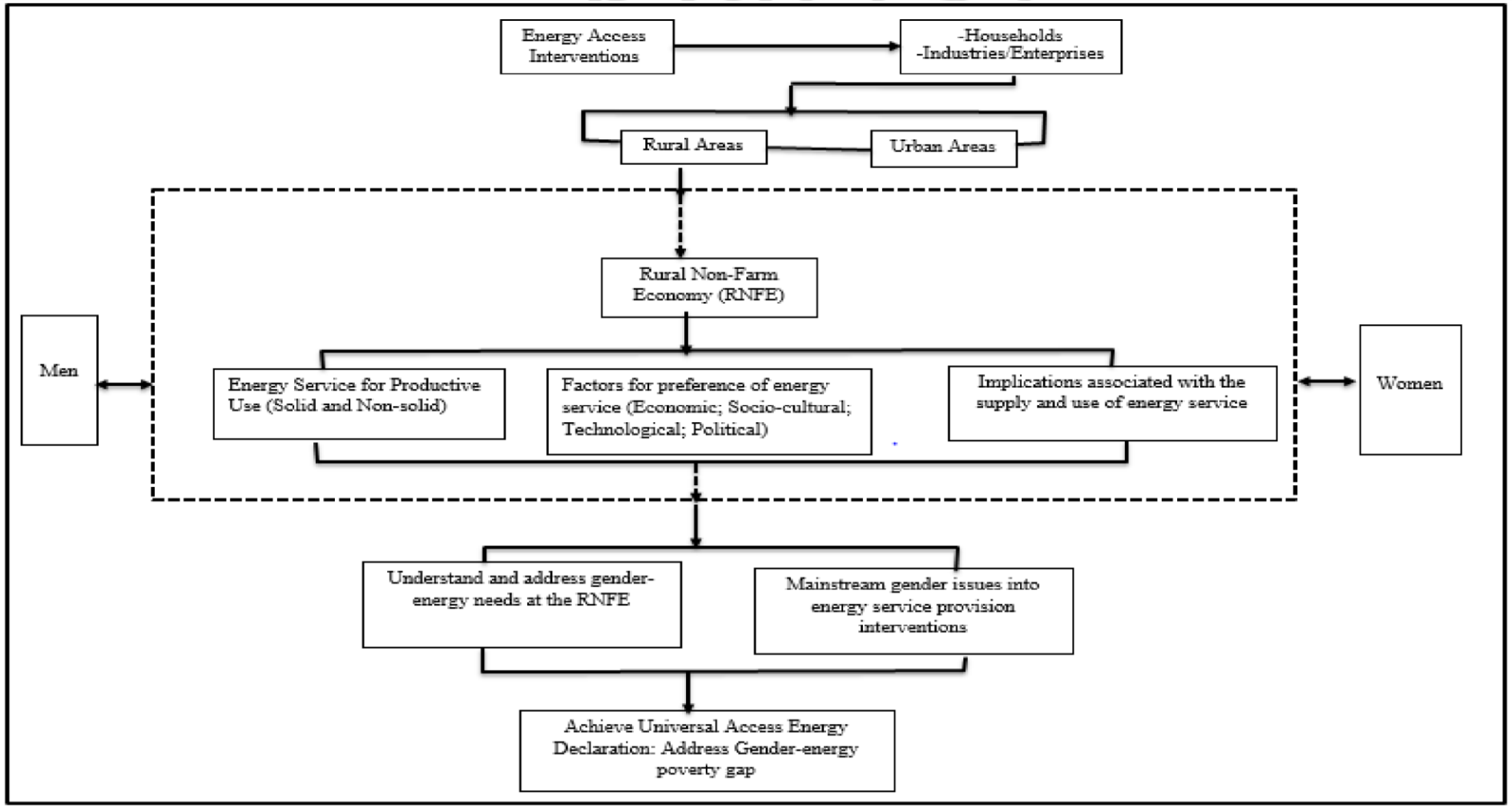


Figure 2.4: Conceptual Framework for the Study

Source: Author's Construct, March 2016

Interventions by governments and other institutions in Africa and across the globe aim at promoting access to cleaner energy services to households and industries in urban and rural communities. Research works however reveal the energy poverty (lack of and inadequate access to cleaner energy services) is pronounced in rural communities who are often cut-off from national energy schemes. Within the rural areas however, households and enterprises require various energy services for their activities. Rural households in developing countries are however increasingly earning their livelihoods from activities other than farming. Activities in the RNFE are revealed to be gender-defined where women engage in the service and the manufacturing sectors such as food and beverages, and cottage industries. The men are however found in the metal, wood and electrical-based sub-sectors.

Sustaining the activities of men and women in the RNFE require adequate and reliable supply of energy services. The energy services required by economic activities are productively used to produce needed goods and services for target beneficiaries. The energy services include solid fuels such as firewood, charcoal, dung and non-solid fuels like electricity, cells, solar, petrol, diesel, and kerosene, among others. The preference for specific energy services by the productive enterprises which are operated by men and women are influenced by several factors which are also argued to be gender-defined. As posited by the traditional energy ladder model, the income of users and price of energy fuel to a large influence the preference for the specific energy service. However, the energy stacking model indicates that socio-cultural, economic, political, and technological factors greatly influence an individual's preference for an energy service. The structural and cultural factors/schools of thoughts further argue that economic and social structures and cultural beliefs to large extent determine and influence the preference for an energy service among gender. Other factors include political and geographical disparities which makes energy services either available or unavailable in some jurisdictions. With that, men and women make use of what is available.

The energy services used by enterprise operators for their productive activities come along with several implications with their supply and utilisation. Operators who utilise solid fuels are exposed to several health risks which come about as a result of the smoke from the inefficient combustion of the fuels. There have been arguments that energy interventions should treat men and women the "same". However, the review has revealed that some authors are of the view that there still exists energy poverty because of not paying attention to the gender-energy access and preference nexus, and so the need to study into them. Identifying the typologies of enterprises in the RNFE, the energy services required by men and women, the factors

influencing preference for energy services by men and women and examining the implications associated with the supply and use of energy services has direct bearing on understanding and addressing the gender-energy needs at the RNFE and mainstream gender into energy service interventions by governments. This would have the long-term impact on achieving the universal access energy declaration of address gender-energy poverty gap, particularly at the rural areas.

Little is known about the specific energy needs of enterprises operated by men and women at the RNFE and the factors who influencing the gendered usage of the energy services. This study was aimed at drawing out and synthesising findings from the primary and secondary data sources regarding the energy needs of enterprises within the RNFE differentiated by gender. The framework thus provides a basic understanding of the relationship between energy needs and the factors influencing preference for the specific energy services by men and women at the RNFE.

2.10 Summary of Literature and Lessons Learnt

The literature has identified that energy play important role in promoting economic, social equity and sustainable environmental development, and that development is impossible without energy options. The users of energy have been revealed to consist of industries (RNFE) and households; both men and women. Thus, men and women have varying energy needs based on some factors or determinants, and that the gender-energy poverty divide which is more skewed towards women would be addressed by obtaining gender disaggregated data on specific energy needs. Ghana has taken several steps through policies, programmes, plans, and projects to address the gender-energy poverty that exist. The literature further revealed that these steps have however not yielded the needed results.

2.11 Linkage between literature and rest of the study

The review of literature has demonstrated the need for obtaining disaggregated energy needs by gender and the factors that influence their decisions for the specific energy services. This need is based on the increasing situation of energy poverty, especially among rural folks in developing countries. A report by the Ministry of Energy (2010b), Ghana dubbed "Gender Assessment of Ghana's Energy Sector" indicates that to address energy poverty among gender and effectively mainstream gender into energy policy and planning calls for a conscious effort to obtain gender disaggregated data on specific energy needs. Chapter three therefore outlines the methods employed by the study in addressing the objectives of the research.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section of the report lays emphasis on the research methodology adopted for the study. According to Kallet (2004), this allows readers to critically evaluate the study's overall validity and reliability. This section presents the research design, type, approach, sample frame, sampling procedure and sample size selected for the study. Data needs and their sources, data collection tools and techniques as well as data analyses and presentation techniques are emphasized in this section. The section ends with analytical framework, ethical considerations and concluding remarks.

3.2 Epistemological Foundation

Epistemology is the philosophy of research concerned with how researchers know what is true (Streubert and Carpenter 2003:362). Mouton (1996:47) states that research done in the epistemological dimension is regarded as the pursuit of valid knowledge (truth). Epistemology is the relationship of researchers to reality and the road that they will follow in the search for truth (De Vos 2002:214). This study explored the "truth" of disaggregated gender energy needs and the factors that influence the decisions for the choice of energy services at the RNFE. The study was committed to "search for truth" in the epistemic imperative. A close relationship exists between epistemology, intentionality and ontology.

Intentionality is a way of knowing reality. It carries the meaning of reality (ontology) as we know it. Ontology is essentially part of the process of constituting a life-world (ontology). Linguistic epistemology refers to the way of knowing reality (truth) through the spoken word (linguistic or lingual), i.e. using words to describe an experience. The study required that men and women operating productive ventures with energy services indicate their choice of energy fuels and the reason for using that energy service and not another. Linguistic epistemology made the researcher opt for the open unstructured qualitative interview to investigate the reasons behind the preference of energy for productive use. This also based on the assumption that what people experience and decide on, they do that in terms of language. These informed the aim of the study: to know the reality and truth of gender energy needs and the factors that influence the preference of energy services at the RNFE.

3.3 Research Design and Approach

3.3.1 Research Design

The research provided a mixture of quantitative and qualitative (descriptive) explanations to the study or research problem. The approach makes provision for at least one quantitative method (designed to collect numbers) and one qualitative method (designed to collect words). The study therefore used a combination of quantitative and qualitative methods to answer the research questions. The methodological eclecticism inherent in the mixed research design results in superior results (Johnson and Onwuegbuzie, 2009).

The quantitative techniques were used to analyse the quantity of energy fuels utilised by the enterprises, the expenditure on procuring them and operating the enterprises, and the linear correlation coefficient (*r)*; which measures the strength and direction of a linear relationship between the choice of energy fuels and incomes of enterprises, which the energy ladder model posits. Consequently, the coefficient of determination (r^2) was also determined to ascertain the proportion of the variance of one variable that is predictable from the other variable. The study also made use of a five-point Likert scale to ascertain the order of significance, the factors that influence the preference for an energy form to another. The linear regression model was also employed to determine the extent to which variations in the income of enterprise operators will affect variations in the quantity of the fuel used (where applicable i.e. if the quantity of the fuel can be determined).

The qualitative techniques on the other hand were used to discuss and explain the responses from the enterprise operators (men and women) to determine their preference for an energy service, the factors that influence such decisions, guided by the energy ladder and portfolio and the implications associated with the supply and use of the energy identified fuels. According to Morse and Field (1996), qualitative research is inductive, holistic, subjective and processoriented method which is adopted to understand, interpret, describe and develop a theory on a phenomena or setting. To ensure internal validity, qualitative techniques were applied to elicit responses from women and men groups who operate enterprises and use any of the energy services identified. The responses from the men and women (individuals) and the groups centred on their specific energy services and why (determinants) they prefer such energy services. The data collected from the men and women groups were triangulated with those obtained from the individual operators (men and women) in the various productive enterprises to render the research findings more accurate and valid and superior to mono-method.

3.3.2 Research Approach

The study adopted the cross-sectional research approach to provide answers to the research questions. With this design, a set of information is collected for a sample at one point in time.

The cross-sectional design involves observation of all of a population, or a representative subset, at one specific point in time. It mostly aimed at describing the pattern of relations before any attempt at casual inference is made: in this case specific energy needs and choices of operators for productive activities. These studies are helpful in determining how many people are affected by a condition and whether the frequency of the occurrence varies across groups or population characteristics (Mann, 2003; Levin, 2006). They commonly make use of surveys to collect data and they do not require participants to be assigned to groups. Thus, the productive enterprises based on the principles of cross-sectional studies were selected. The study took a snapshot of how enterprises were operated, specifically using varied energy services at a point in time. Enterprise operators (both men and women) were asked of their specific energy fuels, the productive purpose or use of the identified energy services, the factors that influenced the decision to use such energy service and the implications associated with the supply and use of the energy services.

3.3.3 Research Process

The research process started with a preliminary review of literature. The research topic was thus conceived from the literature review. The literature review identified the income, relative fuel prices, affordability, availability and commercial viability as the major factors that affect the choice of energy fuels towards a more sustainable productive purpose, among enterprise operators at the RNFE. The review noted that several countries have put in measures to improve access to cleaner energy fuels, particularly to women for household activities, as a measure to minimise the effects of indoor inhalation of smoke from unclean energy. The review however revealed absence of data on energy services used by both men and women for productive uses at the RNFE, and the factors that influence the preference for the energy service. The review established that absence of energy fuels and the use of unclean energy fuels pose enormous health risks to users; particularly, women. The literature review also established that energy plays significant role to poverty reduction and sustainable development in rural areas, if used in productive ventures.

The review revealed that women are energy poorer than men in LDCs and that this results from the non-consideration given to the gender uniqueness in the types of energy services they access. Furthermore, the review revealed that the energy sub-sector investments in Ghana do not consider the unique needs of women and men. Women's productive activities in the RNFE rural communities in LDCs as revealed depend largely on the traditional fuels which are converted by inefficient end-user devices. The researcher, through the literature review, found

no known studies on disaggregated data on gender energy needs, specifically for productive purposes as well as the factors that influence the preference of the energy services for the varied use. The research problem was therefore the knowledge gap on the absence of disaggregated data on the specific energy needs for productive uses and determinant of the energy choices. More specifically, a survey is a method of collecting data in a consistent or systematic way as depicted by Figure 3.1.

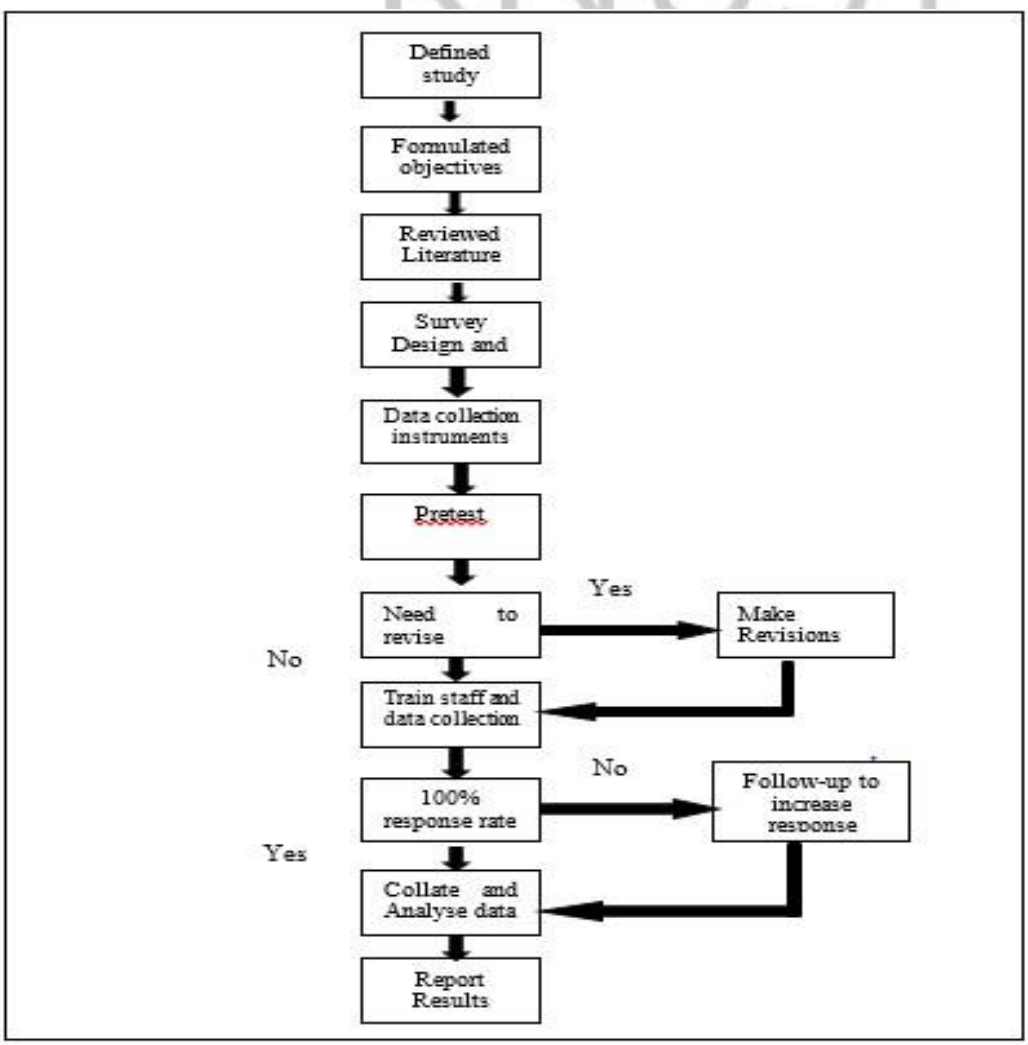


Figure 3.1: Steps for conducting the Survey/The Research process

Source: Author's Construct, 2015

To address the knowledge gap, series of research objectives and questions were designed to gather relevant information. The research objectives, questions and hypotheses were addressed through the application of an appropriate research methodology. The research indicated how and from whom responses to the research questions were obtained and analysed; specifically from the owners/operators of the productive enterprises and relevant institutions that have

jurisdiction over the study. The research findings and conclusions were informed by the research objectives, questions and hypotheses and thus addressed the knowledge gap. The conclusions were therefore drawn based on the research objectives, questions and research hypothesis and propositions.

3.4 Population and Sampling Scheme

3.4.1 Study Population

The population according to Burns and Grove (2003:43) includes all elements that meet certain criteria for inclusion in a study. For the purpose of this study the population consisted of all women and men in the RNFE who make use of energy for productive purposes in the EjisuJuaben Municipality. The Energy Commission (2014) and MOFA (2015) state that the EjisuJuaben Municipality among other political (rural) districts is the most progressive in terms of transiting from a rural municipality to a more urban in terms of economic composition and energy transition in Ghana. This study based on the indicator of communities in transition as explained under section 3.4.1.1 as stated by MOFA (2015) and the Energy Commission (2014), selected 4 communities (Boankra, Adadientem, Hwereso and Kubease) within the Ejisu-Juaben Municipality, a rural Municipality, to examine the energy service used by enterprises operators (men and women) at the RNFE for productive uses.

3.4.1.1 Bases for the Selection of the Study Communities

Thiyagarajan et al (2014) in their article "The Energy Plus Approach: Reducing Poverty with Productive Uses of Energy) argue that in undertaking studies on productive uses of energy access in rural communities where much focus is on household use of varied energy forms, attention should be given to those in 'overgang' (Dutch word for 'transition'). They thus undertook and referenced similar work on energy access and productive use in rural communities in Nepal (on the improved water mill programme in Nepal from 2003 to present), Bhutan (on community micro-hydro for sustainable livelihoods in Bhutan from 2005 to 2009) and Pakistan (on Productive uses of renewable energy in Chutral District, Pakistan from 2008 to present). Jan et al (2011) in a study "Determinants of Rural Household Energy Choices: An Example of Pakistan" looked at communities that were in the process of moving from unclean energy options to cleaner energy options, and also improvement in economic activities and investments. Para-phrasing Thiyagarajan et al (2014), Etcheverry (2003) and Energia (2008) position on "rural areas in transition", transition implies: communities whose production activities are changing from predominant agriculture to industry and services; from low-energy intensive processing of primary products to more energy intensive activities; from unclean

energy fuels to cleaner energy options; 4 km radius away from energy supply sources and from typical rural to urban areas based on investments and infrastructural development, but still rural. This is because the transition exposes or leads to springing up of energy-dependent or intensive activities which ensure maximum productive use of energy forms for improvement in living standards.

The Energy Commission (2014) and MOFA (2015) indicates that the Ejisu-Juaben Municipality among other political (rural) districts is the most "progressive". The transition was observed in terms of changing from a predominantly rural local area to a more urban area (by the number of rural communities and people living in rural communities in the Municipality), diversification in economic activities, infrastructural development and energy transition in Ghana and within the forest agro-climatic region. This led to more than 92% electricity coverage in the Municipality as at 2013 (EJMA, 2010), which exceeds the Ministry of Energy's target or goal of 80% by 2015" (Ministry of Energy, 2010b:5). This was observed to be happening because of the proximity to the Kumasi Metropolis and serving as a dormitory area to the Metropolis. Furthermore, the West Africa International Magazine in 2014 nominated the Ejisu-Juaben Municipality as the best among all 216 metropolitan, municipal and district assemblies (MMDAs) in Ghana for the year 2014. It scored the Municipality high or best in governance which transcends to infrastructural provision and development, including extension of electricity and other cleaner energy forms to other remote areas in the Municipality. The study communities were therefore selected not because of only their population but rather because of the varying energy-dependent enterprises and availability of more than two energy forms so as to ascertain the preference for an energy fuel and not others (Ejisu-Juaben 2010). The selection of the communities was further aided by discussions with the Municipal Planning Office and the Energy Department within the Municipality.

3.3.2 Criteria for the Selection of the Productive Enterprises

According to the International Food Policy Research Institute (IFPRI, 2007), most of the rural population in developing countries engaged in the non-farm sector are either "self-employed" or are engaged as wage labourers in micro-enterprises employing no more than ten workers. The rural non-farm sector enterprises as productive ventures are split into two categories: small-scale household enterprises and the small or medium-size micro-enterprises in rural areas and small towns. The small-scale household enterprises vary widely in size, location, gender, and sector of activity. They mostly are single-person, owner-operating units, or small units engaging family members, subsistence or livelihood enterprises, providing employment

opportunities in the absence of more profitable alternatives and often are one of several secondary sources of income, many of them intermittent, part-time, and seasonal (IFPRI, 2007; IFAD, 2004; 2009). The second category of non-farm sector enterprises mostly employs wage labourers in addition to family members, relatives, or children, and uses higher skills and capital intensity.

Premised on the distinct categorisation of rural enterprises by IFAD (2009) and IFPRI (2007), the study thus identified the typology of enterprises in rural areas based upon which the energydependent ones were purposively selected for the research. Amponsah et al (2012) in their study provides a list of indicators or criteria in selecting such enterprises. The criteria employed by the authors were as follows: Potential effect of energy intervention on gender; including children; Extent of energy usage by different types of productive ventures; Replicability of intervention and potential impact on employment; Health imperatives on enterprise operators; Long-term prospects of enterprise; and the Peculiarity of enterprise to slums. This study therefore adapted the following set of criteria (as employed by Amponsah et al, 2012) in selecting the enterprises (See Table 3.1):

i. The potential effect of energy intervention on men and women;
ii. The extent of energy usage by different types of productive ventures;
iii. The potential impact of the enterprise on employment creation;
iv. Health imperatives on enterprise operators (e.g. Indoor air pollution) which is in tangent with the vision of the 2010 Ghana Energy Sector Strategy and Development Plan;
v. Long-term prospects of enterprise (e.g. Enterprises that thrive on an ongoing construction project will have to fold-up once the construction is over); and
vi. Peculiarity of enterprise to rural areas.

The enterprises must however satisfy the following basic conditions before passing the selection criteria. An enterprise fails to qualify for the selection criteria (Table 3.1) if one of the basic conditions is not met:

i. Any enterprise that is energy-dependent automatically qualifies and then continues through the selection criteria;
ii. The enterprise should be 'immobile' or have a structure for easy identification; and

iii. The purpose for the energy use of that enterprise should be for productive purpose and not household or community purpose.

Thus, enterprises that meet all the above basic conditions then qualify to pass through the selection criteria. Also, an enterprise should pass at least (a minimum) 4 out of the 6 indicators. It should thus have an average score of 0.67 (4/6)

Several of the productive enterprises operating in the rural areas are energy-dependent using several energy services for their operations. Therefore, effective operation of the enterprises towards sustainable poverty reduction and rural development is contingent upon their access to affordable, reliable and safe energy. It was based on this that the study investigated the issues surrounding the energy services used by enterprises (operated by men and women) at the RNFE productive use.

Table 3.1: Criteria for the Selection of Energy-Dependent Productive Enterprises

S/N	Criteria/Indicator	Description	Score
1	The potential productive use and effect of energy fuel/form ('intervention') on users; gender	-The energy form should serve **ONLY** productive purpose (not community or household use/service) - Should not include neither energy for community services nor household use but only productive use	1
2	The extent of alternative energy usage/forms by different types of productive ventures;	-Energy-dependent and intensive or not by way of how energy forms are handled -Enterprises should have potential alternative energy fuels for the same purpose -Any enterprise that is energy dependent qualifies and has other potential alternative energy forms	1
3	The potential impact of the enterprise on employment creation	-The enterprise should have a minimum of 2 employees or have the capacity/potential to employ a minimum of 2 apprentices/workers -Could be owned by one person but should have the capacity to have "apprentices" or employees	1
4	Health imperatives on enterprise operators (e.g. Indoor air pollution)	-Energy-dependent enterprises and how energy fuels are both directly or indirectly handled -Any enterprise that is energy dependent qualifies	1
5	Long-term prospects of enterprise	-The enterprise should be sustainable in terms of transition and aim of establishment. - Not temporal/ad hoc/seasonal (e.g. Enterprises that thrive on an on-going construction project and will have to fold-up once the construction is over do not qualify)	1
6	Peculiarity of enterprise to rural areas	-Enterprises that according to literature do not deviate from what is expected/pertains to rural areas -Not markedly different from what exist in rural areas	1

Source: Adapted from Amponsah et al, 2012

Score: Either 1 or 0 (Has or not/ Qualifies or not)

3.5 Units of Enquiry for the Cross-sectional survey

For the purpose of this study the population consisted of operators of productive enterprises in the RNFE in the study communities. A sampling frame of the respondents was obtained by undertaking a head count (names and location of respondents) of the energy-dependent enterprises in the selected communities in the Municipality that met the set criteria. The respondents consisted of operators that ran energy-dependent productive enterprises in the RNFE in the study communities.

3.5.1 Population and Units of Enquiry for the Key Informant Interviews

The population comprised all the institutions identified in the energy access sector. Their selection was based on their role in the formulation or implementation of policies, plans and programmes that affect energy supply and utilisation productive purposes; namely the Energy Commission, Ejisu-Juaben Municipal Assembly (EJMA) under which the District Planning Coordinating Unit (the EJMA), and the Electricity Company of Ghana division in the Municipality were selected. The heads of these groups/institutions were the units of inquiry.

3.5.2 Population and Units of Enquiry for the Focus Group Discussions

The population for the focus group discussion were men and women groups that operated energy-dependent productive enterprises in the study communities. The units of enquiry, hence, were the members of the men and women groups.

3.6 Sampling Frame and Determination and Sample Size

The sampling frame has been described under the methods adopted for the study. This is to enhance readability and reproducibility of the study.

3.6.1 The Sampling Frame for the Cross-sectional Survey (Enterprise Operators)

A limitation of the study was the absence of data on the number of energy-dependent productive enterprises/industries in Ejisu-Juaben Municipality. Owing to this limitation, the study enumerated all the energy-dependent productive enterprises in the selected communities in the Municipality that met the set criteria to obtain the sampling frame, upon which the sample size was statistically determined. The sampling frame had the names, telephone numbers and location of the respondents (enterprise operators) for easy identification and sampling. The survey obtained a total of 438 enterprises (that had not yet been passed through the selection criteria or the basic conditions) in the four study communities.

3.6.2 The Sampling Frame for the Focus Group Discussion

The entire membership of each men and women group covered in the study was equivalent to the sampling frame. Each group consisted between eight and ten members in each community.

3.6.3 Determination of Sample Sizes

The steps used to determine the minimum number of samples required for the study has been explained in this section of the chapter the methods adopted for the study.

3.6.3.1 Sample Size for the Cross-sectional Survey

The study enumerated all the energy-dependent enterprises in the selected communities in the Municipality that met the set criteria to obtain the sampling frame, upon which the sample size was statistically determined. The survey obtained a total of 438 enterprises in the four study communities (See Table 3.2). The sampling frames were the total number of units from each category likely to be included in the study; the expected frequency was 50 percent, confidence level 95 percent and confidence limits (interval) 5 percent.

Table 3.2: Number of Enterprises from the Study Communities

Enterprise	Boankra	Hwereso	Kubease	Adadientem	TOTAL
Chop bars	3	5	6	4	18
Provision stores	11	12	18	13	54
Metal Works/Welders	2	3	3	2	10
Bakery shops	0	2	2	1	5
Hair salons	4	5	8	3	20
Grinding mills	2	2	3	2	9
Spare parts shops	0	2	0	2	4
Tailoring (seamstress/dressmaking)	4	5	9	5	23
Barbering shops	2	6	5	3	16
Pharmacy shops	0	3	5	3	11
Carpentry shops/Sawmilling	1	3	4	2	10
Wood selling shops	0	3	3	2	8
Phone repair shops	2	2	4	3	11
Electrical and electronic shops	3	5	5	3	16
Charcoal selling	0	3	3	2	8
Palm oil extraction points	4	4	6	5	19
Shoe repairs/mending shops	3	5	7	5	18
Communal toilet	4	3	5	4	16
Water points	4	7	11	4	20
Clothes shops/boutique	0	5	6	5	12
Mechanic shop	1	2	1	1	5
School	4	2	26	5	37
Food vending shops	4	9	7	6	26
Meat and fish mongering	3	6	5	0	14

Mobile phone card shops	6	9	11	9	35
TOTAL	67	113	164	94	438

Source: Field Survey and Author's Construct, May 2015

Based on the basic conditions indicated under section 3.3.2, the study obtained a sample frame of 256 productive enterprises from 15 broad enterprise categories in from the four study communities; Boankra (46), Hwereso (71), Kubease (86) and Adadientem (53) Communities (See Table 3.3).

Table 3.3: Energy-Dependent Productive Enterprises

S/N	Category of Enterprise	Communities (a)				(b)
		Boankra	Hwereso	Kubease	Adadientem	TOTAL
1	Chop bars	3	5	6	4	18
2	Provision/Retail stores/shops	11	12	18	13	54
3	Metal Works/Welders	2	3	3	2	10
4	Bakery shops	0	2	2	1	5
5	Hair salons	4	5	8	3	20
6	Grinding mills	2	2	3	2	9
7	Tailoring	4	5	9	5	23
8	Barbering shops	2	6	5	3	16
9	Carpentry shops/Sawmilling	1	3	4	2	10
10	Phone repair shops	2	2	4	3	11
11	Electrical and electronic shops	3	5	5	3	16
12	Palm oil extraction points	4	4	6	5	19
13	Mechanic shop	1	2	1	1	5
14	Food vending shops	4	9	7	6	26
15	Meat and fish mongering	3	6	5	0	14
TOTAL		46	71	86	53	256

Source: Field Survey and Author's Construct, June 2015

Table 3.3 indicates that, the total number of energy-dependent productive enterprises in the four study communities, representing the sampling frame was 256. Lynch et al's formula below was used to determine a sample size from the population of 256 enterprises (Lynch et al. 1974).

$$n = \frac{NZ^2p(1-p)}{Nd^2 + Z^2p(1-p)}$$

Where: n= sample size; N= study population/number of energy-dependent productive enterprises in the study area; Z= the value of the normal variable/ no. of standard deviation units corresponding to confidence level (1.96) for a confidence level of 95% (See Table 2 in Appendix IV); p= the highest possible proportion (0.5); and d= the margin of error (0.05) (Refer to Appendix II for justification of choice of sample size formula). With a population of 256 productive enterprises from the study communities, the sample size was derived below:

$$n = \frac{256(1.96)^2 * 0.5(1-0.5)}{256(0.05)^2 + (01.96)^2 * 0.5(1-0.5)}$$

$$n = 154\ enterprises$$

Table 3.4: Sample Size of the Energy-Dependent Productive Enterprises

Category of Enterprise	Communities (a)				(b)	(n)
	Boankra	Hwereso	Kubease	Adadientem	TOTAL	Sample
Chop bars	3	5	6	4	18	11
Provision/Retail stores/shops	11	12	18	13	54	32
Metal Works/Welders	2	3	3	2	10	6
Bakery shops	0	2	2	1	5	3
Hair salons	4	5	8	3	20	12
Grinding mills	2	2	3	2	9	5
Tailoring	4	5	9	5	23	14
Barbering shops	2	6	5	3	16	10
Carpentry shops/Sawmilling	1	3	4	2	10	6
Phone repair shops	2	2	4	3	11	7
Electrical and electronic shops	3	5	5	3	16	10
Palm oil extraction points	4	4	6	5	19	11
Mechanic shop	1	2	1	1	5	3
Food vending shops	4	9	7	6	26	16
Meat and fish mongering	3	6	5	0	14	8
TOTAL	46	71	86	53	256	154

Source: Field Survey and Author's Construct, June 2015

a. To obtain the sample size of the individual enterprise (row level);

$$Total\ (a) at\ row\ level = \frac{Total\ (b) at\ row\ level}{Total\ study\ population\ of\ 256} * Total\ sample\ size\ (n)\ of\ 154$$

Example (refer to Table 4.4)

$$Sample\ size\ of\ chop\ bars\ (n) = \frac{18\ (i.e. 3+5+6+4)}{256} * 154$$

$$Sample\ size\ of\ chop\ bars = 11$$

The sample size of 154 enterprises was then distributed proportionally among the four communities as indicated in Table 3.5.

Table 3.5: Distribution of Sample Size

S/N	Category of Enterprise	Community								Sample	
		Boankra		Hwereso		Kubease		Adadientem			
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1	Chop bars	2	1.3	3	1.9	4	2.6	2	1.3	11	7.1
2	Provision/Retail stores/shops	6	3.9	7	4.5	11	7.1	8	5.2	32	20.8
3	Metal Works/Welders	1	0.6	2	1.3	2	1.3	1	0.6	6	3.9
4	Bakery shops	0	0	1	0.6	1	0.6	1	0.6	3	1.9
5	Hair salons	2	1.3	3	1.9	5	3.2	2	1.3	12	7.8
6	Grinding mills	1	0.6	1	0.6	2	1.3	1	0.6	5	3.2
7	Tailoring	2	1.3	3	1.9	6	3.9	3	1.9	14	9.1
8	Barbering shops	1	0.6	4	2.6	3	1.9	2	1.3	10	6.5
9	Carpentry shops/Sawmilling	1	0.6	2	1.3	2	1.3	1	0.6	6	3.9
10	Phone repair shops	1	0.6	1	0.6	3	1.9	2	1.3	7	4.5
11	Electrical and electronic shops	2	1.3	3	1.9	3	1.9	2	1.3	10	6.5
12	Palm oil extraction points	2	1.3	2	1.3	4	2.6	3	1.9	11	7.1
13	Mechanic shop	0	0.0	1	0.6	1	0.6	1	0.6	3	1.9
14	Food vending shops	2	1.3	6	3.9	4	2.6	4	2.6	16	10.6
15	Meat and fish mongering	1	0.6	3	1.9	4	2.6	0	0.0	8	5.2
TOTAL		24	15.6	42	27.3	55	35.7	33	21.4	154	100

Source: Author's Construct, June 2015

Table 3.5 thus indicates that, 24 (15.6%), 42 (27.3%), 55 (35.7%) and 33 (21.4%) energy-dependent productive enterprise owners were interviewed in Boankra, Hwereso, Kubease and Adadientem respectively.

Table 3.6: Distribution of Sample Size by Enterprise and Sex

S/N	Category of Enterprise	Community								Sample	
		Boankra		Hwereso		Kubease		Adadientem			
		M	F	M	F	M	F	M	F	M	F
1	Chop bars	0	2	0	3	0	4	0	2	0	11
2	Provision/Retail stores/shops	4	2	4	3	2	9	3	5	13	19
3	Metal Works/Welders	1	0	2	0	2	0	1	0	6	0
4	Bakery shops	0	0	0	1	0	1	0	1	0	3
5	Hair salons	0	2	0	3	0	5	0	2	0	12
6	Grinding mills	1	0	0	1	2	0	1	0	5	1
7	Tailoring	0	2	2	1	4	2	2	1	8	6
8	Barbering shops	1	0	4	0	3	0	2	0	10	0
9	Carpentry shops/Sawmilling	1	0	2	0	2	0	1	0	6	0
10	Phone repair shops	1	0	1	0	3	0	2	0	7	0
11	Electrical and electronic shops	2	0	3	0	3	0	2	0	10	0
12	Palm oil extraction points	0	2	1	1	1	3	2	1	4	7
13	Mechanic shop	0	0	1	0	1	0	1	0	3	0
14	Food vending shops	1	1	4	2	3	1	1	3	9	7
15	Meat and fish mongering	0	1	0	3	0	4	0	0	0	8
TOTAL		12	12	12	24	18	26	29	18	80	74

Source: Field Survey, September 2015

The males and females thus constitute 51.9% and 48.1% respectively, of the sampled operators of the productive enterprises.

3.6.3.2 Sample Size for Focus Group Discussion

According to Manoranjitham and Jacob (2007), the optimal number of participants for focus group discussion ranges between eight and ten. The number of participants selected from the men and women groups for the focus group discussions was thus inspired by the work of Manoranjitham and Jacob (2007). Ten members each group in the study communities were therefore selected.

3.7 Sampling Techniques

3.7.1 Cross-Sectional Survey

The simple random sampling technique was also applied to select the productive enterprises for the study, after obtaining the sampling frame and sample size. The application of the simple random sampling technique was made possible by the availability of sampling frame which identified the units of inquiry by their names and location. The simple random sampling technique was operationalised through the lottery method. The names of the enterprises/enterprise owners were written on pieces of paper and put in a box. The papers were drawn without replacement until the required number of each set of the units of inquiry was obtained. The sample distribution of the enterprise owners/operators ensured a fair representation of both gender. There was therefore no need for the researcher to intervene and thus allowed existing conditions to prevail.

3.7.2 Participatory Rural Appraisal

This technique was carried out by using focus group discussions. Members of the men and women groups were randomly sampled from the sample frame. The names of the operators were written on pieces of paper. These were then dropped in a box, shuffled and handpicked until the required number of members was obtained. These steps were repeated for the rest of the others that were covered in the focus group discussions.

3.7.3 Purposive Sampling of Key Informants

The institutions that were covered in the study were purposively selected. Their selection was based on their role in the formulation or implementation of policies, plans and programmes that affect energy supply and utilisation productive purposes; namely the Energy Commission, Ejisu-Juaben Municipal Assembly (EJMA) under which the District Planning Coordinating Unit (the EJMA), and the Electricity Company of Ghana division in the Municipality were selected.

3.8 Sources and Types of Data

Data gathering according to Burns and Groove (2003:373) is the precise, systematic gathering of information relevant to the research sub-problems, using methods such as interviews, participant observation, focus group discussion, narratives and case histories. The empirical phase, which involves the actual collection of data, is followed by preparation for data analysis (Polit and Hungler 2004:51). The study used both secondary and primary sources of data to answer the research questions. The secondary information was obtained through a desk study while the primary data were gathered through interviews with the use of structured questionnaires from enterprise owners.

3.8.1 Secondary Sources of Information

The secondary data were obtained from a review of scholarly works on the meanings and characteristics of rural within the agro climate zone of Ghana, role of energy in national development, typology of energy services available to rural communities and the productive uses of energy fuels. As indicated in the references, the sources of secondary data were articles in peer-reviewed journals, conference proceedings, book chapters, magazines and newspapers. The other sources of secondary data were published and unpublished documents such as books, project reports, government policy documents and theses. The information obtained from the secondary sources includes the energy access policies and programmes in Ghana, the theoretical underpinning of energy access policies, programmes and projects and the characteristics of the agro-climatic zones.

3.7.2 Primary Sources of Information

Primary data were gathered through a systematic process. Interview schedules and interviewer administered questionnaires were designed through pre-testing. The Interview schedules and interviewer administered questionnaires were further administered. The primary data were obtained from enterprise owners or operators through direct observation (with observational checklist), structured interviews with the units of inquiry, to enterprise operators that make use of varying energy forms in their activities. Semi-structured interview was adopted because not only does it result in high response rate but also ensures that each respondent understands the questions in the same manner. An observation checklist was also designed and used to gather part of the primary data. These instruments have been described in the subsections below. Key informant interviews and group discussions were also used to obtain data from experts and the relevant associations respectively.

3.9 Key Variables for the Research and Unit of Analysis

A variable is an empirical property which can take on two or more values (Frankfort-Nachmias and Nachmias, 1996:55). This therefore implies that, if a property can change either in quality or quantity, it can be termed as a variable in a research. Based on these, the research's variables their specific indicators as well as their relevance to the objectives of the research are further indicated in Table 3.7.

Table 3.7: Research Objectives and Variables

Variable	Definition/Indicators	Relevance	Units of Inquiry
a. To examine t he types of productive enterprises and their gendered usage of various e nergy services in the RNFE			
Typology and characteristics of productive enterprises	The forms of enterprises that meet the criteria specified in sub-section 3.3.2 that are energy-dependent	To provide an overview of the types of enterprises interviewed	Enterprise Owners/ Operators
	The scale of operation of the enterprises	The identify the number and sex of workers,	Enterprise Owners/Operators
	Beneficiaries of services of the enterprises	To identify the number and category of beneficiaries of the services rendered by the enterprises studied	Enterprise Owners/Operators
	Reasons for the establishment of the enterprises and start-up capital	To reveal the motive behind the establishment of the enterprise and the source of start-up capital of the enterprise	Enterprise Owners/Operators
	Enterprise Income/Returns	To identify the monthly income in Ghana cedis of enterprises To reveal operators' monthly incomes per decile.	Enterprise Owners/Operators
Energy Type, Supply and Utilisation	The forms/types of energy fuels by enterprises for productive use	To identify the various forms of energy fuels used by enterprise operators for various purposes	Enterprise operators, MPO, Municipal Energy Depart, ECG
	The end-user equipment	To identify the end-user equipment of the various enterprises	Enterprise operators
b. To examine the factors influencing enterpris e operators' preference for specific en ergy services in the RNFE			
Choice of energy fuel type for productive use and reasons for usage	The preferred energy type(s) and the reasons for such preference	To determine the factors that influence enterprise operators' choice of various energy fuels/forms for use	Enterprise Owners/operators
c. To assess the implications of the supply and ut ilisation of the energy services availabl e for productive use by enterprise operators in the RNFE			

Benefits, risks or challenges (if any) associated with the access to and use of the different energy fuels	The benefits, risks or challenges associated with the use of energy fuels	To have an overview of the benefits, risks and challenges of enterprise owners in using varied energy forms for activities	Enterprise Owners/Operators and Employees, MPO, Municipal Energy Depart, ECG

Source: Author's Construct, March 2015

3.9.1 Explanation of Research Objectives and Variables

a. Examining the types of productive enterprises and their gendered usage of various energy services in the RNFE

Largely, two variables are considered under the research objective. The firs variable "typology ad characteristics of productive enterprises" seeks to examine the energy-dependent enterprises in the selected communities; the kinds or types, the services provided, scale of operation in terms of labour strength, and beneficiaries of the service rendered by the respective enterprises.

Another variable considered is "the energy fuel type, supply and utilisation". The variable aims at identifying the forms or kinds of energy fuel used by men and women in their respective enterprises. It thus seeks to reveal in terms of frequency the dominant and least used energy fuel and for what respective service. For instance, if the dominant energy fuel is petrol, what service(s) is the identified fuel used for. Lastly, the variable seeks to also identify the end-user equipment of the identified energy form (technological factor).

b. Examining the factors influencing enterprise operators' preference for specific energy services in the RNFE

The variable considered is the "Choice of energy fuel type for productive use and reasons for usage". This variable unlike the two variables considered under the first research objective seeks to further reveal the factors that affect enterprises operators' decision to use a particular energy fuel at the expense of another. For instance, it is possible that two or more energy fuels can serve the same purpose or provide similar service. However, an enterprise may prefer using one fuel to the other fuels. This variable therefore seeks to identify the reason(s) for such decisions or preference.

c. Examining the implications of the supply and utilisation of the energy services available for productive use by enterprise operators in the RNFE

The usage of energy fuel has attendant risks, challenges or benefits. Three key variables are considered. Firstly, the variable "enterprise income or revenue" aims at revealing the incomes or returns of enterprises (gender disaggregated form) using specific energy forms. Thus, in terms of the energy fuels used, the incomes of the enterprises using them would be assessed. This would further be used to test the extent of influence of variation in income of the choice (quantity or energy type) of the energy fuel as posited by the traditional energy ladder. Also, the expenditure of enterprises on energy fuels will be examined. This would provide information on the proportion of enterprises expenditure on fuel to the revenue received. Lastly, the associated benefits, risks or challenges regarding the supply and usage of the specific energy fuels will be identified so as to aid in effective and efficient formulation of policies, programmes and plans or interventions to see to the safe deployment and usage of energy fuels.

3.10 Methods of Data Collection

3.10.1 Design of Interview Schedules and Guides and Training of Enumerators

The researcher designed interview schedules and interview guides to elicit the required responses from the enterprise owners and heads of relevant institutions. The questionnaire gathered information on enterprise characteristics, demographic and occupational characteristics, income and expenditure, energy, cost and end-use equipment and home-based enterprises. Following the design of the survey instruments, enumerators were trained in the administration of the instruments. The purpose of training was to ensure that enumerators understood the import of the questions and could easily translate them into the local languages to aid the collection of the right information.

3.10.2 Pilot Testing of Interview Schedules

The trained enumerators tested the interview schedules in one communities within the EjisuJuaben Municipality; Donaso. As part of the pre-testing, enumerators were to observe the time taken to administer each interview schedule, the responsiveness of participants and any difficulty experienced in understanding and interpreting the questions in the instruments. The results of the pilot testing helped to fine-tune the instruments before a second pre-test was undertaken. The essence of carrying out the second pre-testing was to ensure that all the relevant feedbacks received from enumerators during the first pre-testing were incorporated in the final instrument and to ensure improvement in the quality of the interview schedules. Having quality assured the interview schedules through the pilot testing; the trained

enumerators collected the required data from the 4 communities selected from the Ejisu-Juaben Municipality.

3.10.3 Design of Data Entry Template and Method of Data Analysis

The Statistical Package for the Social Sciences (SPSS) version 20 was used for the analysis of the survey data. The data entry personnel were trained in the use of the software. The software provides a framework that can be used to design templates to meet the specific requirements of the user, unlike others which are normally restricted and inflexible. The topics covered in the training included data collection, data entry, data consolidation, data storage, data management and data delivery. The trainees were taken through the process of the template design, the input of data into the software and redesigning of the template when the need arises. Trainees were educated on how the wrong data collected could negatively affect the outcomes of the project. The facilitator stressed the importance of first identifying the core questions in the questionnaire that should be addressed carefully to ensure that the importance of designing the template is not compromised with other questions of less importance. The trainees were also trained and asked to try entering the responses. The entry personnel who tried entering the data observed any anomalies in the data entry which informed the finalisation and approval of the template. The quantitative data gathered from owners of enterprises were synthesised with the use of SPSS. Descriptive statistics such as the measures of central tendency, percentages and frequency distribution tables were used to present the data.

3.11 Methods of Data Analysis

The analytical methods have been described in line with the research objectives used in the study.

3.11.1 Examining the types of productive enterprises and their gendered usage of various energy services in the RNFE

Data was collected from the enterprise operators in the study communities and relevant institutions on the type/kind of productive enterprise operated by men and women in the communities. In order to obtain credible responses, the first question each respondent was asked was “what type of activity are you engaged in and the outputs of your activity”. Each respondent was further asked to respond by stating the specific enterprise he/she was engaged in. Respondents were further asked to provide answers to relevant issues concerning

their activities; monthly income, expenditure, beneficiaries of their services, sources of startup capital, among others.

Respondents were again asked to indicate the energy services and end-user equipment they used in their respective productive activities. Where applicable, respondents were to indicate the monthly quantity of the energy type used. The Microsoft Excel and SPSS version 20 were used to generate the mean monthly quantities of the energy type used by the enterprises as well as determine the relationship (linear regression) between the quantity of the energy type used and monthly income of the enterprises. This was to help deduce the 'most lucrative' enterprise within the RNFE in the Ejisu-Juaben Municipality. Respondents were asked to explain how they utilised the energy services for their productive activities.

3.11.2. Examining the factors influencing enterprise operators' preference for specific energy services in the RNFE

Works by several authors and the energy ladder and stacking portfolio models have revealed that several factors affect households' choice of energy fuels; economic, social and technological. Respondents were therefore asked to identify the factors that influence their preference for the specific energy services. Respondents after identifying the factors were asked to rank them. A five-point Likert scale was then to ascertain the order of significance, the factors that influence the preference for an energy service to another. The scales used were: 5 –highly significant; 4- significant; 3-uncertain/indifferent; 2-insignificant; and 1-highly insignificant. Respondents were asked to explain the reason for assign a scale to a given factor. The Microsoft Excel was then used to generate the mean, standard deviation and co-efficient of variation to explain the responses given by the respondents in gender disaggregated form. The Pearson Chi-square test was further used to determine the degree of association between gender and the energy service type used. The Pearson Chi-square test was further run to test the hypothesis that "There is no significant association between the gender (men and women) and the type of energy service for productive use in the RNFE in the Ejisu-Juaben Municipality". This was accepted at $p \leq 0.05$.

3.11.3 Examining the implications of the supply and utilisation of the energy services available for productive use by enterprise operators in the RNFE

With reference to this research objective, the first question each respondent was asked was "Are there any implications (challenges or benefits associated with the supply and use of the energy

type?" Each respondent was further asked to respond either 'yes' or 'no' to the question. Given that the responses were either 'yes' or 'no', the SPSS software (version 20) was used for their analyses. Respondents were further asked identify and explain their responses. The analysis was carried out qualitatively by giving a comprehensive description of the implications associated with the supply and use of the energy type. Respondents were further asked if they had preference for alternative energy services. Each respondent was further asked to respond either 'yes' or 'no' to the question. Given that the responses were either 'yes' or 'no' , the SPSS software (version 20) was used for their analyses. The analysis was descriptive using frequency distribution tables and percentages. Respondents were then asked to give reasons on factors that affect the deployment of the alternative energy services they had preference for.

3.12 Ethical Considerations and Validity

3.12.1 Observation of Research Ethics

A letter introducing the study was obtained from the head of the Department of Planning at the Kwame Nkrumah University of Science and Technology. A duplicate copy of the introductory letter was given to the heads of the various institutions covered in the study. The institutions were thus adequately informed about the purpose of the study before interviews began. Owners of the selected enterprises and energy-dependent businesses were also given copies of the introductory letter. Prior to the interviews, the interviewees (i.e. the enterprise owners and employees) were briefed about the purpose of the study and the time needed to complete the questionnaire/interview guide. They were reassured that their responses would be treated with the deserving confidentiality. Participants were required to give their consents prior to the interviews upon agreeing to participate voluntarily in the study. They were required to complete an "informed consent form before the interviews began. By these arrangements, the rights of the respondents were respected. The authors of scholarly works which were referred to in writing this report/thesis were duly acknowledged in both the running texts and the references.

3.12.2 Validity of Findings

3.12.2.1 Internal and External Validity

Internal validity according to Tybout et al (1982) is "how well an experiment is done", with emphasis on whether it avoids confounding. Internal validity has been ensured by gathering data from diverse groups (i.e. primary stakeholders and the institutions) to understand the energy services available to and used by productive enterprises in the RNFE, the factors that influence preference for energy services and the implications associated with the supply and use of them. The data from these multiple sources provided completeness to the study.

External validity according to Drew and Hardman (1985) is the generalisability of the research, that is, the ability of its conclusions to be validly extended from the specific environment in which the research study is conducted to similar "real world" situations. External validity was also ensured by the choice of a representative sample for the study. The sample size has been based on 95 percent confidence level and 5 percent error margin. The representativeness of the samples, the appropriateness of the sampling techniques and the mixture of methods for the collection of data make the results appropriate for generalisation.

3.11.2.2 Triangulation

Triangulation in research is broadly defined by Denzin (1978:291) as "the combination of methodologies in the study of the same phenomenon". Triangulation further refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings. The study ensured data triangulation by obtaining data through several sampling strategies, so that slices of data at different times and social situations, as well as on a variety of people, are gathered. Also, investigator triangulation was also enhanced by using more than one researcher in the field to gather and interpret data. Lastly methodological triangulation was also carried out by using more than one method for gathering data; observation, interviews and focus group discussions.

3.12 Analytical Framework

Analytical framework is a frame which aids and directs the various processes from the literature search to stage where the final report is done (Best and Kahn, 1993). The sequence of the study from literature review, research design, pre-testing and pilot survey to the final report is depicted by Figure 3.2. The research instruments (interview guides and intervieweradministered questionnaires) were modified by pilot survey before the actual survey was undertaken to gather the required data. After the data collection, the analysis was executed using both qualitative and quantitative methods.

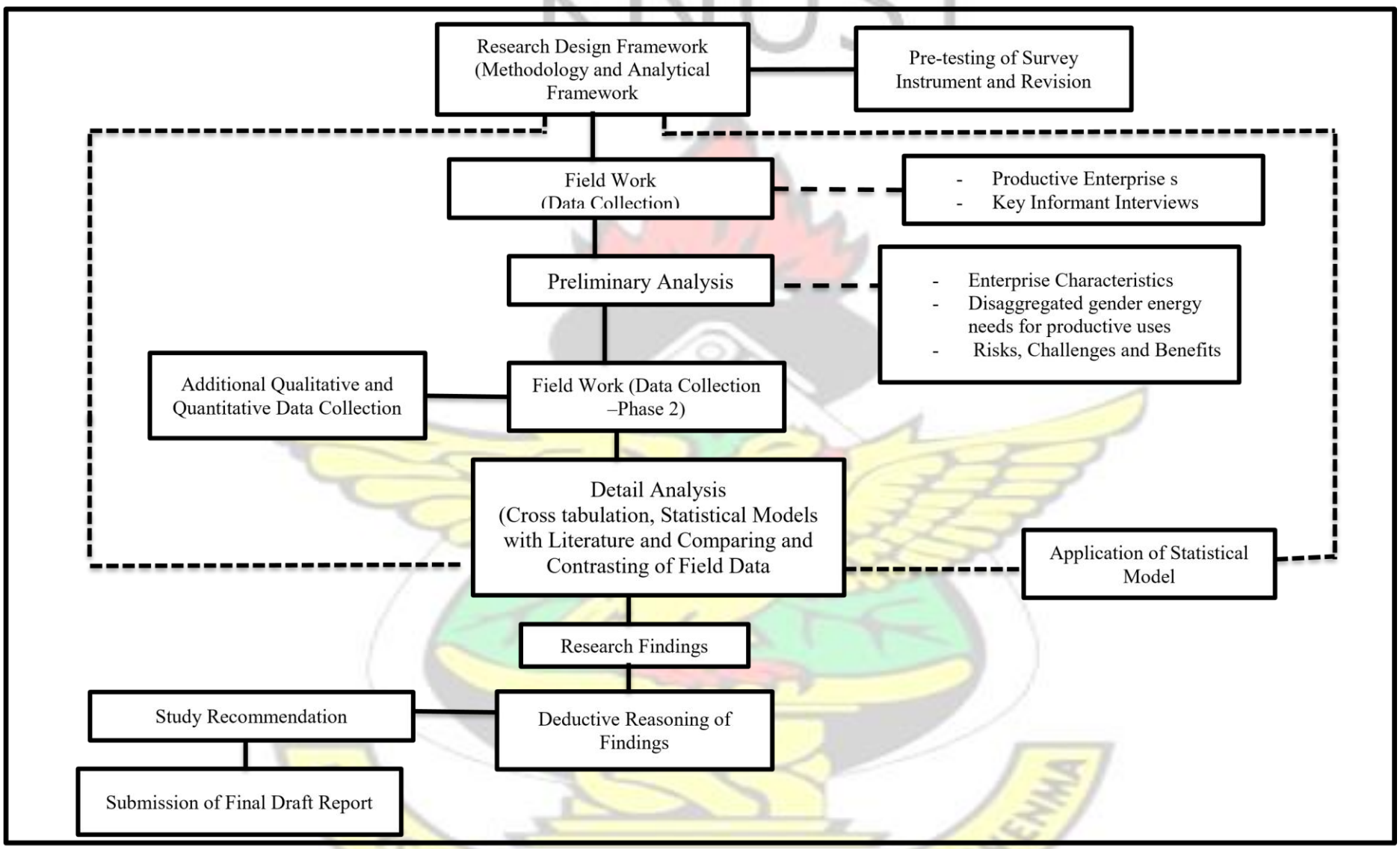


Figure 3.2: Analytical Framework for the Study

Source: Author's Construct, 2015

After the first data collection on both quantitative and qualitative variables as indicated in Figure 3.2, an initial analysis was carried out to reveal the patterns and relate to the literature. The preliminary analysis covered the characteristics of the productive enterprises, the disaggregated gender energy needs for productive use and the risks, challenges or benefits associated with the use of the varied energy fuels. The gaps identified led to a further collection of data from the field to address outstanding issues. The comprehensive data were then analysed, using cross-tabulations and other statistical models, where applicable. The findings of the study were further related to the literature. The relevant recommendations were made and the contribution of the study outlined and areas for future research were presented. The next chapter presents the analysis of the field data and how they assist the researcher answer the research questions.

CHAPTER FOUR

PROFILE OF THE EJISU-JUABEN MUNICIPALITY

4.1 Introduction

This chapter provides an overview of the study area from which the methods were applied. The profile of the Ejisu-Juaben Municipality specifies its location, the population size of the municipality, and the energy supply and utilisation situation for productive purposes in the municipality. The chapter also provides a description of the available energy services as well as energy-dependent productive enterprises in the Municipality.

4.2 Location and Size of the Ejisu-Juaben Municipality

The Ejisu–Juaben Municipality lies within latitudes 1^{o} 15'N and 1^{o} 45'N and longitudes 6^{o} 15'W and 7^{o} 00 W. Occupying a land area of 637.2 km^{2}, the Municipality lies in the central part of the Ashanti Region sharing boundaries with six Districts in the Region; Sekyere East and Afigya Kwabre to the Northeast and North-West respectively; the Bosomtwi and Asante Akim South Districts to the South; the Asante Akim North to the East and the Kumasi Metropolitan Assembly to the West (See Figures 4.1 and 4.2). Ejisu- Juaben Municipality is located 20 km from Kumasi on the Kumasi-Accra highway. It is one of the 31 administrative and political MMDAs in the Ashanti Region with Ejisu as its capital. The Municipal area has a relatively high population density of about 225.6 per sq. kilometer. This is because the

Municipality has become a "dormitory" of the Kumasi metropolis as large number of people live in the municipal area but commute to Kumasi to work. The Ejisu-Juaben Municipality offers available land for development of residential and industrial settlements with attractive transport facilities, labour and agricultural products for daily consumption in the Kumasi Metropolis. The interrelationship enhances the Municipality opportunities for investments from local, national and international investors. Further, the Boankra Inland Port and the industrial Free Zone are major projects that will stimulate development in the Municipality if implemented.

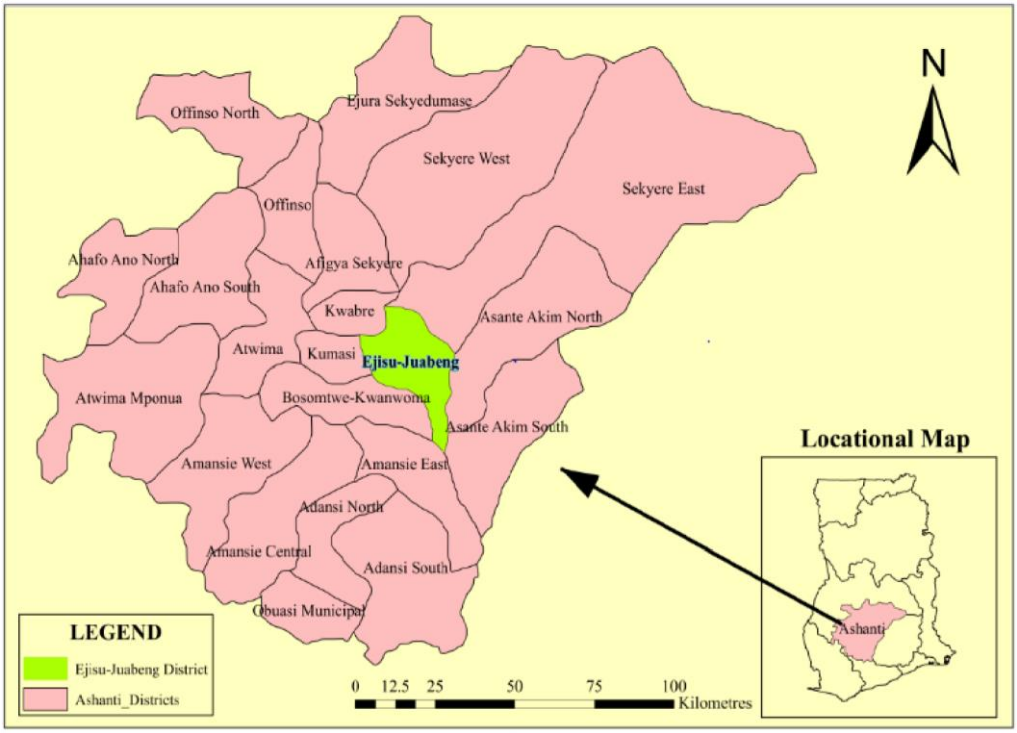


Figure 4.1: Map of Ejisu-Juaben Municipality in Regional Context

Source: EJMA DMTDP 2010

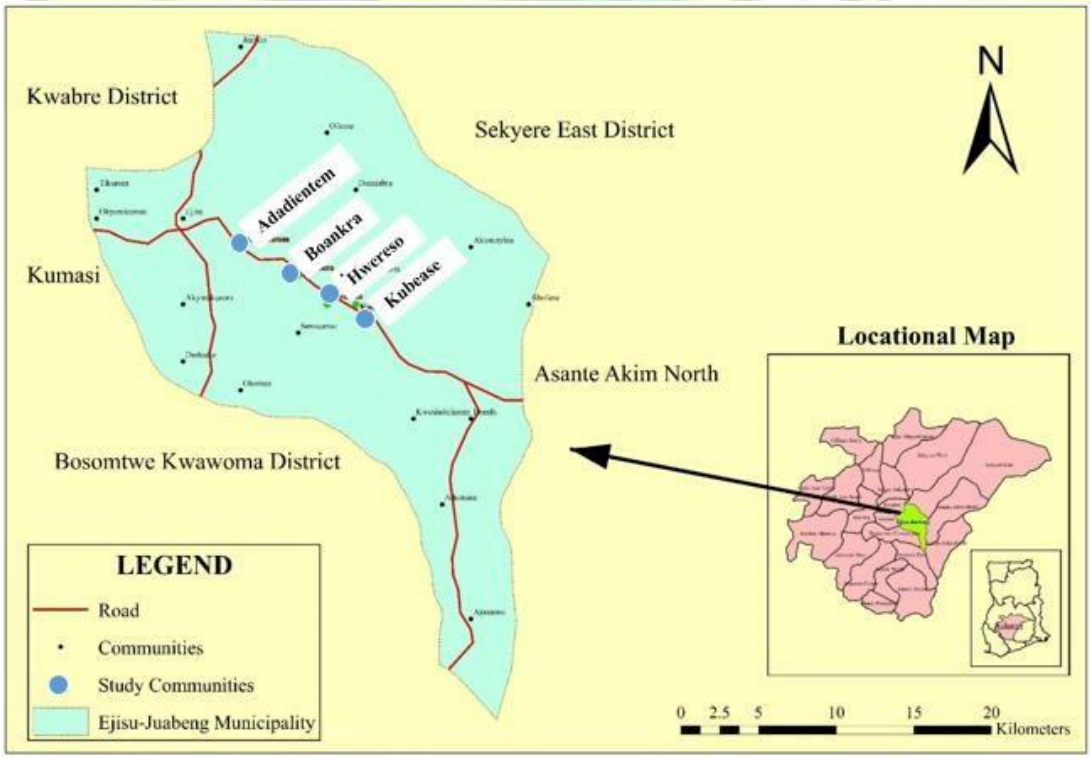


Figure 4.2: Map of Ejisu-Juaben Municipality

Source: EJMA DMTDP 2010 and Author's Design, 2015

4.3 Vegetative Cover

The Municipality lies in the semi-deciduous forest zone of Ghana. The flora and fauna is diverse and composed of different species of both economic and ornamental tree species with varying heights and game and wildlife. The trees shed their leaves during the dry season. The Bobiri Forest Reserve for example is renowned for its butterfly species, greenery and varied flora and fauna. In many places, the forest cover has become secondary forest. The situation is worse in and around Ejisu, Adadientem, Onwe and Manhyia where savannah-like conditions now prevails. The loss of vegetation cover, poor land management practices and heavy torrential rains have led to erosion in some communities including Besease, Kwaso and Ejisu.

4.4 Demographic Characteristics and Sex Distribution

The 2000 National Population Census put the population of the Municipality at 124,176 comprising 59,286 males and 64,890 females. According to the Ghana Statistical Service (GSS, 2012) 2010 Population and Housing Census, the population of the Municipality at 143,762 with 68,648 males (representing 47.8%) and 75,114 females (representing 52.2%). The growth rate between the two inter-censual periods is therefore 1.45%. Majority 104,197 (72.5%) of the population are in the rural areas while 39,565 (27.5%) of the population are in urban areas. According to Ejisu-Juaben Municipal Assembly (EJMA, 2010), the dominance of females may be because many females migrate from the adjoining rural areas and districts to the metropolitan periphery of Kumasi to engage in hawking and petty trading in the metropolis while men move to settle in Kumasi and other cities in search of jobs. It is important to take note of the fact that, not only because men and women have different energy needs, but also because women and men have different access to resources and decision-making. It should be once again stated that the energy-poverty nexus has distinct gender characteristics.

4.5 Spatial Distribution of Population and Rural-Urban Split

Approximately 73% of the entire population; i.e. 104,197 people in the Municipality as at 2010 resided in rural areas (GSS, 2012). This thus indicates that approximately 27% live in the urban centers. The municipal area has eighty-four (84) settlements out of which five (5) were classified urban settlements; Ejisu, Juaben, Bonwire, Fumesua and Kwamo. Over the last decade however, the municipal area has experienced increasing urbanization, a phenomenon that has changed the typical rural Ejisu-Juaben Municipality into a fast growing peri-urban Ejisu-Juaben Municipality. Some of the major towns include Ejisu, Juaben, Kwamo, Fumesua, and Besease. An analysis of the population figures from 1960 to 2000 shows that the Municipality was transformed from a typical 100% rural setting to peri-urban status. Demand

for land for both domestic and commercial purposes is on the increase. These coupled with some other economic activities are on the increase along the major roads and towns within the Municipality.

Table 4.1: Rural-Urban Split

	Population	Urban	%	Rural	%
Ejisu-Juaben Municipal	143,762	39,565	27.5	104,197	72.5

Source: Ghana Statistical Service (2012), 2010 Population and Housing Census of Ghana

4.6 Socio-Economic Characteristics

The local economy exemplifies the national economy. Even though it is agricultural dominated, it is increasingly becoming service and commerce based. It is very fragile and vulnerable to movements in the formal sector. Most people in the municipal area engage in agriculture, commerce, services, and industry. Analysis of the 2010 Population and Housing Census show that while agriculture employs about 62.5 percent of the working population, commerce and services employs about 31.7 percent. The remaining 6.8 percent of the populace are engaged in industry (GSS, 2014). The study thus sought to identify the energy services available for productive use in some of these establishments.

4.7 Energy Consumption and Development

Energy-intensive and dependent enterprises or business require energy to sustain their operations. Premised on this, the study examined the energy needs of men and women for productive purposes in the Ejisu-Juaben Municipality. The chapter therefore identified various energy fuels; electricity, wood fuels and petroleum products (petrol, diesel oil and liquefied petroleum gas), that are currently available and utilised for productive purposes in the EjisuJuaben Municipality. The 2009 Socio-Economic Survey by the Ejisu-Juaben Municipal Assembly revealed that more than 87% of industrial concerns use electricity as their main source of energy (EJMA, 2010). The remaining 13% use other sources including diesel. The frequent power outages and fluctuations is a major bother to industrialists. Tables 4.2 and 4.3 depict the energy forms used for lighting and cooking in the Ejisu-Juaben Municipality in general and in rural localities for domestic purposes. The sources of energy for lighting by dwelling units in the municipality are electricity (69.4%), flash light/torch (16.5%) and kerosene lamp (11.5%). A higher proportion of urban households (79.7%) than rural households (65.1%) use electricity. On the other hand, rural households are more likely than urban households to depend on flash light/torch and kerosene lamps.

Table 4.2: Main Energy Fuels for Lighting

Source of lighting fuel	Total Number of Households	Percent	Urban (%)	Rural (%)
Electricity (mains)	22,952	69.4	79.7	65.1
Electricity (private generator)	238	0.7	0.8	0.7
Kerosene Lamp	3,817	11.5	6.8	13.5
Gas lamp	66	0.2	0.1	0.2
Solar energy	57	0.2	0.3	0.1
Candle	341	1.0	1.1	1
Flashlight/torch	5,457	16.5	11.1	18.7
Firewood	63	0.2	0.1	0.2
Crop residue	17	0.1	0	0.1
Other	70	0.2	0	0.3
Total	33,078	100	100	100

Source: Ghana Statistical Service (2012), 2010 Population and Housing Census

Furthermore, the main sources of cooking fuel for households in the Municipality are Wood (44.5%), charcoal (33.3%) and gas (14.9%). The proportion of households using wood is much higher in rural areas (55.0%) than in urban areas (19.1%). On the contrary, the proportions of households using gas and charcoal are much higher in urban areas (27.3 percent and 45.1 percent respectively) than in rural areas (9.8 and 28.5 percent respectively).

Table 4.3: Energy for Cooking

Source of Cooking Fuel	Total Number of Households	Percent	Urban (%)	Rural (%)
None/No cooking	1987	6	6.9	5.6
Wood	14,724	44.5	19.1	55
Gas	4,928	14.9	27.3	9.8
Electricity	121	0.4	0.4	0.4
Kerosene	102	0.3	0.4	0.3
Charcoal	11,024	33.3	45.1	28.5
Crop Residue	104	0.3	0.3	0.3
Saw Dust	37	0.1	0.2	0.1
Animal Waste	8	0.0	0.0	0.0
Other	43	0.1	0.3	0.1
Total	**33,078**	**100**	**100**	**100**

Source: Ghana Statistical Service (2012), 2010 Population and Housing Census of Ghana

The major problem facing the electricity production and supply in the municipality is the intermittent and unreliable nature of the power supply which affects production activities. Again, the environmental threat caused by the cutting down of trees and their effect on the depletion of the environment continue to be of great concern to the Assembly. To address this problem, liquefied gas is now becoming a popular source of energy for cooking in the urban and peri-urban centres. This is mostly used by the middle income earners. Petrol and diesel are mostly used by the transport sector.

Boankra, Kubease, Hwereso and Adadientem are found along the Kumasi-Ejisu-Accra road (N6). They are located about 180km away from the national capital; Accra. The population of the study communities are below the threshold population of 5,000; thus indicating their rural nature. Kubease with a growth rate of 3.4% is estimated to have a population of 2,975 in 2015; 786 for Boankra (with a growth rate of 1.01%); 603 for Adadientem (with a growth rate of 0.435%) and 1127 for Hwereso (with a growth rate of 0.89%. Industrial and infrastructural development is anticipated to occur in Boankra due to the investment in constructing the Boankra inland port. This would promote the establishment of energy-intensive and productive enterprises to take advantage of the investments. The Bobiri Forest Reserve now famous for its butterfly sanctuary is found at Kubease which serves as tourist site to promote development. Adadientem due to its proximity to the Municipal capital is experiencing rapid infrastructural and industrial development.

The private informal sector (86.9%) is the largest employer in the study communities (EJMA, 2010). According to the EJMA (2010), a greater proportion of the population the study communities; Boankra (83%), Kubease (68.1%), Adadientem (65%) and Hwereso (63.7%) are engaged in agriculture. The remaining are engaged in commerce, services, and industry. There are two main types of agricultural practice namely; crop farming (food and cash crops farming) and animal husbandry. Most households practice a mixture of the two. Majority of farmers (more than 90%) are food crop farmers (GSS, 2014). The service and commerce sector includes food preparation, car repairs and washing, welding, craft, retail vending, banking, hospitality, tourism, communication, ICT, among others. Electricity (mains) is the major source of lighting for about 70.2% percent of households in the communities, followed by flash light/touch (21.2%) and kerosene lamp (9.5%). The main sources of cooking fuel for households in the communities are charcoal (33.3%) firewood (44.5%), and gas (14.9%).

4.8 Conclusion

Electricity is the dominant energy source of lighting in the Municipality, whereas wood fuels represent the major energy form for cooking activities, particularly at the household level (for domestic purposes). Thus high demand for goods and services and expansion of cleaner energy (primarily electricity) has contributed to the proliferation of energy-intensive enterprises in the Municipality. These energy forms that are available in the Municipality at the household level also exist for productive uses. The choice of energy fuel for productive purposes by enterprises have several determinants which the study sough to identify.

CHAPTER FIVE

DATA PRESENTATION AND ANALYSIS OF ENTERPRISES AND ENERGY FOR PRODUCTIVE USE

5.1 Introduction

This chapter of the study presents the analysis of the productive enterprises and specific energy forms in gender disaggregated form. It details the energy forms supplied and utilised by the enterprises, the types and characteristics of the enterprises, background of enterprise operators, sources of start-up capital, reason for enterprise establishment, the labour strength, income distribution, as well as the registration status of the enterprises. The chapter provides both quantitative and qualitative description of the mentioned issues.

5.2 Socio-Demographic Background of Enterprise Owners

This sub-section highlights socio-demographic characteristics: age-sex structure, educational attainment, and marital status of the enterprise operators.

5.2.1 Age and Sex Profiles of Enterprise Operators

The study revealed that male operators of the enterprises were 3.8% more than their female counterparts as depicted by Table 5.1. The proportion of the male operators was 51.90% compared to 48.10% of their female counterparts. This reveals a sex ratio of 92.50%, implying that for every hundred male operators there are approximately, 92 female operators). The study revealed that there is almost "female-male parity" in the operation of energy-dependent productive enterprises. This could suggest that males are the "bread winners" of households and so engage in various productive enterprises to cater for the household. This therefore supports the assertion of the Institute of African Studies (2012) in explaining the concept of households within African societies; that men as household heads and decision makers are the sole bread winners of the household.

Further, cross tabulation between the gender of the owners and operators and the enterprises revealed variations with respect to the kinds of productive enterprises (See Figure 5.1). Females mostly dominated the food preparation enterprises: chop bars, meat and fish mongering; while the males dominated the metal, electrical, and carpentry shops. A study of businesswomen in Kampala by Kwagala (1999) revealed that the majority of women specialise in merchandise

and services that relate to their gender-prescribed roles in the domestic sphere, including food, childcare and dressing. Focus group discussions with men and women group in the study communities revealed that, women at the rural community are undertake household chores: cooking, fetching water, taking care of children, etc.; whiles men were to work and provide the needs of the households or family. At the enterprise level however, everyone was 'free' to engage in any enterprise of choice. However, a respondent in the women group had this to say: "*As for me, though I can undertake any activity I want, I however do what I do now (food vending) because I should make time to help the family farm and take good care of my children, and besides that is what I can do best since I have been cooking all my life".* This confirms similar findings of Amu (2008); FAO (2005a); Duncan (2004) and Anokye and Afrane (2014) that the kinds of activities men and women engage in are defined by the socio-cultural and traditional set up of the locality.

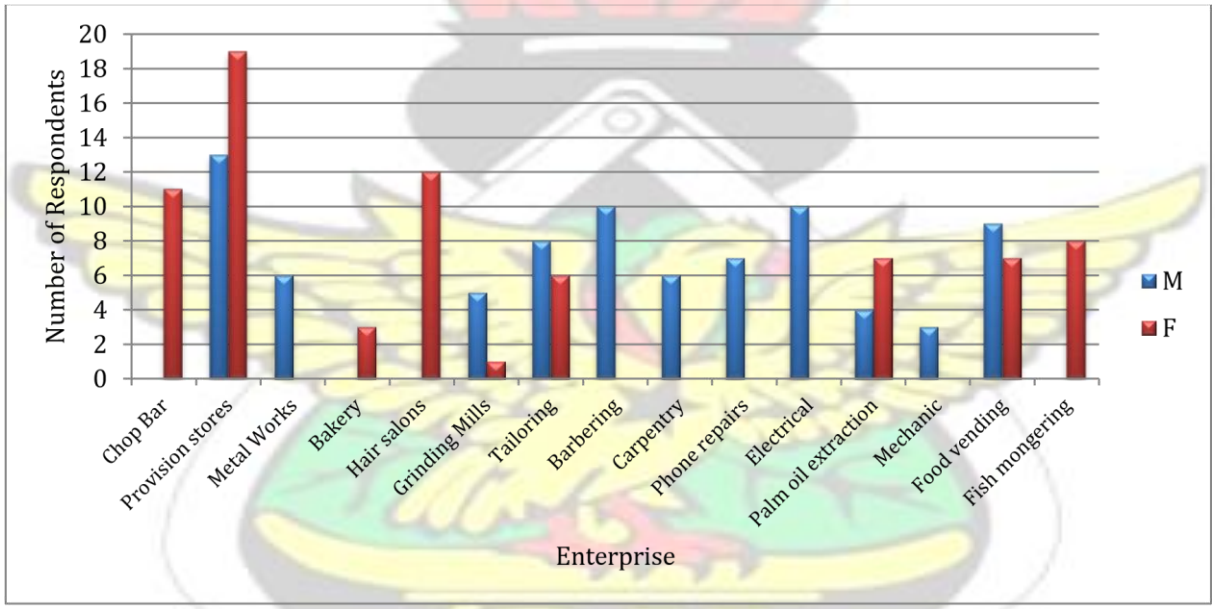


Figure 5.1: Sex Distribution by Enterprise

Source: Field Survey, July 2015

The age structure from the survey revealed that about 94.81% (146 people) of the sample population is in the working age group (15 – 64 years). The remaining 5.19% are found in the 65+ age bracket which that none of the respondents was within the 0-14 year age group. Comparatively, 46.71% (72 out of 154 respondents) and 48.10% (74 out of 154 respondents) females and males respectively, are within the active age group.

Table 5.1: Age-Sex Structure of Enterprise Operators

Sex/Age	15-64	65+	Total

	#	%	#	%	#	%
Male	74	48.10	6	3.89	80	51.90
Female	72	46.71	2	1.30	74	48.10
Total	146	94.81	14	5.19	154	100.00

Source: Field Survey, July 2015

A further analysis revealed a mean age of 26.45years and 23.91years for males and females respectively. This shows that the age structure depicts a youthful group. The Ministry of Youth and Sports (2010) defines 'youth' as "persons who are within the age bracket of fifteen (15) and thirty-five (35)".

5.3 Enterprise Characteristics

5.3.1 Kind of Enterprise, Core Enterprise Activity and Labour Strength

Generally, 15 categories of enterprises were revealed by the study ranging from food-based, electrical to metal-based enterprises (see Table 5.2). As discussed, these enterprises are energydependent. Whiles some of the enterprises were mostly dominated by a man or woman, other enterprises had composition of both gender. Table 5.2 further shows that the food-based enterprises; chop bars, food vending shops, fish and mongering activities were dominated by women. This in a way suggests the socio-cultural responsibility of women who at the rural household level are confined to the preparation of food for the household and other domestic activities as revealed by Amu (2008). The men however dominated the non-food sectors; metal works, mechanic, electrical shops, among other energy-dependent activities.

Table 5.2: Enterprise Category by Gender and Average Labour Strength

S/N	Category of Enterprise	Gender				Average Labour Strength
		Male		Female		
		#	%	#	%	
1	Chop bars	0	0	11	7.1	3
2	Provision/Retail	13	8.4	19	12.3	2
3	Metal Works	6	3.9	0	0	2
4	Bakery shops	0	0	3	1.9	2
5	Hair Salons	0	0	12	7.8	3
6	Grinding mills	5	3.2	1	0.6	2
7	Tailoring	8	5.2	6	3.9	3
8	Barbering shops	10	6.5	0	0	1
9	Carpentry shops	6	3.7	0	0	3
10	Phone repair shops	7	4.5	0	0	2
11	Electrical shops	10	6.5	0	0	3
12	Palm oil extraction	4	2.6	7	4.5	3
13	Mechanic shop	3	1.9	0	0	3
14	Food vending shops	9	5.8	7	4.5	1
15	Meat and fish mongering	0	0	8	5.2	1

TOTAL	**80**	**51.9**	**74**	**48.1**	**2**

Source: Field Survey, July 2015

Table 5.2 reveals that about 51.9% of the enterprises are run by men compared to 48.1% of them being run by women. This shows a fairly equal access to energy-dependent productive enterprises. Out of this, 67.9% and 70.6% are operated by females in the rural setting and nation respectively. According to Baah-Boateng (2009), women in Ghana face difficulties in accessing waged employment as a result of their preference for "flexible types of employment"; particularly self-employment which provides the option to combine market work and home production. The UNDP (2012) further asserts that "an improved share of women in rural nonagricultural wage employment (rural non-farm enterprise) has implication on income of women and their empowerment since earnings are estimated to be higher in wage employment than other types of employment". Women's share in non-agricultural wage employment is higher in urban than in rural areas and higher among the youth than older-age group.

Furthermore, the labour strength of the enterprises was also assessed to know the average number of employees each category of enterprise had. The establishment of the productive enterprises has further created employment opportunities for the labour force of the communities (Table 5.2). It was observed that, the labour strength of an enterprise ranged between 1 and 3 as shown in Table 5.2. It was also realised that the enterprises employed an average of two employees. The labour strength of the enterprise can influence the energy fuel utilised by the enterprise. If the extra hands employed would be paid at the end of every month, it has an effect on the operational cost of the enterprise. This therefore has implications on the quantity of the specific energy fuel been utilised by the enterprise. The study on the other hand revealed that the workers employed in some of the identified enterprises (hair salons, mechanic shops, tailoring, and carpentry) were basically apprentices who were currently under training. Therefore, the non-payment of regular wages permitted enterprise operators to engage many apprentices, confirming study by Anokye and Afrane (2014).

5.3.2 Beneficiaries of Services and Reasons for the Establishment of the Enterprises The research revealed that the services provided by the productive enterprises operating were largely significant for the inhabitants of the communities and other households and residents in the other nearby communities. Interviews and observations revealed that metal workers produced traditional stoves which were sold to the general public, whiles the food-based enterprises cooked prepared food for sale. The metal and mechanic workers fixed vehicles and provided other relevant (related) services to the general public. The oil palm extractors

produced palm oil for sale within and outside the respective communities, whiles the fish and meat mongers processed fish and meat for sale both within and outside their communities. The fish and meat mongers used firewood to smoke fish and meat, using a special type of stove manufactured by local artisans from metallic drums. Fish and meat smoking was done in the open and in the day time. Thus, the enterprise owners did not require any form of lighting to run their commercial activities. This thus suggests that, "not only are the enterprises significant sources of livelihood to the rural dwellers but also important sources of commodities for the urban economy as a whole because the benefits of these enterprises have a wide scope of beneficiaries living outside the communities".

Basically, economic reasons and the quest provide support to supplement other household incomes were the major reasons for the establishment of the enterprises within the rural communities. As noted by Hull (2009) and Ayerakwa (2012), enterprises in rural areas are informal economic activities which are characterised by 'free entry and exit'. The enterprises were owned either by individuals or households and therefore had the luxury of quitting or closing down the enterprise when the need should arise.

5.3.3 Source of Start-up Capital of Enterprises

The Ghana Statistical Service (2014) indicates that the dominant source of capital for non-farm enterprises is household savings (73.0%); followed by support from relatives or friends (14.6%), proceeds from family farms (4.6%), banks (1.9%), among others. This trend is similar to enterprises captured by the study where the predominant source of capital was personal/family savings (83; 54%) as shown in Table 5.3. Furthermore, about 27% (41 respondents) of the operators established their enterprises with funds from relatives and friends, whiles 16% (24) and 6% (9) did so with capital from proceeds from family properties and remittances respectively. Thus the dominant sources: personal savings and support from relatives confirmed GSS (2014) data on the two dominant sources of start-up capital for the establishment of non-farm enterprises in Ghana.

Table 5.3: Source of Start-up capital of Enterprise Operators

Source of Start-up capital	Male		Female		Total	
	#	%	#	%	#	%
Personal Savings	44	55	39	53	83	54
Relatives/Friends	21	26	17	23	41	27
Proceeds from family properties	13	16	11	15	24	16
Remittances	2	3	7	9	9	6
Total	80	100	74	100	154	100

Source: Field Survey, July 2015

The study revealed no disparity among gender in terms of source of start-up capital for enterprise establishment as shown in Table 5.3. Thus, both gender in order of significance obtained start-up capital from personal/household savings, assistance from relatives/friends, proceeds from family properties and remittances. This implies that the four identified sources are important to the establishment of rural non-farm enterprises.

5.3.4 Enterprise Average Monthly Income and Expenditure Patterns

5.3.4.1 Monthly Incomes of Enterprises

Analysis of enterprise incomes indicated a mean monthly income of GH¢ 390.51[1] (equivalent to US$ 104.11) which is about four times lower than the national average of income from nonfarm enterprises of GH¢ 1,518.10 (equivalent to US$ 408.64) (GSS, 2014). Furthermore, it was revealed that none of the productive enterprises earned equal to or more than the national monthly mean income of GH¢ 1,518.10.

Table 5.4: Mean Monthly Income of enterprise operators

Decile Grouping	Range (GH¢)	Number	Percentage (%)
1	0 -100	2	1.3
2	101 – 200	32	20.78
3	201 – 300	48	31.17
4	301 – 400	39	25.32
5	401 – 500	21	13.64
6	501 – 600	6	3.9
7	601 – 700	3	1.95
8	701 – 800	2	1.3
9	801 – 900	0	0
10	901 – 1000	1	0.64
Total		**154**	**100**

Source: Field Survey, July 2015

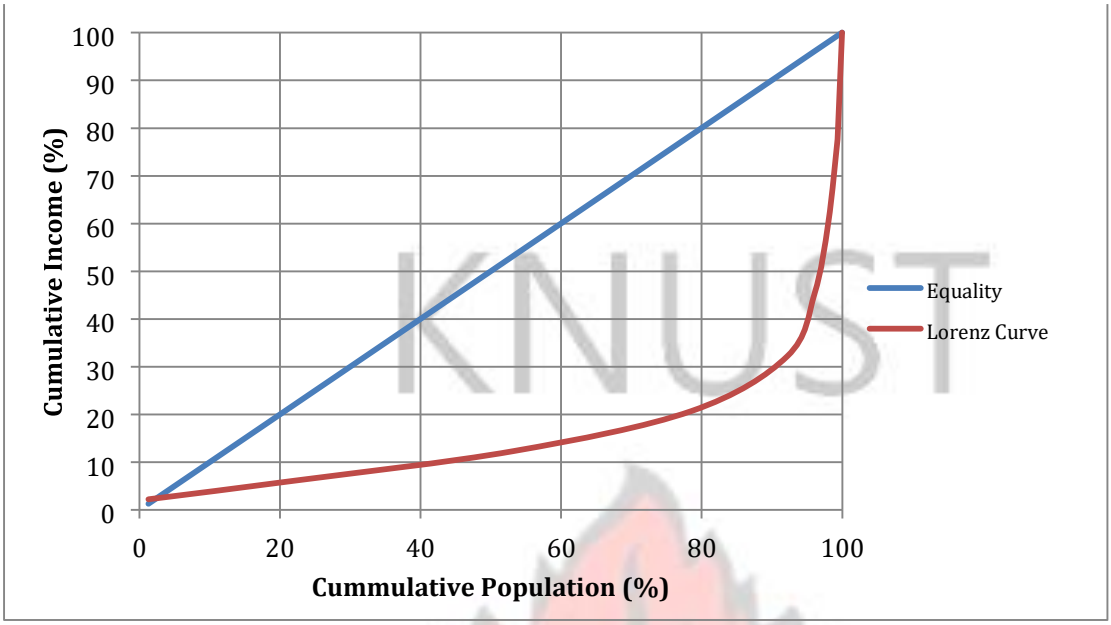


Figure 5.2: Lorenz Curve on Income Distribution

Source: Field Survey, July 2015

GINI Co-efficient of 0.64

[1] 1 USD to GHS to 3.715 USD as at October 5, 2015

The Lorenz is an economic tool used to depict and describe the inequality in wealth or income distribution. It is a function of the cumulative proportion of ordered individuals mapped onto the corresponding cumulative proportion of their income or wealth. The tool makes an assumption that if all individuals are of the same income, the Lorenz curve is a straight diagonal line, called line of equality (line of equal distribution) (FAO, 2005b; Kleiber, 2005; Kleiber and Kotz, 2002; Lambert, 2001). If there is however inequality in size, then the curve falls below the line of equality. The total amount of inequality can be better explained by the GINI co-efficient or ratio which is the ratio between the area enclosed by the line of equality and the Lorenz curve, and the total triangular area under the line of equality. The lower the ratio or closer to 0, the greater the equality, and vice versa.

The Lorenz Curve was thus further used to assess the distribution of incomes among the enterprises. It was identified that about 92% of the enterprise operators had about 33% of the total enterprise income; whereas the top 8% commanded 67% of the total enterprise income (See Table 5.5 and Figure 5.4). A further analysis revealed that the earnings of the enterprises within the income last decile commanded about 22% of the enterprise income. This therefore implies that, enterprises' higher incomes were influenced by the high incomes of earned by the

top 8% of the operators. Gender-wise, the study revealed that about 85% of the enterprises operated by females had about 45% of the total enterprise income (operated by females) whiles the top 15% controlled 55% of the total enterprise income. On the other hand, about 73% of the operators of the enterprises operated by males had about 21% of the total enterprise income (operated by males), while the top 27% controlled the remaining 79% of the total enterprise income. Thus income was fairly distributed among the female operators than the males (see Appendix VII and VIII respectively).

Furthermore, the mean monthly income was highest among the mechanic shop operators GH¢ 816.66 which is about 46.2% lower than the national average of GH¢ 1,518.10. The figure (GH¢ 816.66) was however about 74.3% higher than the mean monthly income earned by operators of the barbering shops (GH¢210.00) who happen to earn the least monthly income as shown in Table 5.6. Table 5.5 further shows that the female-dominated enterprise that ranked first among the enterprises (operated by both gender) was the bakery enterprise, with a mean monthly income of GH¢383.33. This (GH¢383.33) compared to the mean monthly earnings of the male-dominated mechanic shop (GH¢816.66 which is ranked first of the male dominated enterprise) is about 53% lower. The analysis further revealed that the top three enterprises that earned the highest monthly incomes were male-dominated (or operated only by males; mechanic shops, metal workers and carpentry/sawmill enterprises) (see Table 5.5).

Table 5.5: Mean Monthly Enterprise Income of Enterprises

S/N	Category of Enterprise	Median	Rank
1	Chop bars	377.27	7th
2	Provision/Retail stores/shops	234.37	14th
3	Metal Works/Welders	525.00	2nd
4	Bakery shops	383.33	6th
5	Hair salons	366.67	9th
6	Grinding mills	375.00	8th
7	Tailoring	471.42	4th
8	Barbering shops	210.00	15th
9	Carpentry shops/Sawmilling	516.67	3rd
10	Phone repair shops	250.00	13th
11	Electrical and electronic shops	275.00	11th
12	Palm oil extraction points	463.63	5th
13	Mechanic shop	816.66	1st
14	Food vending shops	265.62	12th
15	Meat and fish mongering	318.75	10th

Source: Field Survey, July 2015

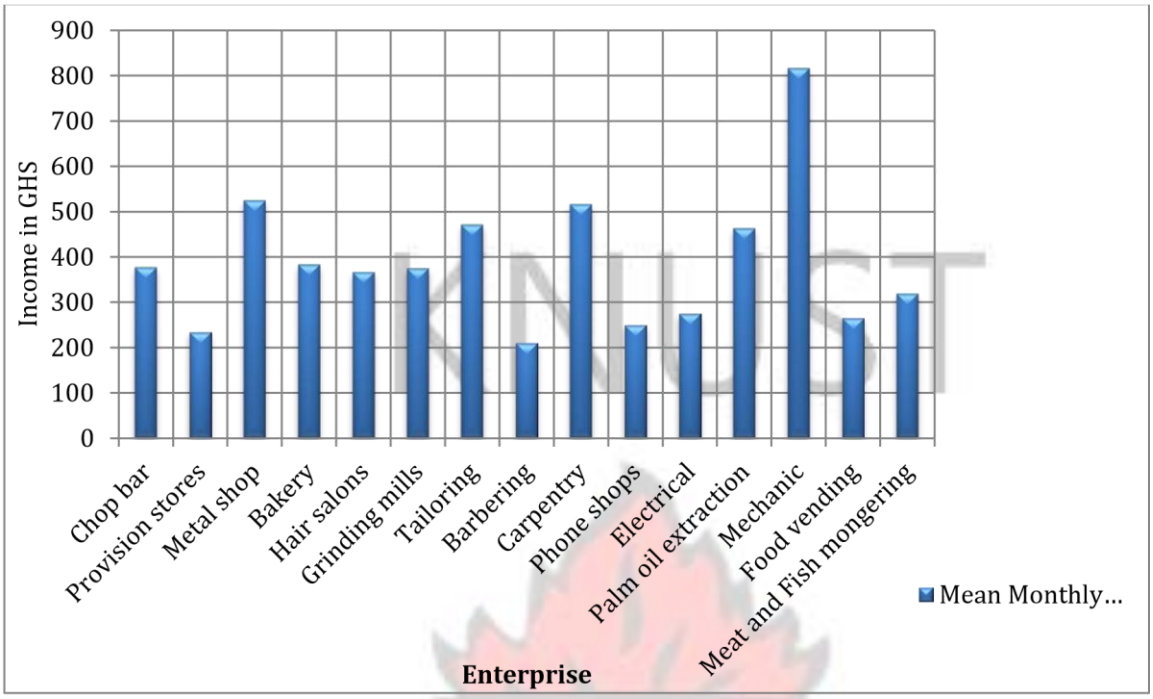


Figure 5.3: Mean monthly income of Enterprises

Source: Field Survey, July 2015

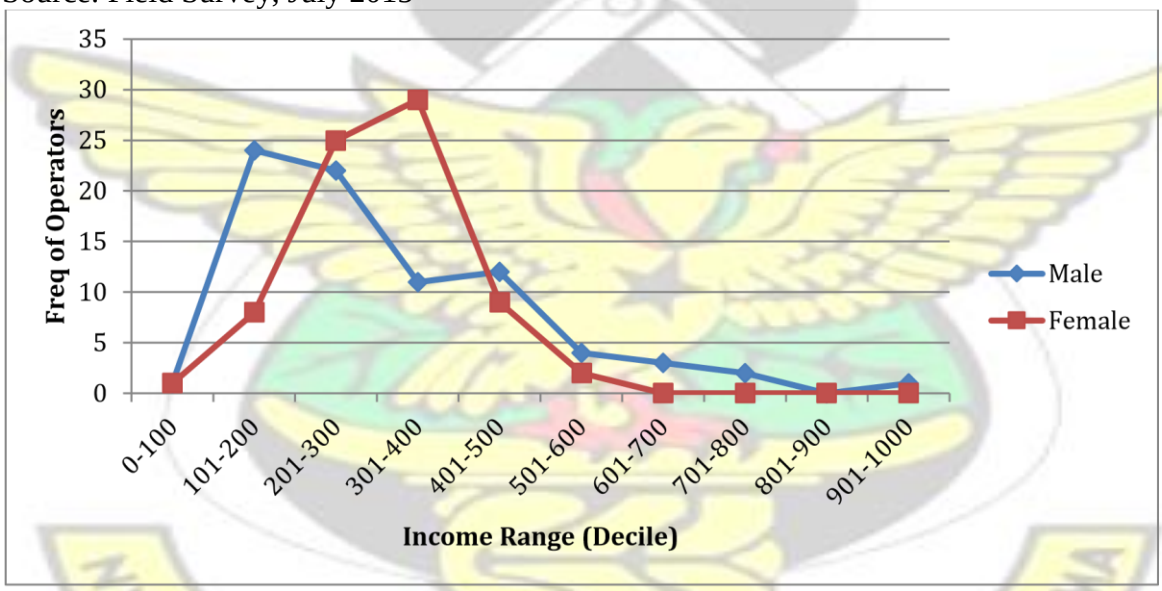


Figure 5.4: Income Distribution

Source: Field Survey, July 2015

Figure 5.4 depicts that a higher proportion of females (72.9%; 54 out of 74) and males (57.5%; 46 out of 80) earn income within the 201-400 and 101 to 300 ranges respectively. The study further revealed that generally, men earned higher average monthly income (GH¢ 446.69.) than their female counterparts (GH¢ 330.50) as the average monthly revenue of the male enterprise operated was about 35% higher than that of their female counterparts (See Appendix VIII). This occurred due to the local political economic circumstance and social construction that

have changed the RNFE (of gender). Men in these circumstances had better capacities in terms of the number of economic activities that are made available for them, readily access to finance (Amo, 2008) and the motivation to work hard, earn revenue to cater for household expenses. Secondly, men on the average were found to invest more of their monthly returns (about 42%) in their operations that women (who invested only 27%) in their activities. A respondent during a male FGD at Hwereso stated that: "*We are the men and heads of our households. We don't expect anyone to cater for the wellbeing of our families. If that should happen, you would be 'looked-down' upon and chastised in the community. I therefore have to really work hard, taking up more than two economic ventures so that I raise enough more to take care of my family and sustain and grow my business*". Re-investing in an enterprise is one better way of sustaining the activity, and having enough returns to cover operational costs and other expenses. This further confirms similar findings of the African Development Bank Group (AfDB, 2014) in Rwanda that male workers within the non-farm enterprises are paid higher than their female counterparts.

5.3.4.2 Expenditure (Total Production Cost of Enterprises)

An assessment of the total costs of production and revenue accrued to the enterprises aids in determining the turnover (profit margins) which can influence the operator's ability to afford or pay for cleaner energy options and technologies. The average monthly production costs and revenues of the enterprises were determined and then the profit margins (see Table 5.6). The study revealed that the average monthly expenditure for the operators of the chop bars was estimated at GH¢182.70 which comprise taxes/tolls, labour costs, food items (raw materials), transportation, and energy costs. However, it was revealed that their monthly revenue averaged GH¢377.27, thus giving a monthly average profit of GH¢194.57 as shown in Table 5.6. Similarly, the average monthly expenditure for the operators of the provision shops was estimated at GH¢184.12 which primarily comprised energy bills and consumer items (beverages and other food items). It was revealed that their monthly revenue averaged GH¢23437, thus giving a profit of GH¢50.25. Furthermore, the average monthly expenditure of the metal welders was GH¢305.27. The monthly cost comprised inputs (raw materials and labour), taxes and tariffs (energy). The average monthly revenue was however GH¢525.00 depicting a profit margin of GH¢219.73.

Similar to the welders' mode of operation, the carpentry shop operators, process the goods (both processed and unprocessed wood) brought to them by customers. Thus, they cut, saw, split, plane and mould logs into usable forms (such as furniture, planks and boards) for

customers. However, the monthly revenue averaged GH¢291.14 with an average monthly revenue of GH¢516.67. This thus reveals a profit margin of GH¢225.53. The study revealed that the total monthly cost of production for the grinding millers averaged GH¢114.61 but earned an average revenue of GH¢375.00. The expenditure covered tariffs (utility), taxes and inputs. The average monthly profit margin was GH¢260.39 as shown in Table 5.6. Further analysis revealed that the enterprise which recorded the highest profit margin was the mechanic shops, which recorded a monthly production cost of GH¢433.91 but a monthly revenue of GH¢816.66; thus revealing a profit margin of GH¢382.75 (See Table 5.6). Thus once again (as revealed by the income earned by the enterprises), the male-dominated enterprise recorded the highest profit margin. Estimation on the average monthly expenditure for males and females in disaggregated form revealed that, males incurred GH¢292.77 as compared to GH¢201.41 for the female on the average. Thus male operators incurred about 42.1% cost higher than their females counterparts. Cross tabulation of expenditure and revenue both sexes revealed, that males on the average had a monthly profit margin of GH¢ 153.92 (GH¢446.69- GH¢292.77) compared to GH¢129.09 (GH¢330.50- GH¢201.41). This therefore gives an indication that males on the average earn profit margins 16.13% higher than their female counterparts who operate the productive enterprises.

Table 5.6: Mean Monthly Enterprise Income of Enterprises

S/N	Category of Enterprise	Average Monthly Revenue (GH¢)	Average Monthly Expenditure (GH¢)	Average Monthly Profit (GH¢)	Rank
1	Chop bars	377.27	182.70	194.57	8th
2	Provision/Retail shops	234.37	184.12	50.25	15th
3	Metal Works/Welders	525.00	305.27	219.73	6th
4	Bakery shops	383.33	196.32	187.01	9th
5	Hair salons	366.67	159.08	207.59	7th
6	Grinding mills	375.00	114.61	260.39	4th
7	Tailoring	471.42	188.16	283.26	3rd
8	Barbering shops	210.00	70.62	139.38	12th
9	Carpentry shops	516.67	291.14	225.53	5th
10	Phone repair shops	250.00	83.00	167.00	11th
11	Electrical shops	275.00	101.64	173.36	10th
12	Palm oil extraction points	463.63	104.37	359.26	2nd
13	Mechanic shop	816.66	433.91	382.75	1st
14	Food vending shops	265.62	196.68	68.94	13th
15	Meat and fish mongering	318.75	255.00	63.75	14th
		390.51	197.11	193.4	

Source: Field Survey, July 2015

Table 5.7 generally indicates that all enterprise operators (both males and females) recorded monthly profits from the operation of their respective enterprises. This depicts the significance

of energy-dependent non-farm enterprises to revenue generation, employment creation and means to improving wellbeing of rural dwellers as opined by Thiyagarajan et al (2014).

5.4 Energy Supply and Utilisation

Findings from the survey revealed that the enterprise operators made use of a wide range of energy forms for several services or purposes; including cooking, lighting, heating, baking, and freezing, among others as shown in Table 5.7. The study thus identified that all the retail/provision shops, operated by either male or female; used electricity for lighting, powering their refrigerators for cooling/freezing purposes to preserve beverages and other perishable items. The metal/welding shops; operated mainly by males, used oxyacetylene torches for welding. The dominance of males among welders is not surprising in the Ghanaian context since a lot of physical strength is required to execute the job. This finding is similar to Aggarwal et al (2010) study of welders in Malawi and Okuga et al., (2012) study in Uganda who found that almost all the welders in their studies were males.

Plate 1: A male welder at Kubease

Source: Field Survey, July 2015

The study further identified that the food vending enterprise operators, particularly the males used LPG for cooking and heating foods, whiles their female counterparts used diverse energy fuels; LPG and charcoal; for similar purposes. The researcher made observation that food preparation and vending enterprises which operated their enterprises at night (or when dusk falls) used electricity and dry cells for lighting purposes (though these were not primary energy forms for their core activities) to sell their food. Furthermore, the use of kerosene and dry cell was not limited to any category of the enterprises as the research revealed that most of the enterprises (particularly those that are run late into the night) used them for lighting purposes (dry cells and kerosene), when there were power outages (grid electricity). This indicates a

similar finding by Amponsah et al (2012) where enterprises used kerosene and candle for lighting when there were power outages in some slums.

Findings from the study further revealed that the food preparation (chop bars) and vending enterprises used firewood and charcoal in traditional stoves and coal pots, respectively, as well as LPG for the preparation of food. The study further identified that the food preparation and vending enterprise owners preferred to use firewood and charcoal for cooking the local dishes. These fuels (firewood and charcoal) according to respondents were used because some of the dishes required vigorous stirring and therefore the local cook stoves were convenient and preferable for that. Also, preparing 'large quantities' of food required the use of large cooking pots and again the traditional cook stoves preferred for doing that. Focus group discussion with some female food preparation and vending operators at Kubease revealed that the preference for firewood to other energy services (particularly among chop bar operators) was because: "*Firewood when used for food preparation cooked faster and was readily available for utilisation. Also, LPG when used for cooking large quantities come at a higher cost which has the tendency of increasing the operational cost, so thus preferred firewood which was relatively cheaper".*

Additionally, the fish and meat mongers used firewood to smoke meat and fish, using a locally-made special type of stove, manufactured by local artisans from metallic drums. Fish and meat smoking was mainly done in the open and in the day time. Enterprise operators thus did not require any form of lighting to operate their enterprises.

Plate 2: A female respondent setting fire for fish mongering at Kubease
Source: Field Survey, July 2015

The oil palm extraction businesses mainly used firewood as the source of energy fuel for their activities. The fuel was used to extract oil from the palm nut fruits to desirable forms. The enterprises thus used the firewood to boil the palm nut.

Plate 3: Traditional (Manual) Oil Milling Machine

Source: Field Survey, July 2015

Electricity was the major energy type used by the grinding mills for running the enterprises. This same energy type (electricity) was used to power grinding machines for the grinding of maize and other vegetables. It was also used for lighting purposes at all times by the enterprises. The study further revealed that the hairdressing, tailoring and barbering enterprises largely depended on electricity to operate. The energy conversion equipment seen in hairdressing enterprises were hair dryers and electric bulbs for the conversion of electricity to lighting and heat energy, respectively; barbering were the barbering machines and electric bulbs; and tailoring machines were electric bulbs and electric sewing machines.

Plate 4: A woman grinding corn at the mill at Hwereso

Source: Field Survey, June 2015

Generally, all enterprises that required lighting for their activities made use of electricity from the national grid. Table 5.8 however shows the core/primary energy forms used by the enterprises in their direct operations.

Plate 5: A tailor at Adadientem

Source: Field Survey, July 2015

Table 5.7: Energy fuel and Purpose of Usage by Enterprises

S/N	Category of Enterprise	Energy and Purpose for Usage	
		Men	Women
1	Chop bars	-	Firewood, charcoal, kerosene and biomass residue for cooking and heating
2	Provision/Retail shops	Grid electricity for powering equipment/gadgets (lighting, coolin g, freezing, ventilation)	
3	Metal Works/Welders	Oxyacetylene torches and gas for cutting metals	
4	Bakery shops	-	Firewood and biomass residue for lighting and heating
5	Hair salons	-	Grid electricity for lighting, heating/drying hair, ventilation
6	Grinding mills	Electricity for lighting and powering grinding machines	
7	Tailoring	Grid electricity for lighting and cooling/ventilation	
8	Barbering shops	Grid electricity for powering gadgets for shaving, lighting and cooling/ventilation	-
9	Carpentry shops/Sawmilling	Electricity for lighting, gas oil/gasoline for sawing	
10	Phone repair shops	Grid electricity for powering equipment, lighting and cooling/ventilation	-
11	Electrical and electronic shops	Grid electricity for powering equipment/gadgets, lighting and cooling/ventilation	-
12	Palm oil extraction points		Firewood and biomass residue for cooking/boiling
13	Mechanic shop	Grid electricity for powering equipment, lighting and cooling/ventilation	-
14	Food vending shops	LPG for cooking	Firewood, charcoal, kerosene and biomass residue for cooking and heating
15	Meat and fish mongering	-	Firewood, charcoal, kerosene and biomass residue for heating

Source: Field Survey, July 2015

Table 5.8: Core/Primary Energy Fuel Used by Enterprises

S/N	Category of Enterprise	LPG		Electricity		Kerosene		Charcoal		Firewood		Petrol		Biomass Residue	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F
1	Chop bars	0	0	0	0	0	11	0	7	0	11	0	0	0	11
2	Provision/Retail shops	0	0	13	19	0	0	0	0	0	0	3	2	0	0
3	Metal Works/Welders	0	0	6	0	0	0	0	0	0	0	0	0	0	0
4	Bakery shops	0	0	0	1	0	3	0	0	0	3	0	0	0	3
5	Hair salons	0	0	0	12	0	0	0	0	0	0	0	3	0	0
6	Grinding mills	0	0	5	1	0	0	0	0	0	0	0	0	0	0
7	Tailoring	0	0	8	6	0	0	0	0	0	0	0	0	0	0
8	Barbering shops	0	0	10	0	0	0	0	0	0	0	3	0	0	0
9	Carpentry shops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Phone repair shops	0	0	7	0	0	0	0	0	0	0	2	0	0	0
11	Electrical shops	0	0	10	0	0	0	0	0	0	0	1	0	0	0
12	Palm oil extraction points	0	0	0	0	0	0	0	0	4	7	0	0	4	7
13	Mechanic shop	0	0	3	0	0	0	0	0	0	0	0	0	0	0
14	Food vending shops	9	3	0	0	0	3	0	7	0	0	0	0	0	3
15	Meat and fish mongering	0	0	0	0	0	5	0	0	0	8	0	0	0	8
TOTAL		9	3	62	39	0	22	0	14	4	29	9	5	5	32

Source: Field Survey, July 2015

The study further revealed the dominant primary energy form for the enterprises to be (grid) electricity as indicated in Table 5.8. Approximately 66.7% of the enterprises (10 out of 15 enterprises) used this energy form for their specific primary/core activities as depicted in Table 5.7. The enterprises as shown in Table 5.8 include retail shops, hair salons, grinding mills, tailoring, barbering, metal/welding shops, carpentry, bakery shops, phone repair, mechanic and electrical shops. The energy form was used by both men (56) and women (39).

Further analysis revealed that 6.67% (1 out of 15 enterprises) of the enterprises used LPG for its activities and this was primarily the food vending shops. It was however observed that the male operators of the food vending enterprise used only LPG as their primary fuel for their activities whiles their female counterparts had various energy forms for the similar purpose; LPG, charcoal, kerosene and biomass residue. This thus gives an indication of the assertion of the energy stacking/portfolio model which states that energy users have multiple energy choices, and thus use any form as and when needed.

The study further revealed that, the solid fuels (charcoal, firewood and biomass residue) were used by both men and women, but were largely utilised by the female enterprise operators. It also discovered that 14, 29 and 32 female enterprise operators used charcoal, firewood and biomass residues respectively, for undertaking their productive activities, compared to 4 males each who used firewood and biomass residues in their productive activities. The enterprises that made use of these solid fuels were chop bars (charcoal, firewood and biomass residue), bakery shops (firewood and biomass residue), palm oil extraction points (firewood and biomass residue), food vending enterprises (charcoal and biomass residue) and the fish and meat mongering businesses (firewood and biomass residue). Thus 4 enterprises (26.7%) use firewood, 2 of the enterprises (13.3%) use charcoal whiles 5 of them (33.3%) use biomass residues for their productive activities.

CHAPTER SIX

PREFERENCE FOR ENERGY FOR PRODUCTIVE USE BY ENTERPRISE OPERATORS

6.1 Introduction

This section of the study presents the findings and discussions on the factors that influence the utilisation of various energy fuels by enterprise operators for productive purposes, in gender disaggregated form. The section therefore presents the findings based on the energy fuels used by the various enterprises. As revealed in the previous chapter, various energy fuels were identified to be utilised by the enterprises for their operations; LPG, electricity, firewood, charcoal, kerosene, petrol and biomass residue.

6.2 Criteria for examining factors for the use of energy fuels

The study revealed that the enterprises use varied energy fuels for their productive services, ranging from solid fuels (charcoal, firewood, biomass residue) to non-solid fuels (kerosene, petrol, electricity, LPG). This section of analysis is carried out on the basis of the fuels used and the factors influencing operators' choice for particular fuels. Further analysis is carried out on the average monthly quantity of the fuel used and expenditure on the fuel. A five-point likert scale was used to assess in order of significance the factors influencing operators' preference for specific energy fuels. Likert scales according to Likert (1932) are a non-comparative scaling technique and are uni-dimensional (only measure a single trait) in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale (Bertram, 2002). Thus, the study avoided the use of just frequencies but made use of the scale to determine how significant or influential respondents assert a 'factor' to be in determining the utilisation of specific energy fuel. The scale ranged from 5 to 1 where:

Scale	Meaning
5	Highly significant
4	Significant
3	Indifferent
2	Insignificant
1	Highly Insignificant

Source: Author's Construct, September 2015 from Likert (1932)

The Standard Deviation (S.D.) provides an indication of how individual responses vary or 'deviate' from the mean. It tells how spread-out responses are; are they concentrated around the mean or scattered far and wide? Did all respondents rate the factor equally or they had varied opinions? In explaining further, the larger the standard deviation is, the more dispersed

the cases (in this case the responses) are; the smaller the standard deviation is, the more concentrated around the mean the cases (or responses) are. If all the cases had the same value on a variable, the standard deviation would have a value of 0.

The coefficient of variation (C.V.) is a measure of the ratio of the standard deviation to the mean. By inference, distributions with a coefficient of variation to be less than 1 are considered to be of low-variance, whereas those with a CV higher than 1 are considered to be of high variance. Between two variables, the variable with the smaller CV is less dispersed than the variable with the larger CV. These; S.D. and C.V. were used together with the Mean value and the assigned values on the five-point likert scale to identify and rank the factors influencing operator's choice for specific energy fuels and explain the variation in the responses.

6.3 Charcoal Utilisation

Charcoal production is an important economic activity in most rural areas of developing countries, and an important source of energy for both household and productive consumption in developing countries. The survey revealed that the all users of charcoal were female operators; basically of food vending and chop bar enterprises. All interviewed females within the food vending enterprises (43.75%; 7 out of 16 food vendors) used charcoal in undertaking their core productive activities, whiles 18.75% (3 of 16) of them had LPG as alternative energy source; thus used both charcoal and LPG. It was therefore observed that none of the males used charcoal in their productive ventures. Furthermore, 63.63% (7 out of the 11) chop bar operators used charcoal for their activities; food preparation as shown indicated in Table 6.1.

Table 6.1: Utilisation of Charcoal

Enterprise	Utilisation of Charcoal				Total	%
	Use	%	Do not Use	%		
Chop Bar Operators	7	63.63	4	36.37	11	100.00
Food vendors	7	43.75	9	56.25	16	100.00

Source: Field Survey, July 2015

Table 6.1 indicates that charcoal was largely used by females in food preparation. Thus 9.1% (14 females out of 154 enterprise operators) of the operators were females that utilised charcoal. A further cross tabulation and regression between the average monthly income and quantity of charcoal utilised was carried to give a better understanding of the relation between the two variables; income and quantity of charcoal consumed (see Table 6.2 and Figure 6.1).

Table 6.2: Cross-tabulation between Incomes and Charcoal Consumption Levels

Income Range	Average Quantity per month (kg/month)		
	All Users	Chop Bar Operators	Food vendors
0 -100	-	-	-
101 – 200	20	-	20
201 – 300	42.5	62.5	32.5
301 – 400	70	75	41.67
401 – 500	100	100	-
AVERAGE	**58.93**	**78.58**	**39.28**

Source: Field Survey, July 2015

Plate 6: A man carrying a bag of charcoal

Source: Field Survey, July 2015

The study's findings revealed the average monthly quantity of charcoal consumed to be 58.93kg; with variations in terms of the quantity consumed by chop bar operators (78.58kg) and other female operators in the food vending enterprise (39.28kg). There is thus about 50% (39.2kg) difference between the quantity of charcoal consumed by chop bar operators and that of the other females within the food vending business – chop bar operators consume approximately 50% more charcoal over what other food vending operators consume monthly. This difference was observed because females within the food vending enterprise also utilised LPG in their productive activities. It was further revealed that on the average, a 1.58kg of charcoal was sold at GH¢1 whiles a 50kg bag of charcoal was sold at GH¢15. Table 6.2 and Figure 6.1 generally depict a positive relation between income and the quantity of the fuel (charcoal) utilised. Thus, the monthly quantity of charcoal consumed/utilised by the enterprises (chop bar and food vending enterprises) increased with increased income levels. This implies that given the average cost of a 50kg bag of charcoal to be GH¢15, chop bar operators spend

GH¢23.57 on charcoal (78.58kg) every month whiles the other female operators in the food vending enterprise spend GH¢11.78 on charcoal (39.28kg) every month. Operators of chop bars therefore spend about 100.1% more on charcoal than operators within the food vending business. Further analysis revealed that chop bar operators spend 6.25% of their monthly income on charcoal, whereas the female operators within the food vending enterprise who use charcoal spend 4.18% of their monthly income (GH¢281.43) on charcoal. Chop bar operators spend more on charcoal than their female counterparts in the food vending business because charcoal is their major energy fuel for their activities, whiles some operators within the food vending enterprise utilised both charcoal and LPG in their activities.

Generally, computation of the linear regression revealed that the monthly income levels positively influenced charcoal consumption. Thus, regressing the monthly quantity of charcoal consumed (x) over income (y) revealed that: y = 2.5673x + 178.71 (See Figure 6.1). This implies that a 'unit' increase in income levels of the enterprise operators will directly or positively lead to a 2.5673kg increase in the consumption of charcoal. The computed product moment correlation coefficient (r) of 0.8092 indicates a strong positive relationship between the income levels of the enterprises and the quantity of charcoal consumed. The co-efficient of determination (r^2) of 65.46% (0.6546 from Figure 6.1) affirmed a strong positive correlation between income levels and quantity of charcoal consumed. The co-efficient of determination (r^2) of 65.46% also gives indication that increase in income can only explain the 65.46% variation in the quantity of charcoal consumed and thus, there are other variables that explain the remaining 34.54% (100%-65.46%) variation in quantity of charcoal consumed. The above suggests that the use of charcoal remains a major component of enterprise energy use for enterprises whose core activities are food preparation (cooking) throughout the country.

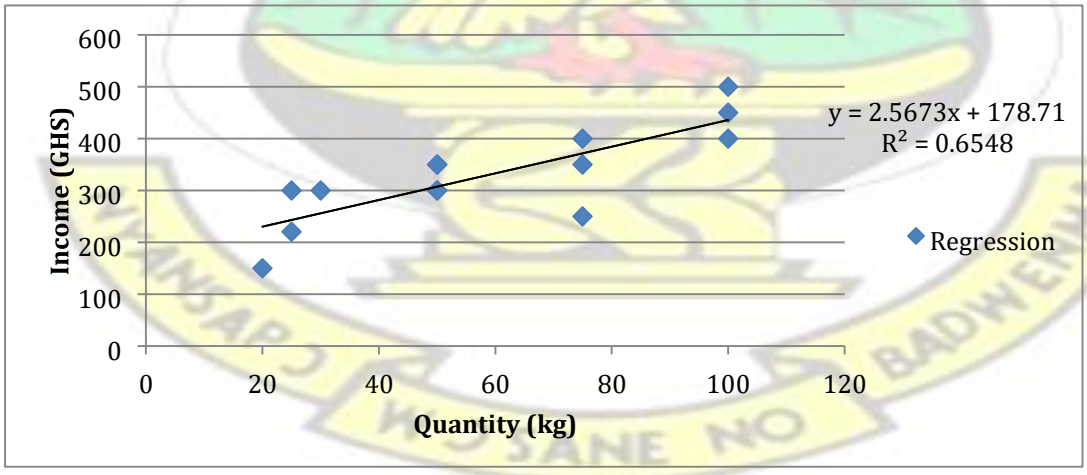


Figure 6.1: Linear Regression on Monthly Income and Quantity of Charcoal Consumed

Source: Source: Field Survey and Author's Construct, July 2015

For enterprise operators using charcoal, having alternate energy fuels for cooking also has some cultural dimension since enterprises, particularly the chop bars, indicated that they preferred to cook certain local food items with specific energy services to ensure they get the 'right taste'. It was further revealed that, some of the local dishes are also better done using the traditional cook stoves than LPG. Sometimes the volume of food being cooked and the amount of stirring that goes with it require the use of the appropriate stoves, and hence the need to utilise this energy form at enterprise level for cooking.

6.3.1 Reasons for Preference of Charcoal

A five-point Likert scale was used to assess the reason(s) for the preference of charcoal to other fuels (see Table 6.3) for similar purpose. It was therefore revealed that female enterprise operators preferred charcoal to other energy forms for reasons of affordability, habit or practice of using the fuel, taste, period/time of cooking, reliability, technological and availability of the fuel as indicated by Table 6.3.

Table 6.3: Preference of Charcoal by Enterprise Operators

Item	N	Minimum	Maximum	Mean	Std. Deviation	C.V (%)
Availability Affordability	14	2.00	5.00	3.5400	.58102	16.4
	14	2.00	5.00	4.8040	.45452	10.3
Reliability	14	2.00	5.00	3.8300	.48951	12.8
Habit/Practice	14	1.00	5.00	4.4400	.47602	10.7
Technological	14	1.00	3.00	3.9200	.49329	12.6
Safe/Clean	14	1.00	4.00	1.8800	.59304	31.5
Cooks fast	14	1.00	5.00	4.1500	.50110	12.1
Taste	14	1.00	4.00	3.9500	.37708	9.6
Valid N (listwise)	14					

Source: Field Survey, July 2015

Findings from the study revealed that enterprise operators (mainly female) who utilise charcoal indicated that there are basically six reasons that positively influenced their decision to use charcoal for their productive activities: availability, affordability, taste, cook fast, reliability, technological and the habit of using it. The affordability of a fuel type in this study is determined by its price, which is a significant factor in enterprise energy use; both in terms of the fuel choice and the quantity of the fuel consumed. The availability explained to mean the presence of the fuel; reliability means regular supply (whenever needed for use) of the fuel; habit indicates the periodic use of the fuel over time and thus users have developed the routine for using it; technological refers to the reason where end-user equipment used for the activities

influence the use of the fuel; and safe/clean refers to the fact that the utilisation of the fuel has a clean attribute, thus does not have health risk on users.

Table 6.3 thus shows that enterprise operators in order of significance attributed affordability, habit/practice, cooks fast, taste, technological factor (use of end-user equipment) reliability and availability as positive reasons for using charcoal stating mean values of 4.80, 4.44, 4.15, 3.95, 3.92, 3.83 and 3.54 respectively. For 'affordability', the mean value 4.80 falls close the assigned Likert scale '5' on the interviewer-administered questionnaire, which gives an indication of the 'high level of significance or importance' of the factor/reason. Respondents based on this scale assert that they prefer charcoal to other energy options for cooking because it highly affordable compared to other fuels for similar purpose. The S.D. of 0.45452 shows a lower degree of dispersion from the mean, implying that a larger proportion of the respondents do support this assertion. This is further confirmed by the C.V. of 10.3%. The other mean values on habit/practice, cooks fast, taste, technological factor (use of end-user equipment) reliability and availability fall close to the agreed scale of '4' (significant, though not high) as ranked on the interviewer-administered questionnaire. Their corresponding standard deviations 0.47, 0.50, 0.38, 0.49 and 0.58 respectively indicate that respondents have varied opinions about the factors influencing their preference for charcoal to other fuels. For instance a standard deviation of 0.58 (factor of availability) compared to 0.38 (factor of taste) indicates that there is wider dispersion of responses around the mean as compared to the factor of taste. Thus, a smaller but significant number of respondents disagree to the assertion that affordability of the fuel plays significant/important role in their preference of the fuel. This is because a S.D. of zero (0) will mean that all responses were exactly the mean value.

These are further confirmed by their co-efficient of variation (C.V.) of 10.3% (affordability), 10.7% (habit/practice of using it), and 12.8% (reliability of the fuel) on the level of dispersion around the means. However, the female respondents using charcoal disagree to it that as safe/clean attribute of the fuel as factor, influence their preference for charcoal to other fuels for their productive activities, with a mean value of 1.88. This mean value falls close to the likert scale '2' which indicates levels of insignificance of the factors on preference for the fuel. Interventions to either promote or reduce supply and utilisation of the fuel should consider the reasons given by the operators so as to effectively attain the objectives of such interventions.

In interview with the Energy Commission on the affordability of the fuel, it was revealed that average prices of charcoal in the country has been fluctuating, rising from GH¢11 per mini bag (25kg) and GH¢18 per maxi bag (50kg) in 2012, and then to GH¢10 per mini bag and GH¢15

per maxi bag in 2015. The high-prices were recorded in the Western and Central regions. The low-prices were recorded in the Ashanti, Brong-Ahafo and Northern regions, where the latter also saw a drop in average mini-bag charcoal price. It can thus be estimated that the average price of charcoal in 2016 could range between 10-15% over 2015 as a result of the general nationwide rise in LPG price, an alternative which is a safer cooking fuel. The Commission further indicated that "*increases could go up between 20-25% on the average, particularly in the southern sector due to LPG supply shortages and further expected rise in transportation and labour costs*". Charcoal is thus an important fuel to food preparation enterprises.

On the source of supply of the fuel (reliability), the operators indicated that they had their supply of charcoal from the Municipal capital, Ejisu and trucks that were moving both within and outside the Municipality but indicated that they were readily available whenever needed. The survey further revealed that the pricing of wood fuels (particularly charcoal) was done purely by the forces of demand and supply. There was no price regulation authority for wood fuels and neither is there an association responsible for pricing of wood fuels. The wood fuels produced in the savannah woodlands of the north, are transported as charcoal to the south.

6.4. LPG Utilisation

Liquefied Petroleum Gas (LPG) is a by-product of crude oil, which in Ghana is refined by the Tema Oil Refinery (TOR) (Energy Commission, 2011). LPG is used in the domestic, industrial, and other service sectors. Analysis of the proportion of operators that use LPG for productive purposes revealed that 1 out of 15 enterprise categories, predominantly food vendors, used LPG basically for cooking and heating. Out of the percentage (as indicated in Table 5.3), the food vending enterprises that were operated by males had the higher proportion (56.25%; 9 out of 16 respondents) of using LPG as the cooking and heating fuel. Furthermore, 18.75% (3 out of 16) of the enterprises operated by females used LPG as fuel for cooking and heating. Thus in all, 75% (12 out of 16) of the food vendors used LPG (See Table 6.4). Generally just 7.8% (12 out of 154 enterprise operators) of all interviewed operators utilised LPG in their core productive activities.

Table 6.4: Utilisation of LPG

Enterprise	Men		Women		Total		Total
	Use	Do not use	Use	Do not use	Use	Do not use	
Food vendors	9	0	3	4	12	4	16

Source: Field Survey, July 2015

A cross-tabulation between income levels of enterprise operators and users of LPG revealed that enterprise's income levels positively influenced the monthly quantity of LPG they consumed. However, computation of linear regression and correlation co-efficient and determination revealed that the income levels of enterprises operated by females did not significantly influence the quantity of LPG as was the case of the male users (see Table 6.5 and Figures 6.2 and 6.3). As indicated by the "energy stacking/portfolio model", females had charcoal and LPG for the same service and thus were unwilling to spend extra cost on the fuel.

Table 6.5: Cross-tabulation between Quantity of LPG Consumed and Enterprise Income

Income Levels (GH)	12.5kg		15kg		19kg		TOTAL	
	Male	Female	Male	Female	Male	Female	Male	Female
0-50	-	-	-	-	-	-	-	-
51-100	-	-	-	-	-	-	-	-
100-150	1	1	-	-	-	-	1	1
151-200	-	-	4	1	-	-	4	1
201-250	-	1	1	-	-	-	1	1
251-300	-	-	-	1	-	-	-	1
301-350	-	-	-	-	2	-	2	0
315-400	-	-	-	-	1	-	1	0
Total	**1**	**2**	**5**	**3**	**3**	**0**	**9**	**3**

Source: Field Survey, July 2015

Table 6.5 indicates that the operators of food vending enterprises use LPG of varying weight (sizes); basically 12.5kg, 15kg and 19kg. Male operators use 12.5kg, 15kg and 19kg of LPG cylinders, whiles their female counterparts consume only the 12.5kg and 15kg cylinders. The study further revealed the average prices of the various sizes to be GH¢31.50, 41.00 and 57.00 for the 12.5kg, 15kg and 19kg respectively. As indicated in Table 6.5, the monthly earnings of the enterprises that used 12.5kg of LPG ranged between GH¢100 and GH¢250. Similarly, about 100% of the enterprises that used 15kg of LPG earned between GH¢151 and GH¢300 whiles 100% of those that used 19kg earned above GH¢300 (i.e. specifically between GH¢301 and GH¢400) as indicted in Table 6.5. Further analysis revealed that male users of 12.5kg, 15kg and 19kg LPG within the food vending enterprise earned an average monthly income of GH¢150, GH¢257.20 and GH¢366.67 respectively whiles their female counterparts who used 12.5kg and 15kg LPG earned GH¢225 and GH¢300 respectively (see Table 6.5). Thus the female operators that consumed the 12.5kg and 15kg LPG within the food vending enterprises earned higher than their male counterparts (see Table 6.6).

Table 6.6: Average Monthly Income and Expenditure (GH¢)

Quantity (kg)	Unit Price (GH¢)	Mal e			Female		
		Average Monthly Income (GH¢)	No. of Trips	Average Monthly Expenditure on LPG (GH¢)	Average Monthly Income (GH¢)	No. of trips	Average Monthly Expenditure on LPG (GH¢)
12.5kg	36.50	150	2	73.00	225	1	36.50
15kg	41.00	257.50	1	41.00	300	1	41.00
19kg	57.00	366.67	1	57.00	-		-

Source: Field Survey, October 2015

Table 6.6 further shows that for male and female enterprise operators, the average monthly expenditure incurred on the consumption of a 12.5kg LPG was GH¢73.00 (which represents 48.6% of their monthly income) and GH¢ 36.50 (which represents 16.2% of their monthly income), respectively. Also, male and female operators who consumed 15kg LPG spent GH¢41.00 each on the fuel which represents 15.9% and 13.7% of their monthly income respectively. Lastly, male operators who consumed 19kg LPG spent GH¢57.00 on the fuel which represents 15.5% of their monthly income. It could be inferred that the male operators generally spent more on the fuel than their female counterparts in absolute terms. This was so because male operators only used LPG and had no preference for other fuels (dignity), whereas the female enterprise operators used both wood fuels and LPG, and so spent less on the LPG.

A male food vendor indicated that: "*I cannot light fire using firewood and other wood fuels because of respect and dignity. If there is no LPG, I still will not use firewood but will wait until there is supply of LPG".*

Computation of the linear regression revealed that the monthly income levels directly influenced LPG consumption. This implies that all things being equal, if the monthly income of the operators increase, there will be increase in the consumption of LPG, and vice versa. Thus, regressing the monthly quantity of LPG consumed (x) over income (y) revealed that: y = 17.874x + 6.0729 for male users and y = 15.333x + 108.33 for female users. These imply that a unit increase in income level of the enterprise would cause consumption of LPG to increase by 17.874kg and 15.333kg for male and female enterprise operators respectively. The

computed correlation coefficient (r) of 0.907 and 0.884 for male and female users of LPG respectively, indicates a strong positive relationship between the income levels of the enterprises and the quantity of LPG consumed. Thus the co-efficient of determination (r^2) of

82.3% (0.8234) and 78.2% (0.7825) for the male and female LPG users respectively, affirms the strong correlation between income levels and quantity of LPG consumed (see Figures 6.2 and 6.3 in Appendix X). The positive regressions support the general theory of income elasticity of demand that "Normal goods" have a positive income elasticity of demand. As incomes rise, more goods are demanded at each price level (fixed). The quantity demanded for normal necessities will increase with income, but at a slower rate than luxury goods. The regression for income and quantity demanded for LPG has a strong positive association; as income of enterprise operators increase, the quantity of LPG for operation increases; though with a marked difference between that of males and females, because the study revealed that females make use of other alternative fuels (charcoal as explained under section 6.2).

The study further employed the product moment correlation coefficient (r) and the coefficient of correlation (r^2) to determine the significance and extent of relationship between income levels and individual quantity of LPG used at the various food vending enterprises.

Table 6.7: Correlation between Income and Quantity of LGP Used

Quantity (kg)	Male		Female	
	Product Moment Correlation Coefficient (r)	Coefficient of Determination (r^2*100)	Product Moment Correlation Coefficient (r)	Coefficient of Determination (r^2*100)
12.5kg	0.83	68.89	0.86	73.96
15kg	0.88	79.01	0.81	65.61
19kg	0.79	62.41	-	-

Source: Field Survey, July 2015

Income was revealed to be a significant determinant for changes in the quantity/volume of LPG consumption of the enterprises. It can thus be seen in Table 6.6 that a percentage increase in the income level of enterprises operated by males will lead to an increase of 12.5kg by 68.89%, 15kg by 79.01% and 19kg by 62.41%. Comparatively, a change in the income of enterprises operated by females is likely to increase LPG use of 12.5 kg by 73.96% and 15kg by 65.61% to the male rate of 50.41%. The findings can further be explained that there are other variables (though not significant) that can explain the variations in the quantities of LPG used by the enterprises, other than income levels.

6.4.1 Reasons for preference of LPG

LPG was revealed to be used solely by food vendors; both males and females. The study revealed that all males in the food vending activity (56.2%) preferred LPG to charcoal. The end-user equipment were gas cylinders and cook stoves. The reasons for this preference were

revealed to be affordability, safety associated with the fuel and easiness with the use of the enduser equipment (technology). A five-point likert scale was further used to assess the reason(s) for the preference of male food vendors for LPG to other fuels (see Table 6.8). The study further revealed that female food vendors that preferred LPG to other energy fuels gave reason of safe use of the fuel. This is depicted by Table 6.8.

Table 6.8: Preference for LPG by Enterprise Operators

Item	Male						Female					
	N	Min	Max	Mean	SD	C.V.	N	Min	Max	Mean	SD	C.V.
Affordability	9	1.00	2.00	3.7250	.48951	13.1	3	1.00	2.00	2.7750	.19029	6.9
Availability	9	1.00	4.00	3.8300	.50574	13.2	3	3.00	5.00	2.9000	.55786	19.2
Safe/Clean	9	2.00	5.00	4.8040	.47434	9.9	3	4.00	5.00	4.0750	.26675	6.5
Habit/Practice	9	1.00	2.00	1.5250	.64452	42.3	3	1.00	3.00	1.9000	.67178	35.4
Reliability	9	3.00	5.00	1.7700	.62010	35	3	1.00	4.00	1.6350	.73301	44.8
Technological	9	1.00	5.00	3.6600	.41130	11.2	-	-	-	-	-	-
Distance (Procurement)	9	-	-	-	-	-	3	1.00	5.00	3.1600	.25000	7.9
Valid N (listwise)	9						3					

Source: Field Survey, July 2015

Table 6.8 shows that reasons for choice of LPG are similar among both male and female food vending operators but with variations in terms of order of significance. Male operators' choice for LPG in order of significance indicates safe/clean use of the fuel with mean value of 4.8 which falls close the assigned value '5' of the likert scale on the interviewer-administered questionnaire (which gives an indication of the high level of importance of the reason). The corresponding S.D. of 0.47434 indicates lower level of dispersion around the mean which is further confirmed by the C.V. of 9.9%. Similarly, their female counterparts also gave the same reason (safe/clean) with a mean value of 4.0 which is close to the assigned scale '4' which gives an indication of the significance (though not high) of that factor/reason. The corresponding S.D. of 0.26675 depicts a lower dispersion from the mean with a C.V. of 6.5%, meaning that there is only 6.5% in the variation in responses to the assertion. Furthermore, both male and female operators gave the second reason for their preference to LPG as the availability of the fuel, with variations in the mean values; 3.8 for males which shows the reason is significant which falls close the assigned likert scale '4' on the interviewer-administered questionnaire (which gives an indication of the importance, though not high of the reason) and 2.9 for females which indicates satisfactory/neutrality of that choice (neither significant nor insignificant of the reason). The availability of the fuel was also found to have significant influence of male enterprise operators' decision to utilise the fuel, with a mean value of 3.8

which is close to the assigned scale '4' which gives an indication of the significance (though not high) of that factor/reason. Female enterprise operators were however indifferent or neutral on the fact that 'the availability' of the fuel either significantly or insignificantly influenced their decision for the fuel. They thus scored a mean value of 2.9 which is close to the assigned scale '3' which gives an indication of the neutrality of that factor/reason. This in a way implies that, the decision to use the fuel is not much dependent on the availability or unavailability of the fuel. Thus, they utilise it if it is available but not bother utilising it if it unavailable. The S.D. of 0.95786 however shows a higher degree of dispersion around the mean indicating that there a significant (about 43.01%) number who will 'look for' the fuel if it is unavailable at the 'normal' source of purchase or sale.

Other factors (reliability and habit or practice of using the fuel) that influence operators' choice for the fuel (LPG) were found to be insignificant. The WHO (2006) for instance asserts that rural dwellers are known for utilising solid fuels (particularly) firewood and other wood fuels in food preparation, and thus has become their practice or habit. Thus any attempt to substitute this fuel for others which comes at a cost (reliability/constant supply and monetary terms) are not very appreciated by them. The study's finding in confirming this claim revealed that the male food vending operators gave the fourth reason for their choice of the fuel to the 'reliability' factor of the fuel though computation of the mean revealed that the option or factor was insignificant with a mean value of 1.7 which on the Likert Scale gives indication of

'insignificance' of the option. The standard deviation of 0.2201 and co-efficient of variation of 12.4% gives indication of lower dispersion of the individual responses or values around the mean. Thus, a larger segment of the operators (81.6%) argue that irregular supply of the fuel deters them at time from utilising the fuel. Thus, if reliability was the only factor to influence their choice for the fuel, they would not use it (LPG) but look for alternatives. Furthermore, male enterprise operators utilised the fuel because they had developed the habit of using it in their activities and thus this significantly influenced their choice for the fuel (with a mean value of 3.5). A respondent stated that "*I have been using the fuel for the past three years and so have become used to its operations. I can use charcoal or others but because I am used to consuming LPG, I will always prefer this to others aside other health reasons".*

However, the female enterprise respondents indicated that the "habit or practice of using the fuel" insignificantly influenced their preference for the fuel with a mean value of 1.9 (which falls close the assigned Likert scale '2' on the interviewer-administered questionnaire which gives an indication of the insignificance of the reason). However the S.D. of 0.9717 shows a

greater degree of dispersion around the mean indicative of the fact that there are smaller (13.6%) but important segment of the respondents who have no "habit-related" issues. These operators have thus developed the habit of using the fuel and so their decision to utilise the fuel is based on the habit of using it.

Also, female enterprise operators indicated that distance to the source of supply (Ejisu) was a barrier to utilising the fuel at certain times. It was revealed that operators had to cover an average distance of 7.65km to procure the fuel. They were generally however indifferent (mean value of 3.16) implying that others (1 out of the 3 operators) did not have problem with it (covering longer distances to procure the fuel) whiles the remaining two had issue with procuring the fuel. Their male counterparts however did not have issue with distance to procuring the fuel. Similarly, reliability in terms of supply of the fuel highly insignificantly influence the decision of female enterprise operators' choice for using the fuel in their core productive activities, with a mean value of 1.0350 and lower S.D. of 0.13301. The LPG supply is plagued with frequent shortages across the country.

It was further revealed enterprise operators who utilised LPG procured it at Ejisu, the Municipal capital (average distance of 7.65km km from the four communities). Male operators indicated that, on the average 2 trips were made in a month to procure the fuel. The average distance covered to procure the fuel is 7.65 km. The disparity in the number of trips could be attributed to the fact that, LPG procurement was largely the responsibility of males. On regularity in supply of LPG, operators argued that there were times where in a whole month they (male operators who relied solely on LPG) had no LPG (at Ejisu) and thus had to close down the enterprise. This negatively affected their operations and turnover. The female enterprise operators in such times resort to the use of solid fuels, which had health and environmental implications. Enterprise operators further argued that they at certain times had to travel to Kumasi (an average of 23.81km) in search of the fuel which was also not unavailable. This they argued came at a cost (transport and time).

Users of LPG perceived it to be associated with the dominant challenge of the irregularity in its supply. All users (100%; both men and women) reported of the irregularity (unreliability) in the supply of LPG making some of the women to resort to the use solid fuels during such situations. Furthermore, Female users of the LPG further indicated that the fuel was expensive, basically due to two reasons; first, the upfront cost which involved the cost of the LPG cylinders, the cooking stove and the LPG and second, the length of time used for cooking particular foods such as beans. On the latter reason, the chop bar operators who sell kenkey and

beans maintained that food preparation undergoes several processes hence using LPG is expensive relative to firewood and charcoal for cooking and for long hours. Kojim (2011) had earlier found that high costs are by far the most important reason users do not switch to LPG. Though, high cost was identified as a major challenge in our study, technological challenges and LPG supply irregularities appear to have had the most significant effects on the transition from the solid fuels to LPG.

The unreliability and shortages of the fuel is buttressed by discussion with the Energy Commission which revealed that "shortages of evident by vivid vehicular queues at the various service stations during the year were indications that there supply shortfalls in the economy". Furthermore, the Commission indicated that "demand for LPG would continue to grow due to vehicle fuel-switch from gasoline to the LPG. What could curtail the LPG consumption is Government's potential inability to raise the required and adequate funds for import due to cross-subsidisation enjoyed by the product and also, physical constraint inhibiting nationwide distribution". Inkoom and Biney (2010) had earlier identified LPG supply irregularities and long queues at the point of sale as one of the major barriers affecting LPG use in Ghana. In the view of Asamoah et al (2012), LPG shortages in Ghana were partly the results of transportation difficulties especially to locations outside the national capital, Accra, where LPG is wholesaled; and financial challenges emanating from the high upfront cost.

The study revealed that the procurement of LPG was the responsibility of young men (aged between 21 and 36 years), with no involvement of women in procuring LPG. The study further revealed that the availability of the fuel is not a problem. With the increasing demand for residential and commercial cooking as well as fuel for vehicles, there are fears of corresponding increment in potential fatal accidents. This however could be mitigated if the National Petroleum Authority (NPA) and Industry assist technical institutions in providing training in LPG handling and technology.

6.5 Kerosene Utilisation

Findings from the study revealed that 29.7% of the female enterprise operators (22 out of 74 female respondents) use kerosene specifically for setting fire for cooking. This includes, all chop bar operators (100%; 11 out of 11 operators), 42.86% (3 out of 7) female food vendors, all the bakers (3 out of 3; 100%) and 5 out of 8 fish mongers (62.5%). Thus none of the male enterprises operators utilised kerosene in undertaking their core productive ventures. The

analysis is therefore based on the 22 female respondents who used kerosene in their core activities as shown in Table 6.9.

Table 6.9: Utilisation of Kerosene

Enterprise	Utilisation of Kerosene				Total	%
	Use	%	Do not Use	%		
Chop Bar Operators	11	100	0	0.00	11	100
Food vendors	3	42.86	4	57.14	7	100
Fish mongers	5	62.50	3	37.50	8	100
Bakers	3	100	0	0.0	3	100
Total	22	-	7	-	29	-

Source: Field Survey and Author's Construct, July 2015

It was further revealed that the fuel was used primarily for setting fire for cooking and heating purpose. This gives an indication of the presence of other energy fuels for the lighting (dry cells and electricity). Users of this fuel preferred it because it was available, reliable and affordable as shown in Table 6.9. Kerosene unlike LPG (which was purchase on relatively larger quantities) was purchased in small amounts or quantities on a daily or weekly basis. Kerosene consumption varied from among the enterprises depending largely on the socioeconomic factors; affordability, reliability and availability of the fuel to the enterprises. The quantity per price of the fuel (kerosene) averaged GH¢ 1.20 of a 300ml bottle.

Computation of the linear regression revealed that the monthly income levels positively influenced kerosene utilisation. Thus, regressing the quantity monthly quantity of kerosene consumed (x) over income (y) revealed that: y 0.7491x + 98.138 for the operators (who specifically happen to be females) (see Figure 6.4 in Appendix X). This implies that a unit increase in income level of the enterprise would cause consumption of kerosene to increase by 0.7491ml (millimetres). Despite a positive relation between income levels and kerosene consumption, a further regression analysis between the average monthly quantity of kerosene utilised and level of enterprise income revealed a weak positive relationship, with a correlation co-efficient (r) of 0.436. This thus indicates a co-efficient of determination (r^2) of 0.19 which implies that the variation in enterprise income only explains 19% of the variations in the quantity of kerosene utilised. This is further supported by a discussion with one chop bar operator who said that: *"I only use the fuel (kerosene) for setting fire for cooking, and another fuel at relatively free cost (biomass residue e.g. saw dust) can be used for the same purpose. I will therefore not be necessarily motivated to increase the quantity of kerosene I purchase if my enterprise income should increase and the price of kerosene should remain the same. I have*

to make enough returns". This therefore implies that increase in the price of the fuel could cause decrease in the quantity of the fuel purchased since, there are other relatively free fuels to serve the same purpose.

6.5.1 Reasons for preference of Kerosene

The five-point Likert scale was again used to assess the order of significance of the reason(s) for operators' preference for kerosene to other fuels in setting fire for cooking.

Table 6.10: Preference for Kerosene Utilisation by Enterprise Operators

Item	N	Minimum	Maximum	Mean	Std. Deviation	C.V.
Availability	22	4.00	5.00	4.5750	.50064	11.0
Affordability	22	3.00	5.00	3.7000	.48687	13.0
Reliability	22	3.00	5.00	4.1000	.37178	9.1
Safe/Clean	22	2.00	3.00	2.8000	.40510	14.0
Habit/Practice	22	1.00	2.00	4.4750	.30064	6.7
Valid N (listwise)	22					

Source: Field Survey, July 2015

Table 6.10 indicates that significant reasons for choice of kerosene in setting fire for cooking were basically the availability of the fuel, the reliability in terms of the supply of it, and the affordability of the fuel with computed mean values of 4.57, 4.1 and 3.7 respectively. The study thus revealed that, operators' choice of kerosene in order of significance was first attributed to the availability of the fuel with a mean value of 4.57 which falls close the assigned Likert scale '5' on the interviewer-administered questionnaire, which gives an indication of the high level of importance of the reason. The computed standard deviation however gives 'satisfactory' (neither high nor low) dispersion around the mean, giving the indication that about half the number of respondents affirm that the availability of fuel highly influences their decision for the fuel. Operators indicated that the safe or clean use of the fuel had 'satisfactory' (neither significant nor insignificant) influence on their preference for kerosene in setting fire for cooking. This is supported by a computed mean value of 2.8000 which falls close the assigned

Likert scale '3', which gives an indication that the reason is satisfactory. About 53.1% of the operators indicated that the fuel was harmful, whiles the remaining 46.9% stated otherwise.

Further analysis revealed that all three variables affordability (r=0.78), habit/practice (r=0.76) reliability (r=0.76) and availability (r=0.83) put together gave a correlation coefficient (r) of 0.842 which indicates that there is a strong positive relationship between the three variables (affordability, reliability and availability of the fuel) and the choice of the fuel. The three variables thus explain 71% variation in the quantity of Kerosene used (see Table 6.11). There are other therefore other variables explain 29% of the variation in the choice of the fuel

(kerosene) used. Enterprise operators therefore will continue to demand or utilise more of the fuel when they are made affordable, available at the various points and there is reliability in terms of supply/deployment.

Table 6.11a: Model Summary of the relationship between the choice of energy and the independent variables (affordability, reliability and availability)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.842	0.7089	0.5015	56.1168

Predictors: affordability, reliability and availability

Table 6.11b: Multiple Regression Model

Multiple Regression Co-efficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.301	.336		4.675	.001
	Affordability	.031	.112	.389	2.742	.003
	Reliability	.037	.002	.533	1.954	.000
	Availability	.017	.144	.167	1.160	.0.01

Source: Field Survey, July 2015

Dependent variable: Preference for energy service for productive use

The predictor variables were found to be significant predictors of the preference for energy services for productive activities. The multiple regression analysis results showed that there are significant relationships between all the predictor variables (p-value=0.01, 0.03, 0.00, 0.01 $p \leq 0.05$ respectively) and preference for energy services. This finding indicate that there should be put in place measures to ensure continuous supply of the fuel in the 'right quantities' for the enterprise operators to aid in their productive activities.

6.6 Biomass Residue Utilisation

Biomass resources include any plant-derived organic matter that is available on a renewable basis, commonly referred to as feed stocks. Findings from the survey revealed that the utilisation of biomass residue as either cooking or lighting fuel relative to the other cooking and lighting fuels was more common among the food preparation enterprises. About 33.3% (5 out of 15 enterprises; bakery, food vending, chop bars, fish and meat mongering, oil palm extraction points) utilised biomass residue as lighting and cooking fuel. The proportion of users of biomass residue corresponds to those who used firewood for their activities. Enterprises either used the fuel to light firewood or charcoal. The study further revealed that the fuel was

however not efficient, though its effectiveness in lighting firewood or charcoal cannot be neglected. Generally, the residues that were palm nut shells, corn husks, sawdust, and fibre from palm nut fruits.

Table 6.12: Proportion of Respondents that Use Biomass Residue

Enterprise	Utilisation of Biomass Residue				Total	%
	M	%	F	%		
Chop Bar operators	0	0	11	100.00	11	100.00
Oil Palm extraction points	4	36.63	7	63.37	11	100.00
Fish mongers	0	0	8	100.00	8	100.00
Food vendors	0	0	7	100.00	7	100.00
Bakers	0	0.0	3	100.00	3	100.00
Total	4	10	36	90.00	40	100.00

Source: Field Survey and Author's Construct, July 2015

Table 6.12 indicates that a higher proportion of females utilise the biomass residue as energy form than the males. About 90% (36 out of 40 enterprise operators) of the enterprise operators that use biomass residue are females compared to just 10% (4 out of 40 enterprise operators) who happen to be male enterprise operators. Generally, 23.4% (36 out of 154 enterprise operators) and 2.69% (4 out of 154 enterprise operators) of the total sample of enterprise operators, who utilise biomass residue, are females and males respectively. None of the males within the food vending enterprise utilised the fuel. Table 6.11 further indicates that the proportion of respondents that used biomass residue was highest among the chop bar operators (7.14%) and oil palm extractions points (7.14%). The researcher observed that the biomass residues were obtained largely from the farms, carpentry and saw mill shops and oil palm extraction points at no monetary cost. Though these fuels through direct observations (farmwastes, sawmill and logging residue) were used in smaller quantities by the enterprises for just setting fire for cooking, several studies have revealed that this fuel, particularly those from agricultural wastes are very reliable and sustainable, compared particularly to hydro-electric power for productive services (DFID, 2009; Wikner 2009; Energy Commission, 2006; Zurburgg, 2002).

6.6.1 Reasons for preference of biomass residue

The five-point Likert scale was adopted to assess the order of significance of the reason(s) for operators' preference for biomass residue in their productive activities.

Table 6.13: Preference for Biomass Residue by Enterprise Operators

	Male						Female					
Item	N	Min.	Max.	Mean	S.D.	CV	N	Min.	Max.	Mean	S.D.	CV

Availability	4	2.00	5.00	3.9583	.53006	13.4	39	1.00	5.00	3.8500	.41214	10.7
Affordability	4	1.00	5.00	3.9500	.60081	15.2	39	1.00	5.00	3.7250	.53979	14.5
Reliable	4	1.00	5.00	3.9083	.66605	17.0	39	1.00	5.00	3.9333	.67030	17.0
		2.00									.40574	
		1.00									.40316	
Safe/Clean	4		5.00	1.6000	.43312	27.1	39	1.00	5.00	1.4250		28.5
Habit/Practice	4		5.00	3.3250	.82394	24.8	39	1.00	5.00	3.9417		10.2
Valid N	4						39					

Source: Field Survey and Author's Construct, July 2015

Table 6.13 shows that reasons for choice of biomass residue in order significance vary among the males and females. Male operators' first reason for the preference of biomass residue is the availability of the fuel with a mean value of 3.9583 (close to the assigned scale 4 which signifies the importance though not high of the reason) compared to a mean value of 3.8500 (which indicates 'the significance of the reason') of their female counterparts though happens to be the third reason for their preference of the fuel coming after coming after the 'reliability' and 'the habit/practice' of using the fuel. Though both mean values of both operators fall close to the assigned '4' on the Likert scale, the variations/dispersion (S.D.) in the responses around the mean are different; 0.53006 for males and 0.41214 for females. Males regard availability as the most significant factor influencing their choice for the fuel whiles females regard other factors more significant (based on the mean values, S.Ds. and C.Vs) than the 'factor of availability'. Table 6.13 shows that male operator's choice for biomass fuel in order of significance is influenced by the availability of the fuel (mean value of 3.9583 and S.D. of

0.53006), 'affordability of the fuel' (mean value of 3.9500 and S.D. of 0.60081), 'reliability of the fuel' (mean value of 3.9083 and S.D. of 0.66605), and the 'habit of using the fuel' (mean value of 3.3250 and S.D. of 0.82394). The male enterprise operators however regard the 'safe or clean use' of the fuel as insignificant (mean value of 1.600 and S.D. of 0.63312).

Similarly female operator's choice for biomass fuel in order of significance is influenced by the 'habit of using the fuel' (mean value of 3.9417 and S.D. of 0.40316), 'reliability of the fuel' (mean value of 3.93433 and S.D. of 0.67030), 'availability of the fuel' (mean value of 3.8500 and S.D. of 0.41214), and 'affordability of the fuel' (mean value of 3.7250 and S.D. of 0.53979). Female enterprise operators regard the 'safe or clean use' of the fuel as highly insignificant factor influencing their preference for the fuel. Rather, the unsafe attribute of the fuel deters them from utilising the fuel (see Table 6.13).

6.7 Firewood Fuel Utilisation

According to ESMAP (2011), firewood is the main fuel used in commercial and informal sector enterprise. Thus economic activities such as bakeries, food preparation, soap manufacturing, groundnut paste manufacturing, fish smoking, cassava processing, and palm oil manufacturing, depend largely on firewood (ESMAP, 2011). The GSS (2008) and NDPC (2010) assert that the dominant use of biomass in Ghana as a whole (63%) is a major cause of the incessant deforestation in Ghana. Among the enterprises surveyed, three of them made use of the fuel, primarily as cooking and heating fuel. The enterprises are the oil palm extraction enterprise, chop bars, bakery shops and fish mongering enterprises (See Table 6.14).

Table 6.14: Utilisation of Firewood

Enterprise	Utilisation of Firewood				Total	%
	M	%	F	%		
Chop Bar Operators	0	0	11	100.00	11	100.00
Oil Palm extraction points	4	36.63	7	63.37	11	100.00
Fish mongers	0	0	8	100.00	8	100.00
Bakers	0	0	3	100.0	3	100.00
Total	4	12.1	29	87.9	33	100.00

Source: Field Survey and Author's Construct, July 2015

Table 6.14 depicts that 21.4% (33 out of 154) of the respondents (operators) of the productive enterprises use firewood as cooking fuel. Out of this figure (33 operators), about 12.1% (4 out of 33 operators) and 87.9% (29 out of 33 operators) of the operators who utilised firewood were males and females operators respectively. Table 6.13 indicates that the proportion of respondents that used firewood was highest among the chop bar operators (33.3%). However, all operators within the chop bar, fish mongering and bakery enterprise utilised firewood in their productive activities. The researcher further observed that firewood was obtained largely from the farms and forests within the environment and at the outskirts of the communities.

6.7.1 Reasons for preference of Firewood

Similarly, the preference for the choice of firewood as useful fuel/energy varied among enterprises and gender. Generally, both men and women who used the fuel (firewood) gave reasons of the availability, reliability, most appropriate fuel for the enterprise and affordability of the fuel. Female operators further gave additional reasons of taste and 'cooks fast'. Thus, the fuel according to them was found within their environment. Once again, the five-point likert scale was used to assess the reasons and the results are presented in Table 6.15.

Table 6.15: Preference for Firewood by Enterprise Operators

Item	Male	Female

	N	Min.	Max.	Mean	S.D.	CV	N	Min.	Max.	Mean	S.D.	CV
Availability	4	1.00	5.00	4.0750	.26675	6.5	29	1.00	5.00	4.7750	.45220	9.5
Affordability	4	1.00	5.00	3.7000	.85335	23.1	29	1.00	5.00	4.2000	.40510	9.6
Reliable	4	1.00	5.00	3.7750	.69752	18.5	29	3.00	5.00	4.2750	.45220	10.6
Safe/Clean	4	1.00	5.00	1.5250	.50574	33.2	29	1.00	5.00	1.4500	.50383	34.7
Habit/Practice	4	1.00	5.00 5.00	2.3250	.88831	38.2	29	2.00	5.00	2.7750	.73336 .49827	26.4
Technological	4	1.00	- -	3.5500	.50383	14.2	29	1.00	5.00	3.600	.44108 .52055	13.8
Taste	-	-		-	-	-	11	1.00	5.00	3.8810		11.4
Cooks fast	-	-		-	-	-	11	1.00	5.00	4.1400		12.6
Valid N	4						29					

Source: Field Survey and Author's Construct, July 2015

Table 6.15 shows that, though both men and women gave similar reasons to the preference of the fuel over others, there are variations in the nature of responses as depicted by the mean and the corresponding standard deviation. For instance, both male and female operators and users of the fuel gave the first reasons for the preference of firewood to fuel to be the availability of the resource. The mean values 4.07 (for males) and 4.77 (for females) differ. Whiles the mean value of the females (4.77) fall close to the assigned likert scale '5; which indicates a higher level of significance of that variable, that of men fall close to '4' which shows the significance (but not high) of the variable. This thus implies that, women of the identified enterprises that utilise firewood make use of the fuel because of the major factor of availability of the fuel. However, the C.V (6.5%) and S.D (0.26675) gives an indication that the mean value for males (their response to the reason for the choice of the fuel) is more precise than the female counterparts, though also less dispersed from the mean value of 4.7750 (S.D. of 0.45220 and C.V. of 9.5%). Technological factors also significantly influenced both male and female operators' choice of the fuel with mean values of 3.55 and 3.6 respectively.

Similarly, other factors that influence their (men and women of the respective enterprises) in order of significance were the same; reliability (3.77 for men; 4.27 for women both indicating significance of the reason/factor), affordability which respondents explained to be nonpayment for the fuel (3.70 for men; 4.20 for women both indicating significance of the reason/factor); the habit of using the fuel insignificantly influenced male operators' choice of the fuel (mean value of 2.32); whereas women were neutral/indifferent about the factor with a mean value of

2.77 which falls close to the assigned likert scale 3, which indicates indifference of respondents over the reason.

Lastly the safe/clean use of the fuel (1.52 for men; 1.45 for women) both indicated the high insignificance of the reason/factor. It could thus be inferred that, both users (men and women) of the fuel regarded the fuel as unsafe and unclean. However, the corresponding standard deviations indicate the degree of dispersion around the mean; thus respondents have varied opinions about the factors influencing their preference for firewood to other fuels. Focus group discussion with some female food preparation and vending operators at Kubease revealed that the preference for firewood to other energy types (particularly among chop bar operators) was that: *"Firewood when used for food preparation cooked faster and was readily available for utilisation. Also, LPG when used for cooking large quantities come at a higher cost which has the tendency of increasing the operation cost, so thus preferred firewood which was relatively cheaper".*

There were also cases where respondents asserted that the smoke from charcoal combustion acted as insect repellent compared to other fuels, specifically LPG. Scarcity of the traditional wood fuels strongly affects energy utilisation and activities of the enterprises that depend on them. It was revealed that enterprises generally respond to shortages by spending more time and labour in the collection, substituting biomass fuels (straw, palm kernel and less favourable fuels), and economising (cutting down on the quantity used) on the wood fuel. The Municipal Health Directorate data on the top ten diseases shows ARI (Acute Respiratory Infection) as the 2nd highest OPD morbidity case after malaria. It was revealed that usually an average of two persons go to collect the wood. On the average, 16 trips per enterprise are made in a month to collect the wood. In the 4 communities, the average distance travelled to collect the wood is less than 2km; specifically 1.5km. This implies that in a month, about 24km has to be covered.

The average time spent on gathering the wood is about 46.01 minutes per trip.

6.8 Petrol Utilisation

The study revealed that petrol was used as an alternative fuel in powering generators to generate electricity, during power outages (from grid electricity). Thus, 5 out of the 15 enterprises (33.3%) utilised petrol for this productive purpose (see Table 6.16). Thus, 9.1% of the enterprise operators (14 out of 154 enterprise operators) utilised petrol to power their stand-by generators to undertake their productive services. Findings from the survey further revealed that 3.2% (5 out of 154 respondents) of the users of petrol were females whiles 5.8% (9 out of 154 operators) were males.

Table 6.16: Utilisation of Petrol

Enterprise/Sex	Male		Fe male		T otal	
	Use	Not	Use	Not	Use	Not
Provision/Retail shops	3	10	2	17	5	27
Hair salons	0	0	3	9	3	9
Barbering shops	3	7	0	0	3	7
Phone repair shops	2	5	0	0	2	5
Electrical shops	1	9	0	0	1	9
Total	**9**	**31**	**5**	**26**	**14**	**57**

Source: Field Survey, July 2015

Respondents utilised this fuel on irregular basis due to the current frequent and irregular power outages ('dumsor'). Respondents preferred grid-electricity to petrol to generate electricity due to its relatively cheaper cost. They however had no option than to utilise petrol when there were power outages. On the average, operators in a month spent twice on purchasing petrol to paying for grid-electricity for the same purpose. This gives an indication that grid-electricity comes at a relatively cheaper cost, compared to petrol for similar purpose.

Table 6.17: Quantity and Expenditure on Petrol

Enterprise	No. of Gallons (a)		Litre (b)		Unit Cost (GH¢) (c)	Total Cost (b*c) (GH¢)	
	M	F	M	F		M	F
Provision shops	5	3	22.73	13.64	2.729	62.03	37.22
Hair salons	-	5	-	22.73		-	62.03
Barbering shops	4	-	18.18	-		49.61	-
Phone repair shops	3	-	13.64	-		37.22	-
Electrical shops	4	-	18.18	-		49.61	-
TOTAL (AVERAGE)	**4**	**3.25**	**18.18**	**14.77**		**49.61**	**40.31**

Source: Field Survey and Author's Construct, July 2015

'Dumsor', the street name for the power outages currently plaguing the state, has become a major problem for individuals and businesses. Hence, enterprises have had to battle with energy crisis much longer than they anticipated. It was revealed that the fuel (petrol) was used primarily for powering generators to generate electricity for respective enterprise activities. Table 6.16 indicates that the average monthly quantity of petrol used by the enterprise operators ranged between 13.64 litres to 22.73 litres. Further analysis showed that the average monthly litre of petrol used by enterprise operators varied among male and female operators. Averagely, male enterprise operators used 18.18 litres of petrol (4 gallons) every month at a cost of GH¢ 49.61, compared to 14.77 litres (3.25 gallons) of petrol at a cost of GH¢40.31 of the female enterprise operators. This thus gives indication that, male enterprise operators on the average spend approximately 11% of their monthly income (GH¢ 446.69 as shown in Table 5.7) on this

alternate fuel. Similarly, the female enterprise operators spend about 12.2% of their monthly income (GH¢ 330.50 as shown in Table 5.7) on this petrol as an alternate fuel during power outages. Thus the female users of petrol spent more on the fuel than their male counterparts. They however in absolute terms spent about 23% (GH9.30) less than what the male enterprise spent on petrol (GHS 49.61).

Further computation of the linear regression revealed that the monthly income levels positively influenced petrol consumption as a result of power outages. Thus, regressing the quantity monthly quantity of petrol consumed (x) over income (y) revealed that: y = 66.176x + 132.35 for male users (see Appendix XII) and y = 37.5x + 300 for female users (see Appendix XII). These imply that a unit increase in income level of the enterprise would cause consumption of petrol to increase by 66.176 gallons (300.84litres) and 37.5gallons (170.47 litres) for male and female users respectively. The computed correlation coefficient (r) of 0.78 for male users of petrol indicates a strong positive relationship between the income levels of the enterprises and the quantity of petrol consumed. Thus the co-efficient of determination (r^2) of 60.16% (0.6016) affirms the strong correlation between income levels and quantity of petrol consumed.
However, there was a positive but weak relationship between the income levels of the female enterprise operators and the quantity of petrol consumed, with a correlation coefficient (r) of 0.0957. The co-efficient of determination (r^2) of 31% gives indication that increase in income can only explain the 31% variation in the quantity of petrol consumed and thus, there are other variables that explain the remaining 69% variation in quantity of petrol consumed. Enterprises are therefore willing to even spend about 12% of their monthly incomes on purchasing alternative fuels (specifically petrol) to run their enterprises. This further supports the assertion of the World Bank (2009) access to cleaner and affordable energy options is essential for improving the livelihoods of the poor in developing countries.

6.9 Grid-Electricity Utilisation

The survey revealed that grid electricity served several productive purposes, primarily lighting, powering of equipment for enterprise activities**.**

Table 6.18: Utilisation of Grid-Electricity by Gender and Enterprises

Enterprise	Male		Fe male		Total	
	Use	Not	Use	Not	Use	Not
Provision/Retail shops	13	0	19	0	32	0
Bakery Shops	0	0	1	2	1	2
Metal/Welding shops	6	0	0	0	3	

Hair salons	0	0	12	0	12	0
Grinding mills	5	0	1	0	6	0
Tailoring	8	0	6	0	14	0
Barbering shops	10	0	0	0	10	0
Phone repair shops	7	0	0	0	7	0
Electrical shops	10	0	0	0	10	0
Mechanic shop	3	0	0	0	3	0
TOTAL	62	0	39	2	101	2

Source: Field Survey, July 2015

Table 6.18 indicates that electricity (national grid) is the predominant energy fuel used by enterprises in the rural areas that have them. Thus, about 65.6% (101 out of 154 enterprise operators) enterprise operators utilise this energy form for their various activities. The enterprises range from retail shops, bakery, and hair salons to mechanic shops as indicated in Table 5.5. However, the proportion of male operators who utilise this energy in their productive activities (61.6%) outweighs that of their female counterparts (38.6%) by 33.3%.

6.9.1 Reasons for Preference

A five-point likert scale was used to assess the reason(s) for enterprise operators' preference for electricity to other fuels (see Table 6.19) for similar purpose. Generally, the reasons for preference for the fuel were similar among both male and female operators (availability, affordability, reliability, safe, technological, and habit). However, the findings revealed that the reasons in order of significance varied among male and female enterprise operators as shown in Table 6.19.

Table 6.19: Preference for Grid Electricity by Enterprise Operators

Item	Male						Female					
	N	Min.	Max.	Mean	S.D.	C.V.	N	Min.	Max.	Mean	S.D.	C.V.
Availability	62	1.00	5.00	4.3250	.47434	10.9	39	1.00	5.00	3.3500	.45220	13.5
Affordability	62	1.00	5.00	3.7417	.70382	18.8	39	1.00	5.00	3.6557	.55207	6.6
Reliable	62	1.00	5.00	2.3917	.20610	11.6	39	3.00	5.00	1.4333	.35032	4.1
Safe/Clean	62	1.00	5.00	3.7333	.47479	12.7	39	1.00	5.00	4.2750	.35838	8.4
Habit/Practice	62	1.00	5.00	3.6211	.98831	27.3	-	-	-	-	-	-
Technological	62	1.00	5.00	3.7250	.43979	11.8	39	1.00	5.00	3.6833	.50362	13.7
Valid N (listwise)							39					

Source: Field Survey, July 2015

Grid-electricity was used by a larger number of enterprise operators for several reasons. The Municipal Energy Department in its quest to attain "Universal (National) Access to electricity" has made conscious efforts to extend electricity to almost every community in the Municipality.

As discussed earlier, the Municipal electricity coverage is above 92% giving indication of the extent made by the Department to extent electricity to every community within the Municipality. Despite the present regular power outages, a larger number of enterprises depend on this fuel for their activities. As it is the objective of the study, respondents were to indicate in order of significance the factors that influence their decision to use this fuel.

It was thus revealed that reasons for the preference of grid electricity varied among the male and female respondents (enterprise operators). Male operators' choice for LPG in order of significance indicates availability of the fuel with mean value of 4.3 which falls close the assigned Likert scale '4' on the interviewer-administered questionnaire, which gives an indication of the significance (though not high) of that factor/reason. The S.D. of 0.47434 shows a lower level of dispersion around the mean thus indicating that a greater number of male respondents support the assertion. However, the female respondents gave reason of the

'safety/clean attribute of the fuel' (electricity) as the only positive/significant factor with a mean value of 4.27 which falls close the assigned Likert scale '4' on the interviewerадministered questionnaire, indicating the significance (though not high) of that factor/reason. The S.D. and C.V. of 0.358 and 8.4% respectively show a lower degree of dispersion around the mean value indicating that a greater number of female respondents support the assertion (that safe/clean attribute of the fuel significantly influences their decision to utilise the fuel over others). This was deemed not surprising since women are most often regarded as energy poor and thus will all things being equal accept cleaner energy options for their activities.

Furthermore, Table 6.18 indicates that the second reason for operators' preference for electricity differed among the male and female enterprise operators. The male operators indicated that the affordability of the grid-electricity significantly (with mean value of 3.74 which is close to the assigned scale '4' which gives an indication of the significance (though not high) of that factor/reason) influenced their preference for it to other sources such as petrol or diesel which is used in generators. Interview with the Municipal ECG revealed that gridelectricity was comparatively cheaper for enterprise activities than petrol or diesel, as between 1-300kWh was sold at GH¢0.5925 compared to GH¢2.729/litre of petrol. On the other hand, the female enterprise operators indicated that their second reason for utilising grid electricity was not its affordability (as indicated by the male enterprise operators) but rather the technological factor or end-user equipment they used in their productive ventures. Thus, the kind of equipment (electronic appliances) they used at their enterprises significantly influenced

their decision to utilise the fuel with a mean value of 3.6833, which falls close to the assigned scale '4' which gives an indication of the significance (though not high) of that factor/reason.

Male enterprise operators further indicated that the technological factor or end-user equipment they used in their productive ventures was the significantly influenced their preference for the fuel, which was the second factor for the female enterprise operators. They (male enterprise operators) thus indicated that the kind of equipment (electronic appliances) they used at their enterprises significantly influenced their decision to utilise the fuel with a mean value of 3.7250

(as indicated in Table 6.18), which falls close to the assigned scale '4' which gives an indication of the significance (though not high) of that factor/reason. The male enterprise operators further indicated the 'habit (frequent practice)' of utilising the fuel also significantly (mean value of 3.6211 influenced their preference for the fuel. However the S.D. of 0.98831 shows a greater level or degree of dispersion around the mean indicative of the fact that the responses were polarised where a smaller (26.81%) but important segment of the respondents had no issue with the 'habit of using the fuel' and thus rated the attribute "1".

Lastly, the study revealed that male enterprises indicated that the 'reliability' of the fuel insignificantly influenced their preference for the fuel with a mean value of 2.3917 (which is close to the assigned scale '2' which indicates insignificance of the factor). Thus, if reliability was the only factor to influence their choice for the fuel, they would not utilise the fuel due to its unreliability. This was due to the frequent power outages ('dumsor') which is experienced across the country. This assertions was similar among the female enterprise operators who also indicated the 'reliability' highly insignificantly influenced their preference for the fuel with a mean score of 1.433 3917 (which is close to the assigned scale '1' which indicates high insignificance of the factor). This once again is not surprising due to current frequent power outages experienced by households and enterprises across the country. Supply of electricity was intermittent. Enterprise operators argued that they had about 57.1% of the expected energy supply in a month. Operators expected to have 168 hours of power supply a week (24 hours a day * 7days). This amounts to 672 hours of power supply in a month. Operators however argued that, they had only 96 hours of power supply in a week and thus had 384 hours in a month which represents 57.1% of the expected power supply of 672 hours power supply in a month. Some operators therefore resorted to the use of petrol to power their generators to generate electricity for their operations.

Interview with the Energy Commission and Municipal Energy Department (ECG) revealed that the frequent power outages were basically due to excessive demand for the fuel over its supply and inability to meet operational cost. This implies that generation capacity must increase by at least the same percentage per year in order to support expanding industrial, institutional, commercial household and other needs as the country develops. There is therefore the need to look for and examine cleaner and more reliable alternative sources of electricity (ASE), to complement the current and future demand for and supply of electricity for domestic and industrial operations.

6.9.2 Computation of Linear Regression

According to ECG, every commercial enterprise ought to have its own commercial (nonresidential) electricity meter. It was however revealed that only 25.7% (26 out of 101 enterprise operators) of the operators that utilised commercial electricity meters (see Table 6.20). As indicated in Table 6.20, only 17.9% (7 out of 39 operators) of the female operators had commercial electric meters, where as 33.9% (20 out of 59 male operators that used electricity) of male operators had commercial electric meters. Similarly, 6.9% (7 out of the 101 operators who use electricity) and 19.8% (20 out 101 operators who use electricity) were female and male operators used commercial electric meters. The quantity of electricity consumed was obtained by collecting monthly (3 month period) electricity bills paid. The linear regression between average monthly income of enterprise operators (y) and quantity of electricity consumed (x) was done using the 26 operators that had the commercial electricity meters.

Table 6.20: Enterprise Operators who utilise electricity

S/N	Category of Enterprise	Electricity		Use Commercial Electric Meter		Do Not Use Commercial Electric Meter	
		M	F	M	F	M	F
1	Provision/Retail shops	13	19	-	-	13	19
2	Metal Works/Welders	3	0	-	-	3	-
3	Bakery shops	0	1	-	0	-	1
4	Hair salons	0	12	-	4	-	8
5	Grinding mills	5	1	5	1	1	0
6	Tailoring	8	6	3	2	5	4
7	Barbering shops	10	0	3	-	7	-
8	Phone repair shops	7	0	2	-	5	-
9	Electrical shops	10	0	4	-	6	-
10	Mechanic shop	3	0	3	-	0	-
TOTAL		**59**	**39**	**20**	**7**	**42**	**32**

Source: Field Survey, July 2015

The computation of the linear regression revealed that average monthly income levels positively influenced electricity consumption. Thus, regressing the monthly quantity of electricity consumed (x) over income (y) revealed that: y = 1.618x-25.506 for male users (see Appendix XIII) and y = 1.0492x + 160.01 for female users (see Appendix XIII). These imply that a unit increase in income level of the enterprise would cause consumption of electricity to increase by 1.618kWh and 1.0492kWh for male and female operators respectively. The computed correlation coefficient (r) of 0.920 for male users of electricity indicates a strong positive relationship between the income levels of the enterprises and the quantity of electricity consumed. Similarly, the computed correlation coefficient (r) of 0.952 for female users of electricity indicates a strong positive relationship between the income levels of the enterprises and the quantity of petrol consumed. Thus the co-efficient of determination (r^2) of 90.6% affirms the strong correlation between income levels and quantity of electricity consumed.

6.10 Test Statistic on Gender and Type and Preference of Energy Service

The study sought to establish whether there is an association between gender and the type and preference for energy service for productive use in the RNFE. The computed Chi-square statistic value of 3.812 with p-value of 0.368 is greater than the significance value of 5% or 0.05 (p>0.05) which gives an indication that there is a statistically no significant association between gender and the type of energy service for productive use in the RNFE (see Table 6.21). There is therefore not enough data to reject the null hypothesis as set by the study. In other words, the type of energy service for productive use in the RNFE is independent of gender.

Table 6.21: Chi-square Tests

	Value	df	Asymp. Sig. (2sided)	Exact Sig. (2sided)	Exact Sig. (1sided)
Pearson Chi-Square	3.812[a]	1	.368		
Continuity Correction[b]	.544	1	.461		
Likelihood Ratio	.813	1	.367		
Fisher's Exact Test				.415	.231
Linear-by-Linear Association	.807	1	.369		
N of Valid Cases	154				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 30.75.					
b. Computed only for a 2x2 table					

Source: Field Survey and Author's Construct, July 2015

Table 6.22: Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.073	.368
	Cramer's V	.073	.368
N of Valid Cases		154	
a. Not assuming the null hypothesis.			
b. Using the asymptotic standard error assuming the null hypothesis.			

Source: Field Survey and Author's Construct, July 2015

This is in variance with findings of a research work done by Okuga et al (2012 in Uganada at where gender is found to be significant when it comes to the preference for energy service for domestic activities at the household level. This according to respondents is not similar at the productive/enterprise level, specifically in rural areas. What can be deduced from this is that, the first point of reference has to do with the kind of productive enterprise one engages in. The type of enterprise an individual undertakes at the RNFE influences the energy service required for the activity. Hence, gender largely plays a role in enterprise selection. Once that is done, the activity presents the most suitable energy service to be used.

Other factors then come to play because the kind/type of productive enterprise gives an operator some energy forms to choose from. The chi-square test value however does not depict the strength of the association between the two mutually exclusive variables. However, the Phi value of -0.073 (see Table 6.22) indicates that gender has no to negatively weak effect on the preference of energy service by gender for productive purposes in the RNFE. The study points out clearly that the type of enterprise (intervening variable) within the RNFE an individual undertakes to a large extent influences the energy type required for the activity, but the activity has a gender-dimension to it where socio-cultural factors define what a man or woman should do in society.

6.11 Implications Associated with the Supply and Use of Energy Services

The third research objective was to examine the implications (risks, challenges or benefits) associated with the supply and utilisation of the current (available) energy forms by the productive enterprises. The details are discussed below.

6.11.1 Solid Fuels

The study revealed that enterprise owners/operators (both men and women) regarded the supply of, firewood, biomass residue, and charcoal as readily available, reliable and affordable. Generally, the solid fuels were revealed to be reliable and in regular supply. The distribution systems of electricity and kerosene were quite good compared to LPG which had to be

purchased either at the Municipal capital or outside the Municipality (mostly Kumasi). Operators complained that they did not utilise LPG because of its irregular supply and the distance they had to travel to procure the fuel. Other solid fuels often found in literature, such as dung was not common in the communities (or received no attention). Enterprises that used wood fuels generally gather it from the community and government forests, with very few of them purchasing wood fuel. It was revealed that usually an average of two persons go to collect the wood.

The enterprises which used firewood perceived its usage as harmful due to the emission of smoke from the combustion of the fuel. The worse affected enterprises were food preparation and vending, palm oil extraction and the fish and meat mongering enterprises. Smoke and excessive heat from the combustion of the fuels used in the enterprises was therefore major worry to many owners of enterprises, particularly food preparation and vending, and palm oil extraction enterprises which used firewood. The researcher observed "chronic coughs and chest pains" of some female enterprise operators. While cases of coughs and chest pains were associated with the use of solid fuels, they still remained central to operations of female operators because they were: readily available, reliable and affordable/cheap. A female enterprise operator narrated that: *"I have over the past 2 years experienced severe chest pains and coughs whenever I inhale the smoke from the firewood. I have been advised to stay away from my work and smoke but I have no choice because I have to work. I truly want to avoid getting close to smoke but that would mean closing down the business or handing it over to someone to operate it".*

Observations by the researcher revealed that women particularly within the food preparation and vending businesses and their youngest children were most exposed to smoke from the solid fuels. Interview with the Municipal Health Directorate revealed that: "*solid fuel use is most firmly associated with acute lower respiratory infections (including pneumonia) in young children, and chronic obstructive pulmonary disease and lung cancer in women (and to a lesser degree in men)".* According to the Directorate, each of these three health outcomes is a major disease category in most societies and hence enterprise solid fuel use is likely to be a major cause of disease burden in communities where it is prevalent. The study posits that determining the impact of solid fuel use at local levels is important for identifying and prioritizing environmental and public health interventions.

6.11.2 LPG

It was revealed that the general shortages, particularly of LPG, in Ghana at certain times, negatively affected the operations of enterprises (largely the food vending businesses) that used them. Enterprise operators in attempts to cope with the unreliability in supply of LPG at times had to close down till they had supply of the fuel. Interview with users of solid fuel only (6 chop bar operators) who were unwilling to use LPG revealed that: "*I heard that if I inhale the LPG for some time, I will contract skin infections and have liver and kidney malfunctioning issues".* One respondent further commented that: *"I stopped using LPG because whenever I use it and I inhale the gas, I am unable to breathe well, feel dizzy and feels like falling to the ground".* Conversation with some experts revealed that inhaling LPG (also known as propane) are much the same as sniffing gasoline/petrol and other hydrocarbons. They further revealed that inhaling the gas has both short term and long term effects. In the short term, one may experience euphoria (feeling happy, elated); dizziness; hallucinations; muscle weakness; nausea and chills; general numbness; disassociation; central nervous system depression. However, with repeated exposure the longer term effects include: brain and nerve damage, seizures, tremor, brain haemorrhage, impaired memory, mood swings, depression, cardiovascular effects such as malformed blood cells, heart damage, irregular and/or depressed heart rate, high blood pressure; increase in infections.

As earlier indicated, women were less involved in the procurement of the fuel because of safety reasons. On regularity in supply of LPG, operators argued that there were times where in a whole month they (male operators who relied solely on LPG) had no LPG (at Ejisu) and thus had to close down the enterprise. This negatively affected their operations and turnover. The female enterprise operators in such times resort to the use of solid fuels, which had health and environmental implications.

6.11.3 Electricity

Similarly, the supply of electricity was irregular. Electric power supply was characterised by interruptions and low currents at certain times. Enterprise operators argued that they in a month had about 57.1% of the expected energy supply. Operators expected to have 168 hours of power supply a week (24 hours a day * 7days). Some operators therefore resorted to the use of petrol to power their generators to generate electricity for their operations. During focus group discussions with both men and women groups in Hwereso, it was disclosed that: "*A day has never passed without power outage. It has become a ritual which we have gotten used to. We cannot complain because no one seems to do anything about. They keep saying it will be over and so we are waiting for them. If our businesses should collapse by then, we will all see what will happen next*." Recounting her frustration, a hairdresser operating in Kubease also had this

to say: "*During days of low current, my customers patronise the services of other hairdressers who may have normal power supply or generators."* Electricity was the most preferred fuel for lighting in all enterprises that needed light. Enterprise activities that went late into the night made use of dry cells in torches as source of light.

6.12 Preference for Alternative Energy Services

Recounting the frustrations the enterprise owners go through with the supply and use of the various energy forms, the study observed that most of the enterprises preferred alternative sources of energy, which were both clean and unclean. Linked to its intermittency, provision shop operators, hair salon owners, electrical shop owners, barbering and phone repair shop owners expressed their desire for improvement in the supply of electricity. To these owners (9.1% of total number of respondents as shown in Table 6.16), there are no other alternatives that are better than electricity. They hence used petrol-powered generators whenever there were power outages. They however argued that the use of petrol-powered generators is far more expensive than electricity. It was thus revealed that, male and female enterprise operators paid on the average GHS49.61 and GHS40.31 every month, respectively.

As a result of the hazardous smoke emission and excessive heat associated with the use of solid fuels, users of the solid fuels desired for cleaner, reliable and affordable alternative sources of energy. This implies that, in attempt to promote the sustenance of these enterprises and ensure sustainable development, there should be in place measures by the Energy Commission and other relevant stakeholders within the energy sector to ensure regular and affordable supply of cleaner energy forms to enterprises whose activities largely depend on solid fuels.

6.13 Summary of Findings

Energy is a major input for economic production. It is clear from the study that for a developing economy like Ghana, economic growth is directly and strongly related to injection of adequate energy. However, the energy needs are unique among gender and enterprises in the RNFE. Thus for policies, programmes and plans on energy access and deployment to be effective, they should consider the energy needs of enterprises run by both men and women at the productive level. It was revealed that the price of non-solid fuels such as LPG is generally not higher than purchased wood fuels, but has to be bought in large amounts, unlike wood fuels that are purchased in small amounts or quantities on a daily or weekly basis. The survey further revealed that the pricing of wood fuels (particularly charcoal) was done purely by the forces of demand and supply.

Among other factors identified by the study to influence enterprise operators' preference for specific energy services, it was revealed that the availability and reliability of energy supplies are important contributing factors to fuel choice. The study also revealed that the availability of clean fuel in the rural areas is not a problem. Of the many options offered, largely four reasons stood out, namely economic (the lack of affordability), socio-cultural, technological and reliability. Majority of the enterprises indicated their willingness to use cleaner energy services for their various business needs. Their willingness to accept and use these modern forms of energy was, however, tied to some conditions that had to be met. These are issues related to how economical and cheap these modern forms of energy would be the regularity of the supply and whether they were likely to reduce the health hazards associated with the current energy types. Affordability is therefore critical for the adoption. The energy fuel types, reasons for preference and quantity of fuels demanded by male and female enterprise operators for their activities generally varied across enterprises. Whiles female operators within the food vending enterprise considered more socio-cultural (taste and practice) and health factors for using wood fuels, their male counterparts considered health and economic (price of fuel and income) reasons and thus used cleaner non-solid fuels; LPG.

CHAPTER SEVEN

DISCUSSION OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

7.1 Introduction

The preceding chapter presented the field data and analysed them under the following distinct headings: typology of productive enterprises in the rural non-farm economy (RNFE), enterprise income and expenditure, energy services used for specific enterprise activities, the factors that influence respondents' preference for energy services as well as the implications associated with the use and supply of the energy services. The objective was to examine energy services of men and women for productive uses in the RNFE, identify the factors that affect the decision to use the types of energy services, and make recommendation to improve activities of the RNFE, living conditions of rural dwellers and address energy access gap among men and women. This section of the study, therefore, seeks to present the main findings from the analyses and relate them to the global discourse. The findings will also inform policy makers on the issues which directly address rural dwellers' (enterprises in the RNFE) in the study communities specifically and Ghana at large.

7.2 The types of productive enterprises and the gendered usage of various energy services in the RNFE

7.2.1 Types of Productive Enterprises in the RNFE

Enterprises for the study were based on those that were energy-dependent and made productive use of the energy services. The study revealed that rural dwellers in Boankra, Hwereso, Adadientem and Kubease in the Ejisu-Juaben Municipality are increasingly earning their livelihoods from activities other than farming - the rural non-farm economy (RNFE). The study revealed fifteen categories of energy-dependent productive enterprises in the study communities within the RNFE: chop bars, food vending, retail shops, mechanic, carpentry, oil mill extraction, welding, hair salon, barbering shops, grinding mills, fish and meat mongering, tailoring and electrical shops. These activities according to Thiyagarajan et al (2014) and Brüderle et al (2011) are typical of rural areas. The major finding was that, activities at the RNFE were similar to the urban informal economy. According to Boapeah (2001), economic activities at the urban informal economy are summarised into three (3) sectors: agricultural, industrial and service sectors. This finding presents three issues that should be considered. First is on social marginality, where actors within the sector (RNFE) are casual or marginal workers with unstable wage earnings. Secondly, the political control or state regulation of the labour process. With this, actors within the economy are self-employed and also labour conditions are characterised by absence of official protection and government support. Thirdly is the economic phenomenon where the RNFE is characterised by heterogeneous set of activities of micro- and small scale activities, no formal registration and free entry and exit.

It was observed that productive activities within the RNFE had a gender dimension to it. Women were largely found in the food preparation and vending, as well as the retail enterprises. This finding supports a study by the World Bank (2015) that women's participation in the nonfarm activities is concentrated in the trade and manufacturing sectors. Newman and Canagarajah (1999) further indicate that women within the manufacturing sector are engaged in the food and beverages, and cottage industries - including wood, textiles, leather and handicrafts. This in a way suggests the socio-cultural responsibility of women who at the rural household level are confined to the preparation of food for the household and other domestic activities as revealed by Amu (2008). The study revealed that activities in the RNFE were profitable since all enterprises recorded operational monthly turnover from their activities (Zwick and Smith, 2001; Newman and Canagarajah, 1991). Male operators earned higher average monthly income than their female counterparts. This was revealed to be the as a result of the local political economic circumstance and social construction that have changed the RNFE. Men had better capacities in terms of the number of economic activities that are made available for them, readily access to finance (Amo, 2008) and the motivation to work hard, earn

revenue to cater for household expenses. Secondly, men on the average were found to invest more of their monthly returns in their operations that women in their activities. In summary, it can be said that the type of economic activity an individual is engaged in within the RNFE is gendered; thus socio-culturally defined. Developing the RNFE has the potential of contributing to the livelihood diversification and living conditions of rural dwellers.

7.2.2 Energy Services for Productive Use in the RNFE

7.2.2.1 Solid Fuels

The study further revealed that several energy services (solid fuels and non-solid fuels) were used by the enterprise operators to run their enterprises. Seven distinct energy services were identified to be used by the enterprises: charcoal, firewood, kerosene, LPG, electricity, petrol, and biomass residue Solid fuels are revealed to be important source of energy for both household and productive consumption in developing countries. Anang et al (2011) indicates that Ghana in terms of charcoal consumption is among the top two countries in West Africa. The fuel was obtained from the farms and forests (bushes) within the environment and at the outskirts of the communities which made its supply reliable and regular by women and children. This confirms findings by the FAO (2006) and ESMAP (2011) that firewood is dominantly used by rural folks due to its abundant nature (presence) in surroundings of communities. This has negative implication on the environment and the resource when there is heavy dependence on it. Scarcity of the resource has implication of losing productive time to cover longer distances to get the fuel. Lastly, the study observed that the utilisation of biomass residue as either cooking or lighting fuel. Users of the fuel however revealed that it was not efficient, though its effectiveness in lighting firewood or charcoal could not be neglected. Generally, the residues that were palm nut shells, corn husks, sawdust, and fibre from palm nut fruits confirming similar findings of Amponsah et al (2012) in their study in Ghana.

7.2.2.1 Non-Solid Fuels

The study revealed that men and women had 'equal' physical access to non-solid fuels: electricity, kerosene and LPG; for several productive services. Current energy discourses as exemplified in the United Nations Universal Access to Energy initiative, have focused on the need to promote safe, reliable, environmentally friendly and cost effective fuels such as LPG for use by enterprises (UNDP, 2004; Gandur, 2007 cited in Williams, 2007). According to Williams (2007), increasing use of LPG is one of several pathways to meeting the United Nations' Sustainable Energy for All Initiative by 2030. Williams (2007) further indicates that if the average African household switched to LPG, each family would save 120kg of firewood

a year and provide health and productivity gains. These imply that LPG and other safer and cleaner energy sources could play instrumental roles in sustainable development.

'Dumsor', the street name for the power outages currently plaguing the communities in Ghana, has become a major problem for individuals and businesses. Hence, enterprises have had to battle with energy crisis much longer than they anticipated. It was revealed that the fuel (petrol) was used primarily for powering generators to generate electricity for respective enterprise activities. Respondents preferred grid-electricity to petrol to generate electricity due to its relatively cheaper cost. They however had limited options than to utilise petrol when there were power outages. A study by Fuel Cells 2000 (2015) in the US reveals that petrol and diesel generators and battery backup systems provide the vast majority of emergency power. Enterprises are willing to spend about 12% of their monthly incomes on purchasing alternative fuels (specifically petrol) to run their enterprises. This supports the assertion of the World Bank (2009), that access to cleaner and affordable energy options is essential for improving the livelihoods of the poor in developing countries and also "the decisions made on how we produce, consume and distribute energy will profoundly influence our ability to eradicate poverty" (AGECC, 2010:2). The survey revealed that grid electricity was the dominant energy service used by both male and female enterprise operators and also served several productive purposes; primarily lighting, powering of equipment for enterprise activities. This supports the findings of Karekezi et al (2002) that access to electricity supply (both grid and non-grid) in many developing countries is almost an exclusive service enjoyed by the poor and non-poor in both urban and rural areas. Thus, the usage of this energy service is not necessarily gendered.

The major finding from this research objective was that the energy services were available for usage to every operator; be it male or female. Hence, there was no 'gendered limitation' in terms of physical access to using the energy service.

7.3 Examining the factors influencing enterprise operators' preference for specific energy services

Enterprise operators used various energy services for several purposes which were influenced by some decisions or factors.

7.3.1 Solid Fuels

Among the users of charcoal: mainly women; it was revealed that the factors that significantly influenced enterprise operators' preference for charcoal in order of significance were revealed

to be “affordability, habit/practice, cooks fast, taste, technological, reliability and availability of the fuel”. Male and female operators that utilised the fuel were therefore affected by the same condition. On the source of supply of the fuel (reliability), the operators indicated that they had their supply of charcoal from the Municipal capital. Studies by Yager (2005) and Aldy (2011) revealed that food vendors preferred charcoal due to food taste and quality. They indicated in their respective studies that food vendors asserted that clean energy services (LPG and electricity) in the contexts of the lack of visible smoke and ashes emitting from the fuel combustion stood the chance of compromising the food taste and quality. Kojim (2011) had earlier found that high costs are by far the most important reason users do not switch to LPG.

The preference for firewood as useful energy also varied among enterprises but similar among gender. The study revealed that complete switching, where one fuel totally substitutes for another was uncommon. The reasons for multiple fuel use are varied and not dependent on economic factors alone, although the affordability or cost of the energy service also has an important bearing on the user’s choice. The study revealed that enterprises preferred to use more than one fuel because they wanted to increase the security of supply as similarly revealed by Pachauri and Spreng (2004) in India, where households used multiple fuels due to security of supply. In other cases, the choice is dependent on cultural, social or taste preferences. Operators (both males and females) regarded the fuel as unsafe and unclean which supports findings of Brüderle et al (2011), Anokye-Mensah (2001) and Barnes et al (1996). Despite these health risks, operators still used them because they were readily available, reliable and affordable. This calls for the need to intensify primary and public health care programmes on the efficient handling of the fuel so as to minimise associated health risks.

7.3.2 Non-Solid Fuels

The reasons for the choice for LPG were similar among both male and female food vending operators but with variations in terms of order of significance. With the male operators, factors of ‘safe/clean attribute, availability, affordability and technological’ were revealed to have significant influence on their preference for the fuel. FGD with men group revealed that ‘dignity’ served as a deterrent to using solid fuels. Likewise, among female users, only the factor of ‘safe’ attribute of the fuel significantly influenced their preference for the fuel. However factors such as ‘reliability and habit’ were revealed to have insignificant influence on operators’ preference for the fuel. Enterprise operators that used LPG further indicate that there were times where in a whole month they (male operators who relied solely on LPG) had no LPG (at Ejisu) and thus had to close down the enterprise.. The female enterprise operators in

such times resort to the use of solid fuels, which had health and environmental implications. Inkoom and Biney (2010) had earlier identified LPG supply irregularities and long queues at the point of sale as one of the major barriers affecting LPG use in Ghana.

In summary, there are several factors that influence preference for energy services: economic, technological, social, and cultural, among others. Several studies have however placed much emphasis on the economic factors. The study therefore asserts that in order to understand the energy needs of enterprise operators (of both men and women), there is the need to consider other non-economic factors as well as the differing reasons of men and women in using some energy services over others.

It however appears from the study's findings that the reasons for the preference of energy services are not very gendered at the RNFE as posited by some researchers but rather influenced by the type of activity one engages in. The local political economic circumstance and the social construction that shapes the RNFE of gender should be considered first. This is because gender largely plays a role in enterprise selection. Once that is done, the activity presents the most suitable energy service to be used. Having done these, then the factors that influences ones preference for an energy service over the other for productive use should be looked. This would aid meet the energy demands and needs of operators (male and females) at the RNFE, expand and sustain their activities and improve upon their living conditions.

7.4 Examining the implications of the supply and utilisation of the energy services available

7.4.1 Solid Fuels

There are several implications – benefits, risks and challenges – associated with the supply and utilisation of specific energy services among male and female enterprise operators. The study revealed that enterprise operators regarded the supply of firewood, biomass residue, and charcoal as reliable and affordable. Generally, the solid fuels were revealed to be reliable and in regular supply because they found in the farmlands and forests and thus were always available for utilisation for enterprise activities. The combustion of sold fuels has been revealed to be associated with several health and environmental risks.

Observations by the researcher revealed that women particularly within the food preparation and vending businesses and their youngest children were most exposed to smoke from the solid fuels. According to the Ejisu-Juaben Health Directorate, each of these three health outcomes is

a major disease category in most societies and hence enterprise solid fuel use is likely to be a major cause of disease burden in communities where it is prevalent. This is better explained by Schlag and Zuzarte (2008) who indicate that transition from solid fuels to modern energy is not only influenced by income as thought to be the case in the energy ladder but also social and technological factors as explained by the energy stack. Also, Herltberg (2003) was right when he claimed that there is little indication that the smoke from solid fuels is perceived as a nuisance by large numbers of users. Schlag and Zuzarte (2008) are however optimistic that better awareness would increase consumers' willingness to switch to cleaner and safer energy forms. The study therefore argues that determining the impact of solid fuel use at local levels is important for identifying and prioritizing environmental and public health interventions. The two main intervention options should focus on developing the physical and economic infrastructure to either encourage enterprises to switch to cleaner fuels, or to employ improved stoves with chimneys or other means of reliable ventilation. In either case however, education plays a vital role.

7.4.2 Non-Solid Fuels

The study revealed that the general shortages of LPG at certain times, negatively affected the operations of enterprises (largely the food vending businesses) that used them. Enterprise operators in attempts to cope with the unreliability in supply of LPG at times had to close down till they had supply of the fuel. This was common among the male operators. This resulted in lower returns (income) to pay for expenses of the enterprise. Female operators however resorted to the use solid fuels which as indicated earlier posed enormous health risks. Conversation with some experts revealed that inhaling the gas has both short term and long term effects. The study revealed that the procurement of LPG was the responsibility of young men (aged between 21 and 36 years), with no involvement of women in procuring LPG similar to findings in India by Pachauri and Spreng (2004), where males covered longer distances from the rural areas to the urban centres with LPG cylinders to procure the fuel to be used by women.

Women due to reasons of inflammability of the fuel, 'time-waste' and fear of explosion were unwilling to go to such sites and procure them

The supply of electricity was also revealed to be irregular. Electric power supply was characterised by interruptions and low currents at certain times. The Energy Commission and Municipal Energy Department (ECG) revealed that the frequent power outages were basically due to excessive demand for the fuel over its supply and inability to meet operational costs. Ghana's energy sector (hydro-electricity) is confronted with challenges of irregularity in supply

and unreliability for operations. As posited by the AGECC (2009) and IEC (2013), without a minimum consumption of energy, there will be no development. Ghana's middle income vision through growth and poverty reduction can better be enhanced if its energy supplies are reliable and sustainable. There is therefore the need to look for and examine cleaner and more reliable alternative sources of electricity (ASE), to complement the current and future demand for and supply of electricity for domestic and industrial operations. Thus the "so-called" cleaner energy services were revealed to be irregular in supply at the RNFE.

7.5 Summary of Discussions

Cabraal et al. (2005) show that if consumers, and this case enterprises have access to a variety of fuels, there is a greater tendency that they will choose modern fuels over traditional solid fuels. Research works by Davis (2008), Masera et al. (2000) and Barnett (2000) indicates that the switch from "inefficient" to more "efficient" fuels is not linear or unidirectional as posited by the energy ladder model. Complete switching, where one fuel totally substitutes for another, is rare. Therefore, users of solid fuels, who largely happen to be women should not be expected to make such switch. In this regard, governments have sought to encourage the construction of new LPG refilling centres in areas that are without access. The study observed that the activities at the RNFE were similar to those of the urban informal economy. Furthermore, energy services; both solid and non-solid, were available to both men and women at the RNFE. Everyone was not hindered from accessing or exercising control over any of them. Hence, physical access in terms of availability of the energy services however was not gendered (gender-determined

The factors influencing operators' preference for energy services were similar among gender. It thus appeared that, these factors were not gendered as posted by some researchers on the topic. What emerged was that the utilisation of the energy services determined by the type of enterprise one was engaged in which presented the most suitable energy service to be used. However, the type of activity was revealed to be socio-culturally defined and gendered. In an attempt to develop the RNFE, promoting productive uses of energy in essence is an attempt to make the energy input work directly and effectively for economic development (Kapadia, 2004). It is therefore almost a consensus that access to and productive uses energy services among enterprise in the RNFE should contribute to income generation. Synthesis of the study's findings are presented in Table 7.1.

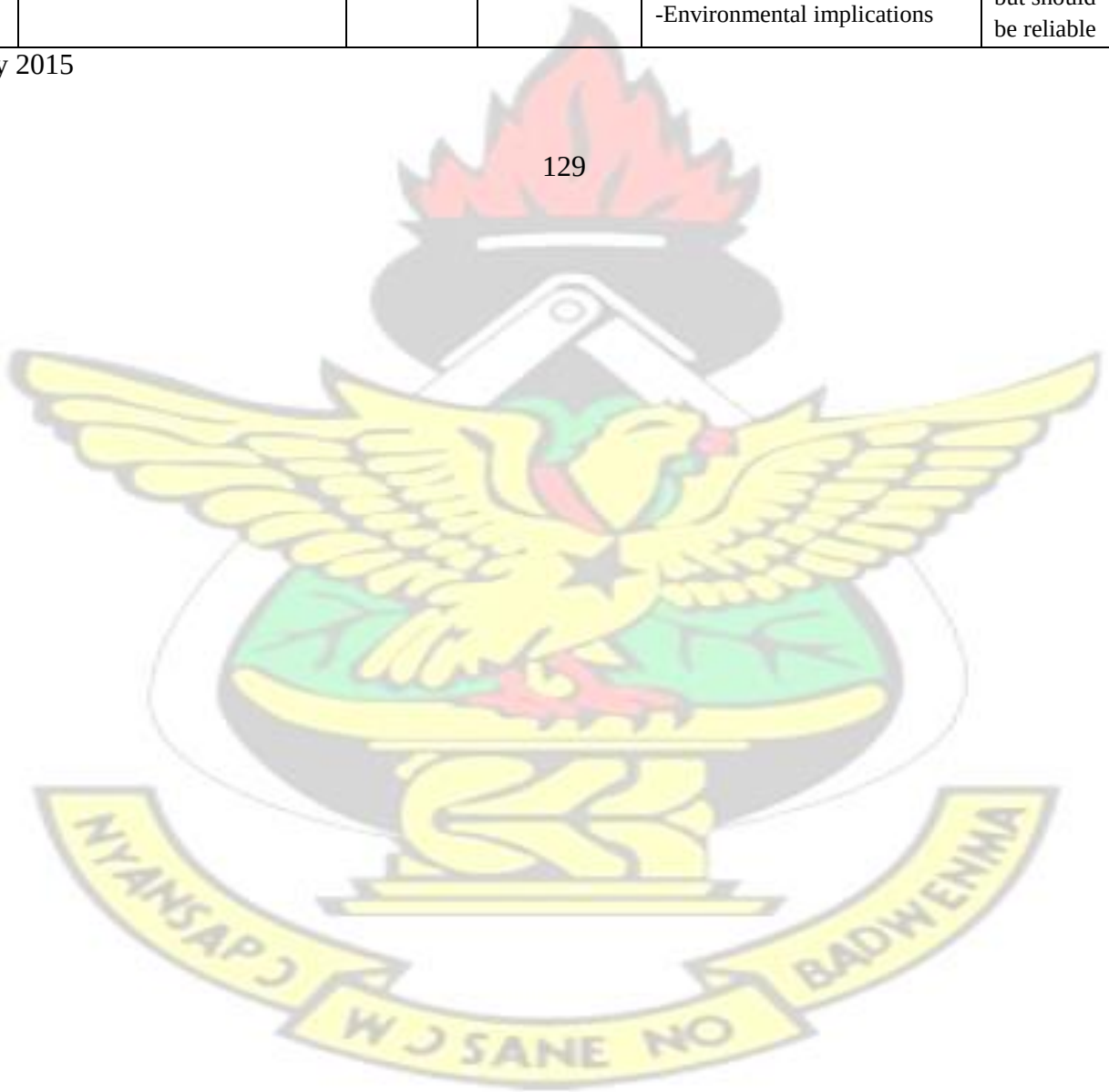
Though findings of the study has revealed that the preference for energy service at the RNFE is not gendered, the study however points out that in issues of who has access to what energy service, what it is being used, who procures it, and how much is paid for the service, and several other questions to be also tackled from a gender perspective, since there is a gender dimension to them. Also, theories on energy use and access should not only consider the general access and use of an energy service, but the specific gender issues in relation to them; thus the need to have theories that address the gender issues on energy access and use at both the domestic and enterprise/productive level. Lastly, interventions aimed at making available cleaner energy services should go beyond the economic environment or capacity of users to looking at the activities men and women are engaged in, the energy services they require for their specific activities, as well as the factors that will influence their decisions for the energy services. Understanding these specific issues will provide first-hand information which can be built upon to address the challenges at RNFE, gender-poverty gap, improve economic status of men and women and effectively mainstream gender into service provision.

Table 7.1: Synthesis of Research Findings

Fuel	Proportion (% of users)		Type of Enterprise	Reasons for Preference		Implication with supply and use	Preferred Alternative	Gender-Based conclusion
	Male	Female		Male	Female			
Electricity	40.3	25.3	Retail shops, metal works, bakery, hair and barbering shops, grinding mills, tailoring, phone repair, electrical and mechanic shops	Available, affordable safe/clean	Safe, technological, affordable	Irregular and unreliable. Operators have 57.1% monthly supply of it	None but want reliable and regular supply	Both men and women have 'equal' access to the service
Charcoal	-	17.5	Chop bar and food vending enterprises	-	Affordable, habit, cooks fast	-Harmful due to the exposure to smoke. -Purchased from charcoal truck operators	LPG and grid electricity but should be reliable	Used only by women and so are more exposed to health risks due to the combustion of the fuel
LPG	5.8	1.9	Food vending enterprise	Safe, available, affordable	Safe	-Unreliable supply and harmful. -Procured by men who travel over 23.81km to retail points in Ejisu and even outside Ejisu	-	Both men women have access to the fuel. However women use other alternative solid fuels when there is shortage of the fuel, whiles the men close down the enterprise until there is supply
Kerosene	-	18.8	Chop bar, food vending, fish and meat mongering and bakery shops	-	Available, habit, reliable	-Harmful. The fuel is used to light solid fuels which exposes users to smoke -Procured from retailers in the communities	-	Used only by women to light fire (solid fuels) and so are more exposed to health risks due to the combustion of the fuel
Biomass Residue	2.6	23.4	Chop bar, food vending, palm oil extraction, fish and meat mongering and bakery shops	Available, affordable, reliable	Reliable, habit, available	-Gathered free from the environment by women -Harmful to operators due to exposure to smoke	-	Used by both men and women to light fire for their activities. Thus both are exposed to smoke and its associated health risks
Petrol	2.6	18.8	Retail shops, hair salons, barbering shops, phone repair and electrical shops	Used as an alternative fuel to power ge nerators during electricity o utages		-Comes at an extra operational cost to operators -Procured from retail points in the Municipality	Reliable and regular grid electricity supply	Used by both men and women to generate electricity

Firewood	5.8	3.2	Chop bar, food vending, palm oil extraction, bakery and fish and meat mongering	Available, reliable, affordable	Available, reliable, affordable	-Gathered by women from the farms and environment. -Harmful due to the exposure to smoke -Environmental implications	LPG and grid electricity but should be reliable	Used by both men and women for their activities. Thus both are exposed to smoke and its associated health risks.

Source: Field Survey, July 2015



7.6 Recommendations

Based on the study findings, recommendations have been presented to improve activities at the RNFE of gender, enhance equal access and utilisation of reliable and cleaner energy services and improve the socio-economic lives of rural people in the study area. The emphasis is placed on activities in the RNFE and energy usage at the RNFE as ways of improving the sector and living conditions, as well as the policy implications and areas for future research. These interventions have been grouped into long term and short to medium term options. Short term ones are those that can be addressed within the first six to twelve months, whilst the medium term options can be done within the first to about the fifth year, with the long term ones from one to about eight years as they require huge resources for their implementation compared to the short and medium term ones.

Long-term Interventions

7.6.1 Policy Orientation towards developing the RNFE

Attitudes towards activities of the RNFE which are similar to the urban informal economy are gradually changing but are not only peripheral and not deep enough to ensure sustainable enterprise development in the Municipality. The study recommends the need for a change towards a complete and unconditional acceptance and accommodation in the formal environment. The policy intervention being proposed by the study requires the integration of the RNFE into the mainstream Municipal economy and environment in physical terms. This should be spearheaded by the Ministry of Trade and Industry through the National Board for Small Scale Industries/BAC and the Municipal Planning Authority. This is significant because the RNFE is a manifestation of people's needs, rights and ingenuity in creating jobs and establishing enterprises. There is also no duality between the formal and non-farm economies; rather the activities are all components of the integrated municipal economy, complementing each other's roles. Based on this policy orientation, the strategies proposed should consider two key areas: institutional and spatial dimensions.

7.6.1.1 Institutional Support for Enterprise Development

The study recommends for the need for the Municipal Assembly and other local actors to introduce changes in its local planning regulations by removing restrictive and prohibitive measures, implementing business and labour regulations concerning non-farm enterprises in a gradual manner, and increasing the enterprises access to public facilities and services. This should be done taking into consideration the gender needs.

7.6.2 Encouraging Public-Private Partnerships to promote investment into Research and Development (R&D) and the deployment of alternative cleaner energy forms

The study recommends encouragement of public-private partnerships by government bodies; Ministry of Energy, Energy Commission, and the PURC to take over from solely governmental initiatives. Due to the fact that solar systems are costly beyond the financial strength of operators, PPPs should support research into improved ways of using solar energy for use. The partnerships should seek to promote research into the viability of using solar concentrating panels as substitutes or complements for electricity in the enterprises that utilise electricity, especially those that run late into the night (provision/retail shops). The partnership should further seek to promote the development of biogas systems to supply sustainable energy for the food preparation, welding and bakery enterprises. These interventions should however go with some public education as well as the participation of gender (enterprise operators) for the acceptance of the technologies.

7.6.3 Encouraging Gender Participation in Energy Policy Initiatives

Having identified that the specific energy needs of enterprises run by men and women at the RNFE, the study calls for a shift in the paradigm in terms of policy initiatives, whereby policy attempts should ensure the participation of gender. Thus the National Energy Policy and other Energy intervention schemes should consider the participation of gender since they are directly involved in handling and managing various energy forms. The question of how policy translates into implementation should be critically explored so that measures will be put in place to address them. The Ministry of Energy and other relevant stakeholders in the energy sector should ensure that policy initiatives and projects are formulated to have gender-based outcomes. Both male and female enterprise operators' participation must be ensured in all initiatives so that they become direct beneficiaries of the initiatives. Therefore, in the formulation of energy supply and access policies, greater attention should be given to the gendered energy needs at the RNFE.

Short to Medium-Term Interventions

7.6.4 Simplifying and improving the administrative and regulatory framework for enterprises to acquire commercial meters

The Municipal Assembly through the Business Advisory Center (BAC) should ensure that all the enterprise owners are well informed and made to register so as to have a database of the enterprises, create the avenue to effectively mobilise revenue from the enterprises to undertake

its planned activities. Furthermore, there should also be conscious steps to sensitise owners of enterprises on efficiently managing their financial statuses (revenues and expenses). Owners should be educated on how to practice sound savings so as to have 'easy' access to credit support from financial institutions to sustain their businesses, pay their taxes (as source of IGF) to the Municipal Assembly for it (the Assembly) to undertake its planned programmes and projects.

7.6.6 Investments to Encourage Clean use of Fuels

Interventions by the Energy Commission and the Ministry of Energy should be designed to encourage enterprise operators that specifically utilise solid fuels to move up "the energy ladder" to cleaner fuels at a lower income levels than would occur without intervention. The interventions would require that the reliability, affordability and availability of the cleaner fuels are enhanced. Furthermore, there may be enterprise operators whose expenses (on enterprise operations and household) leave them with no cash income (no turnover). These operators would have access to only wood fuels and will be unwilling to access cleaner fuels, let alone acquire improved end-user equipment, without larger subsidies which are often unsustainable in the long-term. Instead of subsidies (which is unsustainable), support can be given in the form of micro-credit and loans. There should however be efforts to effectively target these operators so as to disseminate improved end-user equipment to them to reduce associated challenges with the use of wood fuels. There is therefore need for increased awareness of energy management through improved stoves, biogas, energy efficiency and other technologies. The Energy Commission and the Ministry of Energy could increase the proportions of food-based enterprises using LPG as their main source of energy if the erratic supply of LPG is addressed. Enterprise operators, particularly female operators, should be further assisted through alternative and convenient means to have easy access to LPG. For instance, cylinders of different sizes could be widely distributed for easy access.

7.6.7 Intensify Public Health and Primary Care Programmes

As the study observed that exposure to smoke from solid fuels is and can be a major cause of ill health, efforts should be made to reduce the burden of disease from solid fuel combustion through intensive public health and primary care programmes specifically for operators' who utilise solid fuels (particularly female operators, since they are more exposed to acute lower respiratory infections (including pneumonia) and chronic obstructive pulmonary disease and lung cancer. Furthermore, measures by operators such as behavioural modifications to reduce, improvement in ventilation, and improvement in end-user equipment which are more

energyefficient are key to reducing risk of exposure to smoke from the combustion of solid fuels. The programme should place emphasis on the negative implications (health and environmental) of utilising the traditional fuels for operators to better appreciate the implications. The public health and primary care programmes and interventions should also be geared towards encouraging operators to use high quality and lower emitting fuels (kerosene, LPG, or biomassbased alcohol and bio-gas).

Furthermore, operators that utilise LPG should be educated on the importance of using the fuels; avoiding continuous inhalation of the fuel, and the implications of not using them so as to reduce the revealed associated risks of mishandling the fuel. The survey shows that with improvements in literacy, the adverse health impacts of respiratory and eye-related diseases are likely to be reduced. The Ministry of Energy should work closely with the Ministry of Information, the Energy Commission and Ghana Health Service (Municipal Health Directorate) to undertake these programmes and interventions. These interventions will call for the development of effective communication medium/tools to channel the message across to the operators and all members of the communities.

7.7 Conclusion

Energy is a major input for economic production. It is clear from the study that for a developing economy like Ghana, economic growth is directly and strongly related to injection of adequate energy. The rural non-farm economy (RNFE) has over time grown rapidly, and contributing significantly to both employment and rural income growth. The energy needs (energy fuel type, reasons for energy fuel preference and implications) were unique among the enterprises at the RNFE which were gender. The study revealed that the energy needs (utilisation of energy fuels and factors influencing choice of fuels) are different among enterprises which are ran by men and women. The fuels range from traditional solid fuels to cleaner energy fuels. The factors influencing male and female operators' preference for the specific energy services were similar, with variations in terms of the order of significance. Thus, whiles male operators used energy due largely to economic reasons, female operators utilised fuels based on economic, health and socio-cultural reasons. Having said this, the factors influencing preference for energy services were found not to be gendered, and that there is no significant association between gender and the type and preference for energy service for productive use at the RNFE. The study revealed that cleaner energy fuels (LPG, Petrol and Electricity) were available but irregular in supply, while solid fuels were readily available and regular in supply but had health and environmental implications. There was little involvement of women in the procurement of LPG due to safety

reasons. The study recommends that there should be encouragement of private-public partnerships to promote research into alternative but sustainable energy forms such as solar and biogas for the enterprises. Also, there should be public and primary health care programmes to educate operators on the negative implications associated with the use of solid fuels so for them to better appreciate the implications and find cleaner energy alternatives. Lastly, the study recommends that in order to address gender-energy poverty nexus, there should be the encouragement on gender participation in policy initiatives so that they become direct beneficiaries of initiatives. The formulation of energy supply and access policies should also give greater to gender equity.

7.8 Areas for further research

Underpinned by the fact that rural areas are energy poorer, the study proposes that in order to achieve the aim of Universal Access to Cleaner energy, a similar approach used by the study (identifying the energy forms, the factors that affect decision to use the energy forms and the implications associated with the use and supply of the energy forms) should be adopted to understand the gender-energy needs at the household level for domestic use. Also, due to the diversity of various localities across the country, future studies/surveys should expand the scope to cover the productive and domestic use of energy services in rural localities across the ten administrative regions of Ghana. This is because areas without the influence areas of cities may exhibit different characteristics from those with influence of cities (which may exhibit peri-urban features). The study approach should be supported with other qualitative techniques so as to have "in-depth" understanding of the unique energy needs of gender in order to ensure effective mainstream of gender issues into energy access and utilisation policies, programmes and plans.

7.9 Contribution of the study to knowledge

The prime reason for undertaking this research was to contribute to knowledge within the energy access and service provision arena. The results of this study are to provide useful findings and recommendations for energy interventions to promote access to cleaner energy services for productive use among gender. Premised on the analysis and discussions, it was realised that the study has contributed to the following:

The study revealed that energy needs at the RNFE are different among enterprises and men and women. Access to energy services has direct impact on the growth of enterprises, which are energy-dependent. Women due to socio-cultural reasons largely operated the food vending

enterprises and used traditional solid fuels at the expense of cleaner energy services for diverse reasons; but predominantly availability, affordability and cultural (taste and cooks fast). The men dominated the electrical, wood and metal-based enterprises and largely used electricity from ECG. Despite this, the factors influencing preference for energy services were similar and not very gendered. The major factor was the type of enterprise one was engaged in. Gender only played a major role in the enterprises selection. The first point of reference should be the consideration of the local political economic circumstance and social construction that have shaped the RNFE of gender. This therefore calls for the need to have a relook at how gender and energy issues are treated in the energy discourse.

Works on the productive use of energy service among gender have largely focused on "the impact of rural electrification on communities. This study however considered all available forms of energy at the RNFE for productive use by men and women. This was to provide firsthand knowledge in guiding policy formulation on mainstreaming gender into energy service provision interventions and also appropriately attempt to bridge the gender-energy gap. Though studies have found affordability, availability and reliability to be influential factors of the choice of energy services at the household level, this study has revealed socio-cultural and technological factors (taste, cooks fast, habit, technical requirement) in addition to similar factors (affordability, availability and reliability) at the productive level at the RNFE. Theoretically, the study has revealed that operators utilise energy services that maximises satisfaction which supports the neo-classical theory. Lastly, food-based enterprises (largely run by females) stack energy services thus supporting the assertion of the energy stacking theory.

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APPENDIX I

Table 3.: Confidence level with their corresponding Z factors

Confidence level	Z factor
99.9	3.29
99.7	3.0
99.5	2.8
99.0	2.57
98.0	2.32
95.5	2.0
95.0	1.96
92.0	1.75
90.0	1.64
85.0	1.43
80.0	1.28

Source: Computed from Spiegel, 1972 and tallied with Air University, 1996 **APPENDIX II**

Table 3.8: Enterprise Selection using the Criteria Selection Test

S/N	Enterprise	Criteria						Average Score
		1	2	3	4	5	6	
1	Chop bars	1	1	1	1	1	1	1
2	Provision stores	1	1	0	0	1	1	0.67
3	Metal Works/Welders	1	1	1	1	1	1	0.83
4	Bakery shops	1	1	1	1	1	0	0.83
5	Hair salons	1	1	1	0	1	1	0.83
6	Grinding mills	1	1	1	0	1	1	0.83
7	Tailoring	1	1	1	0	1	1	0.83
8	Barbering shops	1	1	1	0	1	1	0.83
9	Carpentry shops/Sawmilling	1	1	1	0	1	1	0.83
10	Phone repair shops	1	1	1	0	1	1	0.83
11	Electrical and electronic shops	1	1	1	0	1	1	0.83
12	Palm oil extraction points	1	1	1	1	1	1	1
13	Mechanic shop	1	1	1	1	1	0	0.83
14	Food vending shops	1	1	1	1	1	1	1

15	Meat and fish mongering	1	1	1	1	1	1	1

Source: Author's Construct, June 2015

APPENDIX III

3.9: Estimate of Population of Towns

Town/Population	1970	1984	2000	Growth Rate	2015*	Dominant Economic Activity
Kubease	838	1,034	1,787	3.4	2,976	Agriculture
Boankra	989	575	676	1.01	786	Agriculture
Adadientem	498	527	565	0.435	603	Agriculture
Hwereso	662	855	986	0.89	1,127	Agriculture

Source: EJMA MTDP 2010 -2013 and Author's Construct

$P_t=P_oe^{rt}$ In $(P_t/P_0)/t$ $P_o= P_t/e^{rt}$ **APPENDIX IV**

Justification of Sample Size Formula

$$n = \frac{NZ^2p(1-p)}{Nd^2 + Z^2p(1-p)}$$

Where: n= sample size; N= study population/number of energy-dependent productive enterprises in the study area; Z= the value of the normal variable/ no. of standard deviation units corresponding to confidence level (1.96) for a confidence level of 95%; p= the highest possible proportion (0.5); and d= the margin of error (0.05).

The formula is used to estimate the sample size when the researcher has no idea about a population's behaviour and variations. Slovin's formula of $N/1+N(e)^2$ shows that is the error margin automatically 8% when confidence level is 92% which isn't always the case. Lynch et al's (1974) formula however allows the researcher variation in the confidence level and margin of error (*d)* when determining the sample size of a population in a study.

The population proportion (p) in the formula also makes the formula preferable when you are dealing with more than two groups of respondents and there may be variations in their characteristics. The samples/groups are independent; that is, observations in group 1 may not

be affected by observations in group 2, and so the researcher gives the 50% chance in variations in the groups. This is because, the larger the sample size (n) or the closer p is to 0.50, the closer the distribution of the sample proportion is to a normal distribution.

Alternatively, the *population proportion (p)* is the proportion of individuals in the population who have a certain characteristic of interest (for example, the proportion of all enterprise owners who use electricity for their operations, or the proportion of all owners who own cellphones). For example, if you take a sample of 100 enterprise owners and find 60 of them own cellphones, the sample proportion of cellphone-owning enterprise owners is 0.6 (60/100). However, because this is uncertain at the beginning of the research, the researcher gives a 50% chance of that variation or possible outcome.

The formula thus has 'all' the necessary parameters needed for this study and for accurately determining the sample size for a research, premised on the conditions of the study/researcher.

APPENDIX V

Table 5.10: Educational Attainment of Enterprise Operators

Enterprise	None		Primary		JHS		SHS/Tech		Vocational		Tertiary		T otal	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Chop bars	-	7	-	4	-	0	-	0	-	0	0	0	-	11
Provision/Retail shops	2	3	11	16						0	0	0	13	19
Metal Works/Welders	0				4		1		1	0	0	0	6	0
Bakery shops	-	0	-	3	-	0	-	0	-	0	0	0	-	3
Hair Salons	-	1		6		4		1		0	0	0	0	12
Grinding mills	3	0	1	1	1			-		0	0	0	5	1
Tailoring	0	0	3	0	4	3		1	1	2	0	0	8	6
Barbering shops	2		3		2		1		2	0	0	0	10	0
Carpentry shops	0		2		3				1	0	0	0	6	0
Phone repair shops	0		4		3			-	0	0	0	0	7	0
Electrical and electronic shops	0	-	1	-	1	-	4	-	4	0	0	0	10	0
Palm oil extraction points	3	3	1	4	0	0	0	0	0	0	0	0	4	7
Mechanic shop	-	-	-	-	2	-	1	-	-	0	0	0	3	-
Food vending shops	3	5	2	2	4	-	-	-		0	0	0	9	7
Meat and Fish Mongering	-	8	-	0	-	0	-	0	0	0	0	0	0	8
TOTAL	12	27	28	36	24	7	7	2	9	2	0	0	80	74

Source: Field Survey, July 2015

APPENDIX VI

Table 5.13: Income Distribution in decile of female enterprise operators

Decile Grouping	Range (GH¢)	Number	%	% Cumulative Frequency	Mean Income	%	% Cumulative Mean Income
1	0 -100	1	1.35	1.35	100	5.04	5.04
2	101 – 200	8	10.81	12.16	175	8.83	13.87
3	201 – 300	25	33.78	45.94	248.80	12.55	26.42
4	301 – 400	29	39.19	85.13	375.86	18.95	45.37
5	401 – 500	9	12.17	97.30	483.33	24.37	69.74
6	501 – 600	2	2.70	100	600	30.26	100
7	601 – 700	0	0	100	0	0	100
8	701 – 800	0	0	100	0	0	100
9	801 – 900	0	0	100	0	0	100
10	901 – 1000	0	0	100	0	0	100
Total		**74**	**100**		**1982.99**		

Source: Field Survey, July 2015

APPENDIX

VII

Table 5.13: Income Distribution in decile of male enterprise operators

Decile Grouping	Range (GH¢)	Number	%	% Cumulative Frequency	Mean Income	%	% Cumulative Mean Income
1	0 -100	1	1.25	1.25	100	2.24	2.24
2	101 – 200	24	30	31.25	182.50	4.09	6.33
3	201 – 300	22	27.5	58.75	281.82	6.31	12.64
4	301 – 400	11	13.75	72.50	377.27	8.45	21.09
5	401 – 500	12	15	87.50	496.15	11.11	32.20
6	501 – 600	4	5	92.50	587.50	13.15	45.35
7	601 – 700	3	3.75	96.25	666.67	14.92	60.27
8	701 – 800	2	2.5	98.75	775	17.35	77.62
9	801 – 900	0	0	98.75	0	0	77.62
10	901 – 1000	1	1.25	100	1000	22.38	100
Total		**80**	**100**		**4,466.91**	**100**	

Source: Field Survey, July 2015

APPENDIX

VIII

Income Distribution by Gender

Income Decile	Range	Male		Female	
		Freq	Mean Income (GH¢)	Freq	Mean Income (GH¢)
1	0 -100	1	100	1	100
2	101 – 200	24	182.50	8	175
3	201 – 300	22	281.82	25	248.80
4	301 – 400	11	377.27	29	375.86
5	401 – 500	12	496.15	9	483.33
6	501 – 600	4	587.50	2	600
7	601 – 700	3	666.67	0	0
8	701 – 800	2	775	0	0
9	801 – 900	0	0	0	0
10	901 – 1000	1	1000	0	0
Total		**80**	**446.69**	**74**	**330.50**

Source: Field Survey, July 2015

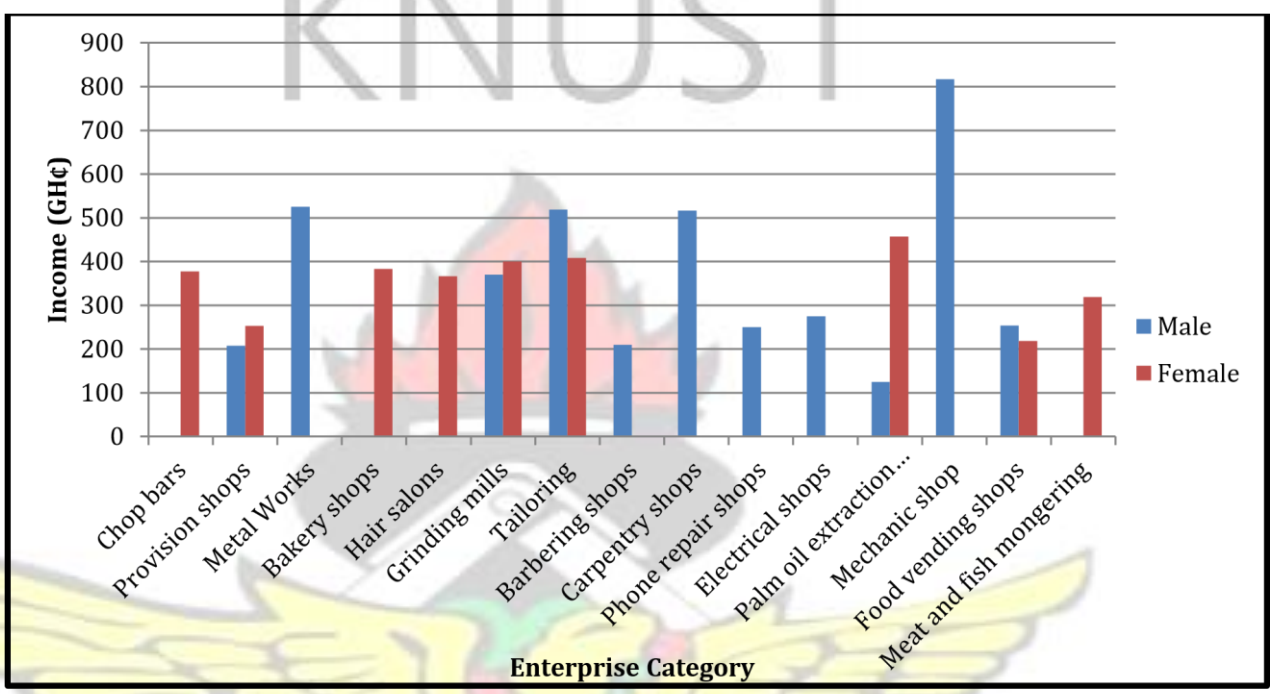
Average Monthly Income by Enterprise and Gender

S/N	Category of Enterprise	Male (GH¢)	Female (GH¢)	Average (GH¢)
1	Chop bars	0	377.27	377.27
2	Provision/Retail shops	207.69	252.63	234.37
3	Metal Works/Welders	525.00	0	525.00
4	Bakery shops	0	383.33	383.33
5	Hair salons	0	366.67	366.67
6	Grinding mills	370	400	375.00
7	Tailoring	518.75	408.33	471.42
8	Barbering shops	210.00	0	210.00
9	Carpentry shops	516.67	0	516.67
10	Phone repair shops	250.00	0	250.00
11	Electrical shops	275.00	0	275.00
12	Palm oil extraction points	125	457.14	463.63
13	Mechanic shop	816.66	0	816.66
14	Food vending shops	253.33	218.43	265.62
15	Meat and fish mongering	0	318.75	318.75
AVERAGE		**446.69**	**330.50**	390.51

Source: Field Survey, July 2015

APPENDIX

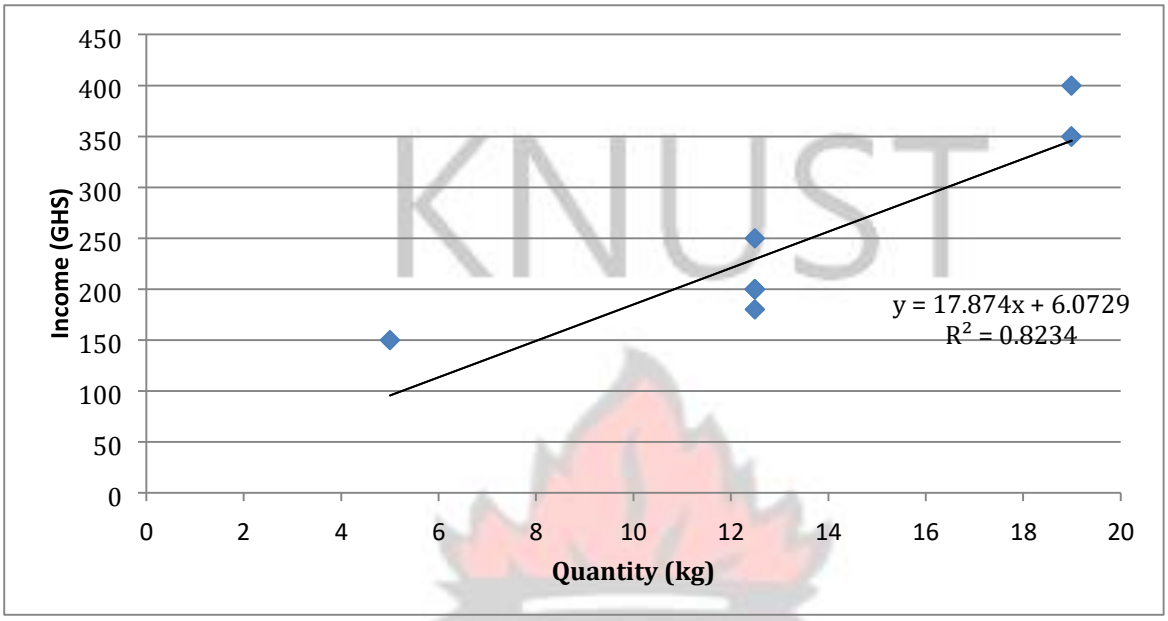
IX



Average Monthly Income of Enterprise Operators

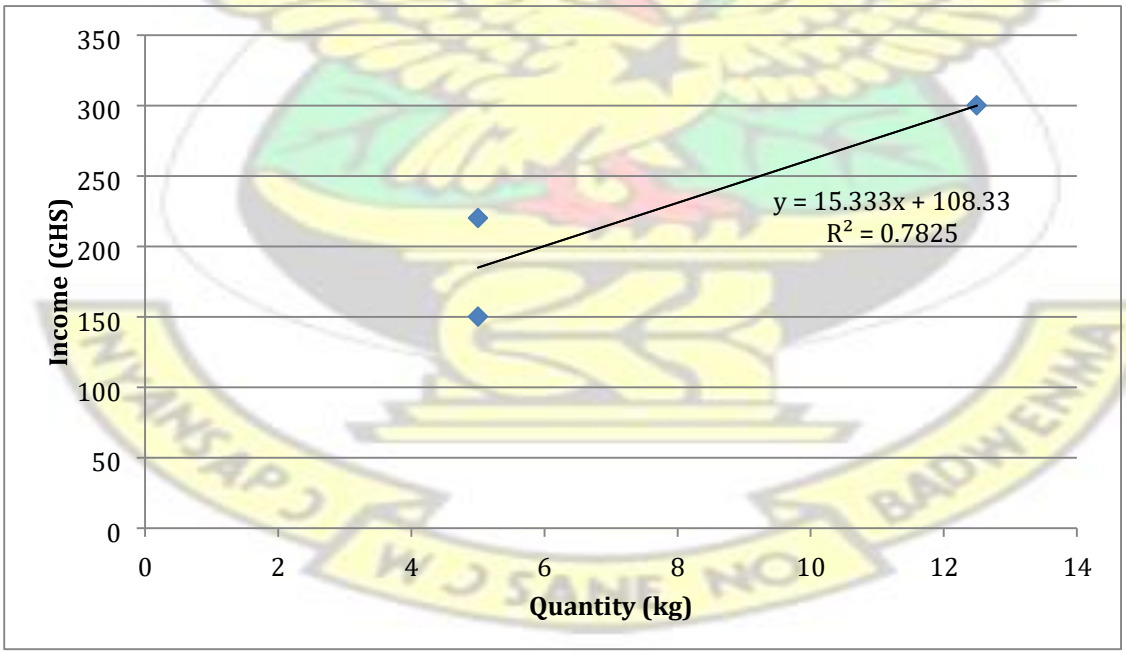
Source: Field Survey, July 2015

APPENDIX X



Linear Regression on Monthly Income and Quantity of LPG Consumed by Male Operators

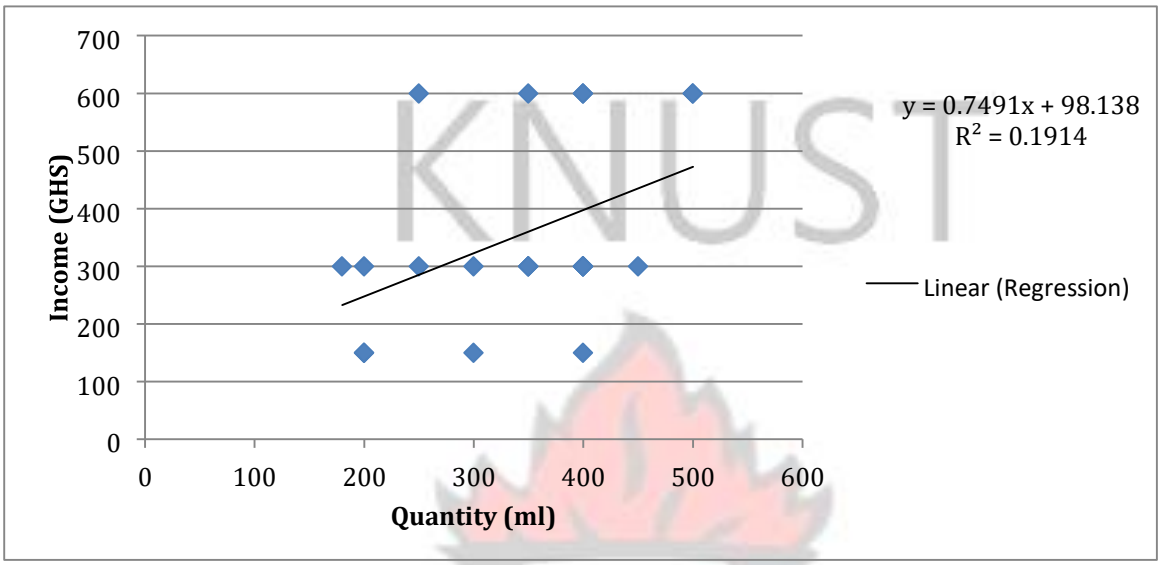
Source: Field Survey and Author's Construct, July 2015



Linear Regression on Monthly Income and Quantity of LPG Consumed by Female Operators

Source: Field Survey and Author's Construct, July 2015

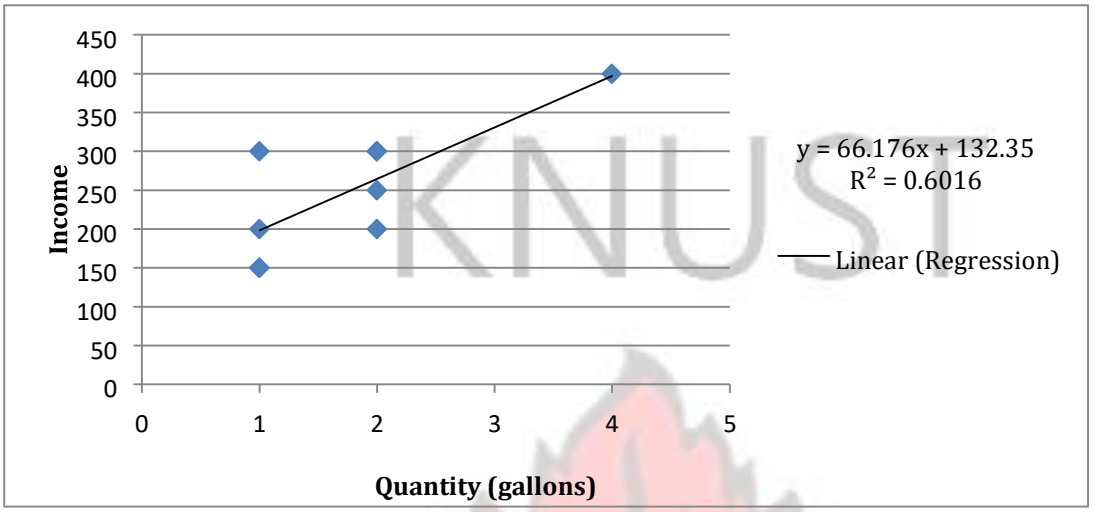
APPENDIX XI



Linear Regression on Monthly Income and Quantity of Kerosene Consumption by Enterprise Operators

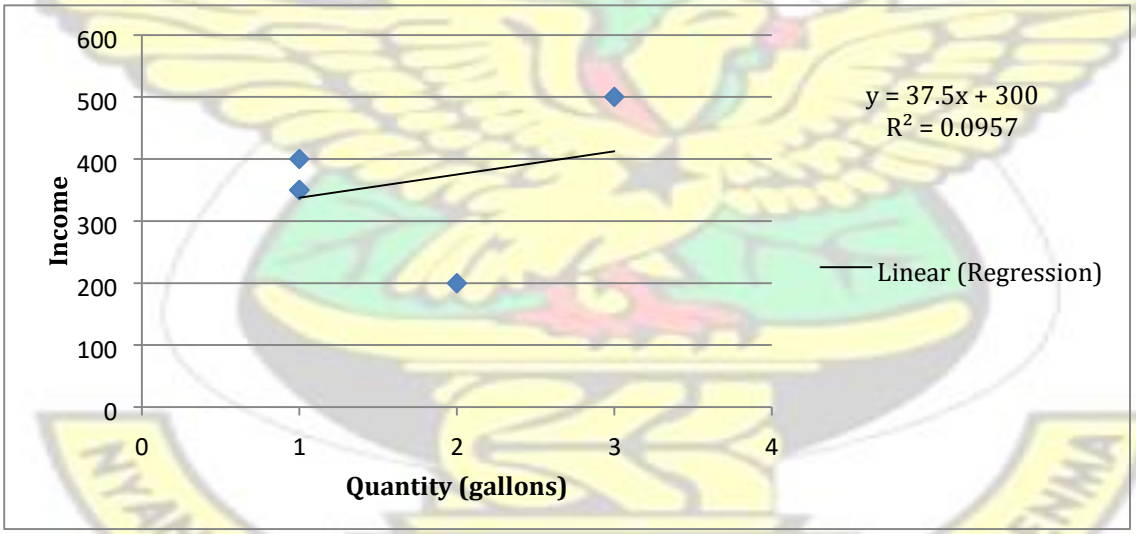
Source: Field Survey and Author's Construct, October 2015

APPENDIX XII



Linear Regression on Monthly Income and Quantity of Petrol Consumption by Male Enterprise Operators

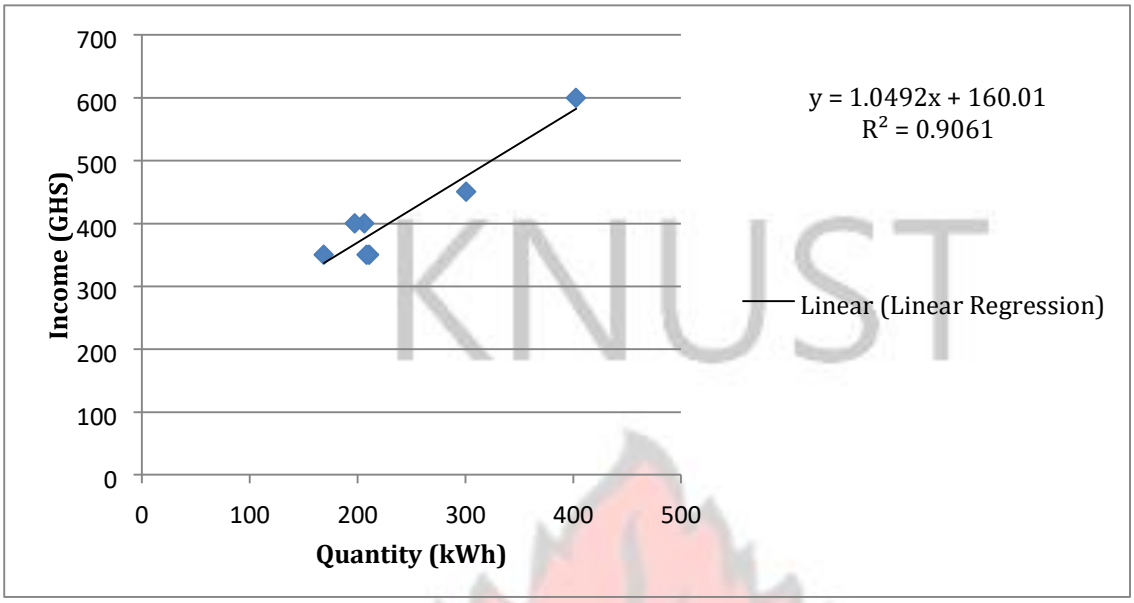
Source: Field Survey and Author's Construct, October 2015



Linear Regression on Monthly Income and Quantity of Petrol Consumption by Female Enterprise Operators

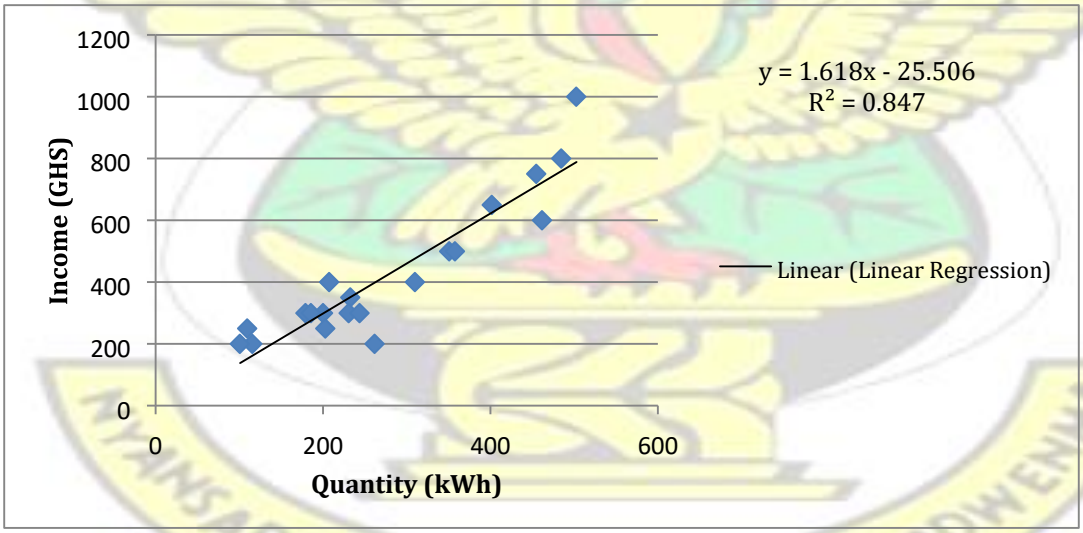
Source: Field Survey and Author's Construct, October 2015

APPENDIX XIII



Linear Regression on Monthly Income and Quantity of Electricity Consumption by Female Enterprise Operators

Source: Field Survey and Author's Construct, July 2015



Linear Regression on Monthly Income and Quantity of Electricity Consumption by Male Enterprise Operators

Source: Field Survey and Author's Construct, July 2015

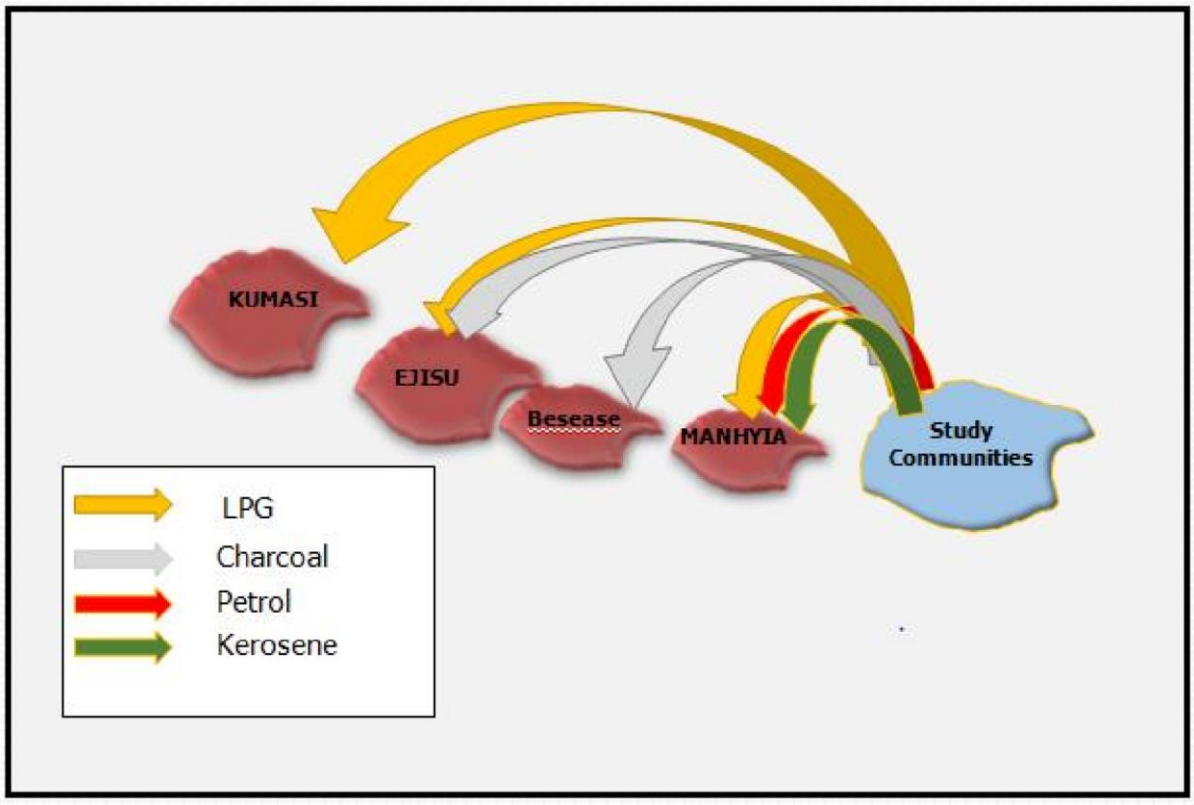
APPENDIX XIV

Gender * Choice of Energy Fuel for Productive use Crosstabulation

			Does gender influence energy choice		Total
			Yes	No	
Sex	Male	Count	44	36	80
		Expected Count	46.8	33.2	80.0
	Female	Count	46	28	74
		Expected Count	43.2	30.8	74.0
Total		Count	90	64	154
		Expected Count	90.0	64.0	154.0

Source: Field Survey, July 2015

APPENDIX XV



Sources of Energy Supply

Source: Field Survey, July 2015

APPENDIX XVI

DEPARTMENT OF PLANNING

COLLEGE OF ART AND BUILT ENVIRONMENT

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

ENTERPRISE SURVEY QUESTIONNAIRE

(GENDER AND ENERGY SERVICES IN THE RURAL NON-FARM ECONOMY OF EJISU-JUABEN MUNICIPALITY)

Questionnaire Number: ..... Name of Community: .....

Name of Respondent: ..... Telephone No. of Respondent: .....

Name of Enumerator: ..... Telephone No. of Enumerator: .....

Date of Interview: ...../...../.....

Time Started: ..... Time Ended: .....

Data Entered by: ..... Date: .....

This study is to kindly solicit your opinion on the choice of energy fuels by men and women who operate productive enterprises in the Ejisu-Juaben Municipality. This study is towards the partial fulfilment for the award of Master of Philosophy Degree in Planning. This is purely for academic purpose but not for profit motives, response given will be treated confidentially.

A	**PROFILE OF ENTERPRISE OWNER/OPERATOR** **Please tick the appropriate responses**	
	Sex of Respondent/Owner	Male [ ] Female [ ]
	Age	..... years old
	Are you the head of your household?	Yes [ ] No [ ]
	Highest educational level attained	None/no formal education [ ] Primary [ ] JHS/JSS/Middle School [ ] SHS/ Technical [ ] Vocational [ ] Tertiary [ ] Other (specify) ..... .
	Were you born and raised here?	Yes [ ] No [ ] Don't Know[ ]
	If No, what is your hometown (include region)?	**Hometown** **District** **Region** ....
	Marital Status	Single [ ] Married [ ] Widowed [ ] Consensual Union [ ]
B	**CHARACTERISTICS OF ENTERPRISE (Please tick the appropriate responses)**	
	What is the enterprise's core business?	
	How long have you been working in this enterprise?	..... years
	Is the enterprise registered with the appropriate authorities?	Yes [ ] No [ ]
	If Yes, list authority registered under.	
	If No, explain why the business is not registered?	Not necessary [ ] Don't know where [ ] No money [ ] Night business [ ] Not government business [ ] Other (specify).....
	Do you pay toll/tax to the city authorities	Yes [ ] No [ ]
	If yes, how much do you pay?	GH¢.....
	Are you (the enterprise) a member of any association	Yes (Name of association)..... No [ ] 2
	Number of Employees	Male ..... Female ..... Total .....
	Source of Start-up capital for enterprise establishment	Personal Savings [ ] Group savings/Bank [ ] Relative/Friends [ ] Family property [ ] Other (specify) .....

	Reasons for establishing enterprise (**Multiple Answers allowed)**	Economic [ ] Only source of Livelihood [ ] Other (specify)..... .....
	Final Products produced/ What services/goods do you render/produce in each enterprise/commercial activity?	.....
	Type/Category of customers	Retailers [ ] Wholesalers [ ] Other (specify).....
	Location of Customers	Within Community [ ] Outside Community [ ].....
	What type of activities is the enterprise into?	Service based [ ] Manufacturing/ production based [ ] Commercial/trading [ ] Other (specify).....…….....

Bi If into **MANUFACTURING**, please answer the following

Type of Items Manufactured	**Unit price (GH¢)**	**Total (GH¢)**	**Category/Type of Customers**

Bii If into **SERVICE ENTERPRISE,** please answer the following

How many people do you serve in a day (averagely)	
Who are your customers/clients?	
How many employees does the enterprise have?	…….employees .....Males .....Females
What is the peak and lean hours/seasons of your enterprise?	Peak season ……..... Lean season …….....
On the average how much income do you make?	..... GH¢ day/week/month

C **ENTERPRISE INCOME**

What is the income/revenue of the enterprise? (Please, indicate whether the earnings are daily/weekly/ monthly/seasonal (e.g. GH¢10/day)) and make sure the income/revenue is recorded appropriately. Note the income/revenue	..... GH¢/day/week/month

	TRANSFER PAYMENTS (OTHER SOURCES OF INCOME/REVENUE TO THE ENTEPRISE)	
	Do you obtain **income/revenue** from any other source to run the business?	Yes [ ] No [ ]
	If **YES,** choose the most appropriate answer(s) from below and indicate the amount per day/wee/month/year	
	Remittances (specify e.g. from son, daughter, etc).	Amount..... GH¢/day/week/month/year
	Insurance (e.g. old age, disability, etc)	Amount..... GH¢/day/week/month/year
	Monetary allowance and gifts	Amount..... GH¢/day/week/month/year
	Income from rent of property (please estimate monthly amount if lump sum is received).	Amount..... GH¢/day/week/month/year
	Interest on savings and loans	Amount..... GH¢/day/week/month/year
	Reward and prize	Amount..... GH¢/day/week/month/year
	Other (specify).....	Amount..... GH¢/day/week/month/year
OV ERALL TOTAL		

D	**EXPENDITURE(Record the Expenses made on running the Enterprise only)** **AVERAGE MONTHLY EXPENSES ON : (Indicate the most appropriate item and indicate the amount)**			
	Fixed Cost Items	**Day/Week/Mnth/Year (GH¢)**	**Variable Cost Items**	**Day/Week/Month/Year (GH¢)**
	Purchase and Rental of Land/Shop		Energy (*Reconcile this with sub-section.....)*	
	Land charges and administrative cost		Wages/Salary (Average amount * No. of workers)	
	Servicing enterprise-related loans		Water	
	Replacement values of machines including depreciation, interest and insurance.		Transportation	
	Other (specify) .....,.....		Machine repair and maintenance	
	Other (specify) .....,.....		Taxes/Tolls	
	Other (specify) .....,.....		Renting machines/equipment	

Other (specify) ……,……		Other (specify) ……,……		
Other (specify) ……,……		Other (specify) ……,……		
Other (specify) ……,……		Other (specify) ……,……		
Other (specify) ……,……		Other (specify) ……,……		
Other (specify) ……,……		Other (specify) ……,……		
Other (specify) ……,……		Other (specify) ……,……		
OVERALL TOTAL		**OVERALL TOTAL**		

E	**ENERGY USAGE BY THE ENTERPRISE/ENERGY SUPPLY AND UTILISATION** **Types of energy used and purposes for which they are used (Please tick (√) as appropriate)**										
	Fuels/Energy Type	**Purpose for which fuel is used**							How much do you spend on the quantity of energy by type mentioned in question 39 per day/week/month? (Please specify whether it is day, week or month).		
		Lighting	Cooking	Heating	Washing	Cooling	Automobile (eg. in cars, etc	Other (specify)	Quantity (e.g. 1 beer (600ml) of lighting) bottle for kerosene	Price e.g. GH¢2	Duration (For how long does it last?) e.g. 1 week
	Fossil fuels										
	LPG										
	Kerosene										
	Petrol/diesel (e.g. in a generator)										
	Electricity										
	From the grid										
	Solar PV										

	Traditional fuel										
	Firewood										
	Charcoal										
	Biomass (saw dust, palm kernel shell, etc)										
	Dung										
	Other energy services										
	Candle										
	Dry cell batteries										
	Wet cell batteries										
	Biogas										
	Other (specify)										

PREFERRED ENERGY TYPE AND REASONS FOR PREFERENCE (USE LIKERT SCALE TO RANK PREFERENCE AND REASON)

On a SCALE of 1 to 5 (1-Highly significant, 2-Significant, 3-Satisfactory, 4-Insignifcant, 5-Higly Insignificant)

FUEL/ENERGY TYPE	**Reasons for Choice of Fuel (Please tick (√) as appropriate) except that of the Social Reasons and Other**							
	Availabilit y	Affordabilit y	Reliability	Commercial Viability	Safe/Clea n(eg. Health Reason)	Social Reasons (Gendersensitive, culture, etc) **[Kindly write the response]**	Technological	Other (specify) **[Kindly write the given response]**
Fossil fuels								

	LPG								
	Kerosene								
	Petrol/diesel (e.g. in a generator)								
	Electricity								
	From the grid (mains)								
	Solar PV								
	Traditional fuel								
	Firewood								
	Charcoal								
	Biomass (saw dust, palm kernel shell, etc)								
	Dung								
	Other energy services								
	Candle								
	Dry cell batteries								
	Wet cell batteries								
	Biogas								
	Other (specify).....								

F	**ELECTRICITY AS MAJOR SOURCE OF ENTERPRISE ENERGY ONLY (ADDITIONAL FOR ELECTRICITY USERS ONLY)**	
	What is your main source of electricity?	Grid (Mains) [ ] Generator [ ] Solar [ ] Batteries (dry/wet cell) [ ] LPG [ ] Other (specify)..... .....
	If your source of electricity is the "grid-main", who connected your enterprise?	ECG [ ] Private individual [ ] Self [ ] Unwilling to tell [ ] Don't know [ ] Other (specify).....
	If yes, how much was paid for the electricity connection?	Amount (GH¢) ....., ...

What were the quantities of electricity consumed in the last three months and how much did you pay? **(Please, request for the electricity bill to answer this question). Record the "total this month" only**.

Month Last Month Two Months Ago Three Months ago

Units (kWh)

Cost (GH¢) (total this month)

Fi Alternative Forms

Do you have a standby source of energy for your Yes [ ] No [ ] activities?

If yes, please identify the standby sources

Generator [ ] Solar [ ] Biomass (wood, saw dust) [ ] Other (specify) .,..... What type of fuel/energy is used in the standby None [ ] Diesel [ ] Petrol [ ] Kerosene [ ] Solar [ ] Biomass [ ] source?

Other (specify) .....

How much do you spend (on the average) per GH¢.....

month on fuel/energy used in the standby source?

What problem(s) is/are associated with this form None [ ] Harmful [ ] Expensive/Unaffordable [ ] Irregular Supply [ ] Unavailable of energy? [ ] Other .....

G PROBLEMS/CHALLENGES ASSOCIATED WITH SUPPLY AND USE OF CURRENT ENERGY

What disadvantages can you associate with the **form(s)** of energy used for your operations? Please **Rank on a Scale of 1 to 5** as appropriate

	Energy Form	**Disadvantage**
I		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....
Ii		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....
Iii		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....
Iv		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....
V		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....

Vi		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....
Vii		None [ ] Harmful [ ] Expensive/Unaffordable [ ] Unavailable [ ] Other .....
H	**FACTORS AFFECTING THE DEPLOYMENT OF MODERN ENERGY FORMS** Please **Rank on a Scale of 1 to 5** as appropriate	
	What factors affect the deployment of modern/cleaner/safer energy forms for your operations	High cost [ ] Harmful [ ] Time_wasting [ ] Unhealthy [ ] Irregular supply [ ] Other (specify).....
	Does gender influence your choice of fuel for your productive activity?	YES [ ] NO [ ]
I	**PERCEPTUAL SWITCH (FOR ONLY USERS OF SOLID FUELS**	
	If there should be increase in your income and prices of fuel remain the same, would you change from using this solid fuel to a non-solid cleaner fuel?	YES [ ] NO [ ]
	Provide reason for your answer above	

APPENDIX XVII

DEPARTMENT OF PLANNING

COLLEGE OF ART AND BUILT ENVIRONMENT

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTERVIEW GUIDE FOR ENERGY COMMISSION

(GENDER AND ENERGY SERVICES IN THE RURAL NON-FARM ECONOMY OF EJISU-JUABEN MUNICIPALITY)

Name of Respondent: ..... Designation of Respondent: .....

Telephone No. of Respondent: .....

Name of Enumerator: ..... Telephone No. of Enumerator: .....

Date of Interview: ...../...../.....

Time Started: ..... Time Ended: .....

This study is to kindly solicit your opinion on the choice of energy fuels by men and women who operate productive enterprises in the Ejisu-Juaben Municipality. This study is towards the partial fulfilment for the award of Master of Philosophy Degree in Planning. This is purely for academic purpose but not for profit motives, response given will be treated confidentially.

1. Does the Energy Commission organise programmes on using safe energy forms.

   Yes [ ] No [ ] If YES, what is/are details of the programme (s)?

.....

2. Available Energy forms/fuels (Kindly Complete the table below)

Energy Fuel/Form	Use(s) of fuel	Sources of purchase	Sources of sale

3. What factors affect choice of energy fuels for use?

.....

4. To what extent are gender issues considered in energy planning, projects or programmes?

.....

5. Does the Commission think projects or programmes undertaken are gender-oriented/bias?

   Yes [ ] No [ ] (Kindly give reason for your answer)

.....

6. What challenges affect the energy supply and utilisation? ….....
7. In what way(s) can these challenges be addressed? .....
8. What measures have the assembly put in place to promote the activities of these energydependent enterprises? .....
9. What measures can be put in place to ensure that gender issues are considered in energy planning, project or programme to implementation? .....

PART II

ENERGY FUELS

1. What is/has been the energy fuel situation (supply, pricing, utilisation, etc.) in Ghana over the past years?

   .....

   a. Charcoal b. LPG c. Electricity d. Firewood e, Petroleum Products

2. What measures can be put in place address challenges confronting the energy sector?

APPENDIX XVIII

DEPARTMENT OF PLANNING

COLLEGE OF ART AND BUILT ENVIRONMENT

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTERVIEW GUIDE FOR EJISU-JUABEN MUNICIPAL PLANNING DEPARTMENT

(GENDER AND ENERGY SERVICES IN THE RURAL NON-FARM ECONOMY OF EJISU-JUABEN MUNICIPALITY)

Name of Respondent: ..... Designation of Respondent: .....

Telephone No. of Respondent: .....

Name of Enumerator: ..... Telephone No. of Enumerator: .....

Date of Interview: ...../...../.....

Time Started: ..... Time Ended:

.....

This study is to kindly solicit your opinion on the choice of energy fuels by men and women who operate productive enterprises in the Ejisu-Juaben Municipality. This study is towards the partial fulfilment for the award of Master of Philosophy Degree in Planning. This is purely for academic purpose but not for profit motives, response given will be treated confidentially.

1. What are the transiting rural areas/communities in the Municipality?

.....

2. What makes them transiting communities?

.....

3. Available Energy forms/fuels (Kindly Complete the table below)

Energy Fuel/Form	Use(s) of fuel	Sources of purchase and sale	Risk associated

4. What factors affect choice of energy fuels for use (determinants of the choice of energy fuel)? .....
5. What forms of energy-dependent productive enterprises are in rural areas in the Municipality? .....
6. To what extent are gender issues considered in energy planning, projects or programmes in the Municipality? .....
7. Does the Assembly think some projects or programmes undertaken by Energy Department are gender-oriented/bias? Yes[ ] No [ ]
8. What challenges affect the energy supply and utilisation in the Municipality?

.....

9. In what way(s) can these challenges be addressed?

.....

10. What measures have the assembly put in place to promote the activities of these energydependent enterprises?

.....

11. What measures can be put in place to ensure that gender issues are considered in energy planning, project or programme to implementation?

.....

.....

APPENDIX XIX

DEPARTMENT OF PLANNING

COLLEGE OF ART AND BUILT ENVIRONMENT

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTERVIEW GUIDE FOR ENERGY DEPARTMENT OF THE EJISU-JUABEN MUNICIPALITY (ECG)

(GENDER AND ENERGY SERVICES IN THE RURAL NON-FARM ECONOMY OF EJISU-JUABEN MUNICIPALITY)

Name of Respondent: ..... Designation of Respondent: .....

Telephone No. of Respondent: .....

Name of Enumerator: ..... Telephone No. of Enumerator: .....

Date of Interview: ...../...../.....

Time Started: ..... Time Ended: .....

This study is to kindly solicit your opinion on the choice of energy fuels by men and women who operate productive enterprises in the Ejisu-Juaben Municipality. This study is towards the partial fulfilment for the award of Master of Philosophy Degree in Planning. This is purely for academic purpose but not for profit motives, response given will be treated confidentially.

1. Does the Energy Department organise programmes on using safe energy forms.

   Yes [ ] No [ ] If YES, what is/are details of the programme (s)?

.....

How many communities in the district does ECG serve? .....

Location Sub-Station	Number of sub-stations	MW served

10. Available Energy forms/fuels (Kindly Complete the table below)

Energy Fuel/Form	Use(s) of fuel	Sources of purchase	Sources of sale

11. What factors affect choice of energy fuels for use (determinants of the choice of energy fuel)? .....

12. What forms of energy-dependent productive enterprises are in rural areas in the Municipality? .....

13. To what extent are gender issues considered in energy planning, projects or programmes in the Municipality? .....

14. Does the Department think projects or programmes undertaken are gender-oriented/bias? Yes [ ] No [ ] (Kindly give reason for your answer)

.....

15. What challenges affect the energy supply and utilisation in the Municipality?

.....

14. In what way(s) can these challenges be addressed?

.....

15. What measures have the assembly put in place to promote the activities of these energydependent enterprises?

.....

16. What measures can be put in place to ensure that gender issues are considered in energy planning, project or programme to implementation?