FACTORS AFFECTING PERFORMANCE OF RURAL ELECTRIFICATION PROGRAMME IN UGANDA

CASE STUDY: RUKUNGIRI DISTRICT

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DEDICATION

This book is dedicated to Mr. Asaph Nuwagira and his wife Ms. Annet Kabarungi; their children Arnold Asiimwe, Anita Atukunda and Aaron Ahabwe.

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LIST OF ACRONYMS

ERA	Electricity Regulatory Authority
GoU	Government of Uganda
IEA	International Energy Agency
LPG	Liquid Petroleum Gas
MEMD	Ministry of Energy and Mineral Development
MoFPED	Ministry of Finance Planning & Economic Development
MoLG	Ministry of Local Government
MFIs	Microfinance Institutions
PEAP	Poverty Eradication Action Plan
PSRPS	Power Sector Reform and Privatization Strategy
PV	Photovoltaic
REA	Rural Electrification Agency
REB	Rural Electrification Board
REF	Rural Electrification Fund
RESP	Rural Electrification Strategy and Plan
UBOS	Uganda Bureau of statistics
UEB	Uganda Electricity Board
UNHS	Uganda National Household Survey

ABSTRACT

The study was conducted to examine the factors affecting performance of rural electrification programme in Uganda with Rukungiri district as a case study. The factors studied included Rural housing characteristics, household size, Household income level, connection costs/charges and price of electricity with the sole purpose of determining their impact on performance of rural electrification programme.

A cross sectional research design was adapted whereby a total sample of 113 respondents with electricity and 54 respondents were selected for quantitative data using systematic random sampling and purposive sampling respectively. 29 key informants were also selected for qualitative data using purposive sampling. The primary data was collected using structured and semi-structured questionnaire and interview guides as well as secondary data from reports. Data collected was analysed using Stata.

The study found out that performance of rural electrification programme was significantly and negatively affected by household size ($\beta2= -0.6339819$; $P=0.0000<0.05$) and connection costs ($\beta_4= -0.2147675$; $P=0.037<0.05$); price of electricity also having a positive significant impact ($\beta_5=0.6292673$; $P=0.0000<0.05$) while rural housing characteristics and household income level had a positive insignificant impact on performance of rural electrification programme with ($\beta_1=0.1121203$; $P=0.059>0.05$) and ($\beta_3=0.0616083$; $P=0.085>0.05$) respectively. The model specified exhibits $R^2 = 0.6918$ implying that factors under this study explain up to 69.18% of the variations in performance of rural electrification programme which reflects that the variables and data used were fit for this study.

The study recommends government to provide Incentives to recover the costs by permitting projects below 3 MW to operate with minimal government regulation such that investors can charge realistic tariffs that cover operating costs and yield a return on investment but consistently conducting studies into the trends of household incomes and peoples' perception on the existing price levels to mitigate the risk of power companies misusing incentives to charge exorbitant prices for abnormal profitability; Develop a mode of payment for electricity connection where by households pay in installments or make the period of electricity connection payment longer for example six months or even one year; Roll out the use of pre-paid meters and subsidize the price of these electricity meters by reducing taxes on companies importing them to reduce upfront connection costs; Prioritise development strategies that increase income generations among households and at the same time promote rural electrification; population control measures like family planning, girl child education and make use of population control policies.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 Introduction

This study aimed at examining the factors affecting performance of rural electrification programme in Uganda. These factors were conceived as the independent variables while performance of rural electrification programme was the dependent variable. Factors affecting performance of rural electrification programme were measured in form of housing characteristics, household size, Household income level, connection costs/charges and price of electricity while performance of rural electrification programme was measured inform of electricity consumption per capita. This chapter outlines the background to the study, statement of the problem, general objective of the study, research questions, hypotheses, conceptual framework, justification, significance, scope of the study and operational definitions of terms and concepts.

1.1 Background to the Study

Access to reliable, affordable and environment friendly energy services like electricity is a basic right of every human being under international law and policy (Naeem *et al*, 2010). Electrification is believed to contribute significantly to achievement of Millennium Development Goals (MDGs) agreed upon by all the 191 United Nations member states at the Millennium Summit in September 2000, in New York. This is based on the assumption that sustainable access to modern energy services fosters economic and social development and leads to improvement in the quality of life (Gunther *et al*, 2010). It is universally accepted that electrification enhances quality of life at household level and stimulates economy at a broader level. The immediate benefit of electrification comes through improved lighting which enhances other household activities such as social gatherings after dark while electric gadgets such as radios and televisions improve access to information by rural households (Khandker *et al*, 2009).

The International Energy Agency (IEA) estimates that 1.5 billion people lacked access to electricity in 2008, more than one-fifth of the world's population. Some 85 percent of those without electricity live in rural areas mainly in Sub-Saharan Africa and South Asia (Enrique *et al*, 2010). Most African countries including those in the Southern sub-region face a major challenge in trying to achieve their development and social obligations because of serious lack of modern energy services. Electricity access clearly demonstrates this deficiency because it is only 17% for sub Saharan Africa as a whole and less than 5% in rural areas (Davidson & Sokona, 2002). This situation needs major changes not only for development demands but for the region and its sub regions to be competitive with other developing regions of the world. In East Africa, electrification rates are lower for example in Rwanda; the electrification rate is considerably lower at 1.3% (Gunther *et al*, 2010).

Uganda has been generating electricity for over half a century since 1954 and its major source was situated at the source of the Nile which is the potential for hydroelectric power in Uganda. The British colonial authorities noted this potential and commissioned the construction of Owen falls dam in 1954 that was later renamed Nalubaale power station. Electricity consumption in Uganda has steadily been growing from 11,432 customers in 1954 (Zachary, 2009) to 380,000 customers in 2010 (ERA, 2010). Similarly, the number of units generated increased from 13 Giga Watts per hour in 1954 to 1756 in 2003.

The power subsector covers electricity generation, transmission and distribution including rural electrification**.** In 1999, following approval by Cabinet of the Power Sector Reform and Privatization Strategy (PSRPS) and enactment of a new electricity law (The Electricity Act, 1999), the Electricity Regulatory Authority (ERA) was established to regulate the industry.

The Uganda Electricity Board (UEB), the national utility company lost its monopoly in the sector by this enactment as part of the liberalization process. Such reforms have mainly involved the unbundling of vertically integrated government utilities into three separate segments for generation, transmission and distribution (ERA & MoFPED, 2008). The major aim of these reforms was to improve quality of service, connectivity, reliability, reduce losses and attract private capital investment into the sector thus enhance overall sector efficiency (Mawejje *et al,* 2012).

The rural electrification programme was also conceived from this new policy framework-PSRPS to reduce inequalities in access to electricity through development of Uganda's rural energy. The Electricity Act of 1999 provided the legal framework for achieving government's objectives for rural electrification. It is under this Act that the minister responsible for energy issued the statutory instrument No. 75 of 2001 that established three inter-related mechanisms for management of Uganda's rural electrification program namely; the Rural Electrification Fund (REF), the Rural Electrification Board (REB) and the Rural Electrification Agency (REA) all under his supervision. REA serves as the Secretariat to REB whose principal responsibility is to ensure management of the fund for equitable promotion of rural electricity access and connectivity as defined in the Act. Recognizing the need and importance of accelerating electricity to rural areas, a Rural Electrification Strategy and Plan (RESP) was established and adopted by Cabinet in February 2001. REA is mandated to facilitate the Government's goal of achieving a rural electrification rate of at-least 12% by the year 2012 from 1% at the beginning of the decade (REA, 2006).

The hydroelectric power potential of Uganda is high and estimated at over 2,000 MW mainly along River Nile. By 2002 exploitation was about 317 MW, of which 300 MW was on the river Nile and generated by the Uganda Electricity Generation Company Limited, Kilembe

Mines Ltd, Kasese Cobalt Company Ltd and others generated a total of 17 MW. Two major independent power producers, AES Nile Power and Norpak Power Company were in various stages of setting up large power plants. Their combined capacities would be 450 MW when completed (MEMD, 2002). By December 2010, Uganda boasted of 8 power Generators, 590MW installed capacity, 1376 km of 132kV grid length, 38km of 66kV grid length, 18,650km of 33kV & Lower grid length, 4 distribution companies and approximately 340,000 power consumer connections (ERA, 2011).

However, Uganda's electricity customers have been very few. By 2002, only 200,000 customers were connected to the grid with an annual growth rate estimated between 5.5% and 7.5%. Electricity was consumed by the residential (55%), the commercial (24%) and the industrial (20%) sectors and for street lighting (1%). Roughly, 5% of Uganda's households had access to electricity. In rural areas, the figure was about 2%, of which less than a half was provided by Umeme and the remainder coming from household generators, car batteries and solar Photovoltaic (PV) units. About 4 million households in Uganda did not have access to electricity; the overwhelming majority (about 3.7 million households) were in rural areas (MEMD, 2002).

1.1.1 Overview of Performance of rural electrification programme in Uganda

The overview of performance of rural electrification programme in Uganda revealed that the RESP for 2001-2010 did not meet expectations. The plan anticipated growing rural electricity access ten-fold from the then-estimated 1% in rural population access to 10%. However, the actual result was to increase rural electricity access by less than 5% percent. Even though 400 grid extension projects large and small were successfully executed, consumer service connections rates often remained below planned levels (MEMD, 2012:10).

Focusing on targeted household connection, only 7,968 (7.3%) out of a target of 109,000 households were connected to the national grid by 2013. This implies that 101,032 (92.7%) of the targeted households were not connected during the 10 years of RESP. Also, 3,330 (16.7%) out of target of 20,000 households were provided with solar home systems in 93 districts leaving a huge gap of 16,670 (83.3%) targeted households (MEMD, 2013:3).

Using electricity usage among households as another rural electrification performance indicator, only 3.8% of the households in rural areas use electricity for lighting, majority 76.3% using ‘‘Tadooba’’, lantern 12.2% and others 7.7%. In terms of energy used for cooking, only 0.3% of households in rural areas use electricity for cooking, 86.3% use firewood, charcoal (10.4%), kerosene (1.7%) and others 1.3% (UBOS, 2010:117).

Furthermore, the level of electricity consumption in Uganda seems to be wanting. It was noted that Uganda has one of the lowest electricity consumption levels in the world. The electricity consumption per capita is 75kWh/capita compared to Malaysia at about 3,668kWh/capita, Korea at about 8,502kWh/capita. It compares poorly even with its peers like Kenya at 152kWh/capita and Ghana at 253kWh/capita (GoU, 2010:30).

Government intervention through rural electrification programme seems to be very clear with the goal of accelerating electrification in the country. Grid electricity extension has been enhanced in rural areas, mini-hydro power projects designed including that of Kisiizi in Rukungiri, solar PVs installed in schools and hospitals, but with the above indicators, performance of rural electrification programme in Uganda seems to remain poor. It is upon this background that the study was conducted to find out what could have been the factors behind this poor performance against the targeted goals.

1.2 Statement of the problem

The rural electrification programme in Uganda has been attracting a lot of funds from government, donors, development partners and the private sector expressing interest in undertaking huge investments in rural electrification projects with total expenditure on the Energy for Rural Transformation (ERT) programme estimated at US$2,666,268.23 excluding the ICT component (Umaru Lule, 2007). However, rural electricity penetration rate seems to remain extremely low less than 3% by 2011 with only 10% of originally projected consumers getting connected (MEMD, 2013:4). Worse still, less than 5% of the rural population had access to electricity service by 2012 (MEMD, 2012:5) yet 85% of the total population resides in rural areas (UBOS, 2010:8). Electricity consumption has also generally been low at 75kWh per capita (GoU, 2010:30) which is significantly lower than Africa's average of 578kWh per capita and the world's average of 2572kWh per capita (MEMD, 2011a). Furthermore, not much information has been provided as to what could be the drivers of low electricity usage and consumption even for households with greater proximity to the energy supply lines mainly in rural areas.

This undesirable situation in rural electrification programme performance could be attributed to rural housing characteristics, household size, Household income level, connection costs and price of electricity among other factors. Therefore, this necessitated a study to critically investigate on what could be the factors affecting the performance of Rural electrification programme in Uganda.

1.3 General objectives of the study

The general objective of the study was to examine the factors affecting performance of rural electrification programme in Uganda.

1.3.1 Specific objectives

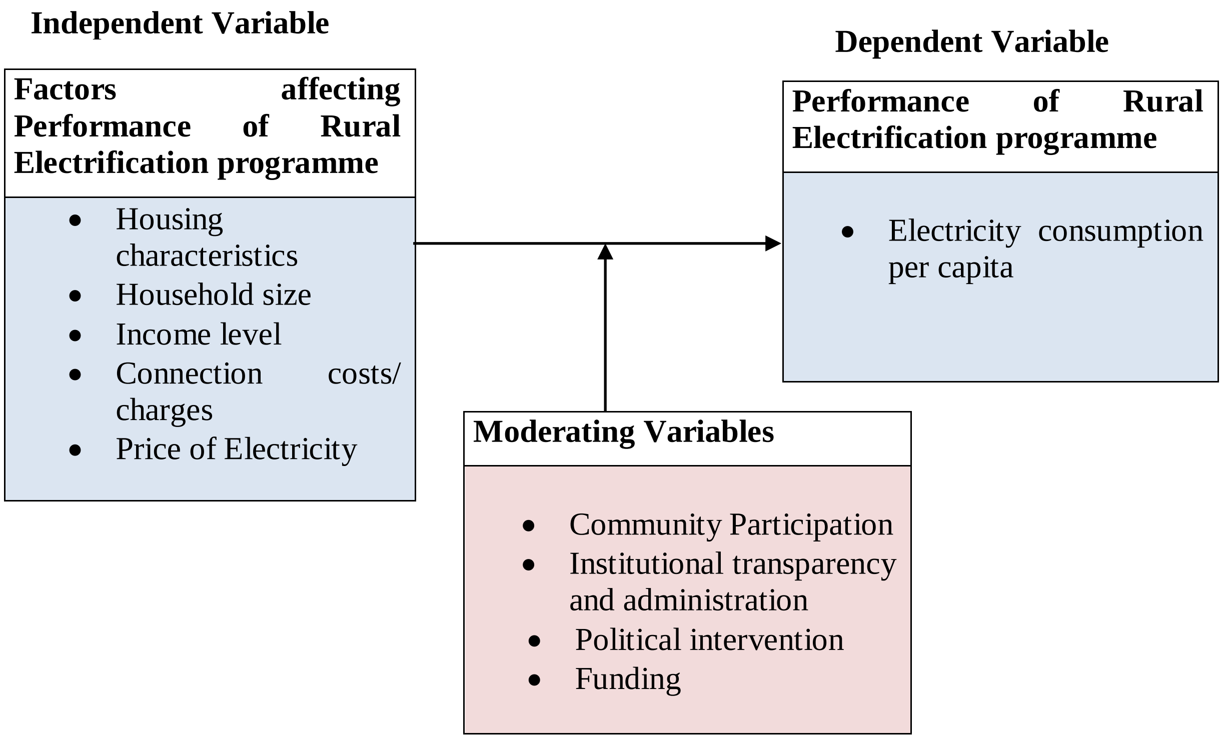
The study was guided by the following specific objectives;

i. To examine the impact of rural housing characteristics on the performance of rural electrification programme.
ii. To assess the relationship between household size and performance of rural electrification programme.
iii. To examine the impact of household income on performance of rural electrification programmed.
iv. To establish the extent to which connection costs/charges impact on performance of rural electrification programme.
v. To examine the effect of price of electricity on performance of rural electrification programme

1.4 Hypotheses of the study

i. Rural housing characteristics have no significant relationship with performance of rural electrification programme
ii. Household size has no significant relationship with performance of rural electrification programme.
iii. Household income has no significant impact on performance of rural electrification programme
iv. Connection costs/charges have no impact on performance of rural electrification programme to a small extent.
v. Price of electricity has no significant effect on performance of rural electrification programme

1.5 Conceptual Framework



Source: Adopted from literature review and modified by the researcher.

Figure 1.1: Conceptual framework

The above conceptual framework shows the relationship between factors affecting performance of rural electrification programme and performance of rural electrification programme itself. It diagrammatically shows how rural housing characteristics, household size, household income, connection costs/charges and price of electricity impact on performance of rural electrification programme. The moderating variables like community participation, institutional transparency of administration, political intervention and funding were also highlighted.

1.6 Justification of the study

This study was justified because the rural electrification programme in Uganda started with a target of achieving the rural electrification rate of at least 12% by the year 2012 (REA, 2006). To achieve this rate, the government, donors, development partners and the private sector invested huge amounts of money in rural electrification projects in various parts of the country. However, rural electrification rate was less than 5% and electricity penetration rate in rural areas remain extremely low less than 3% by 2011 with only 10% of originally projected consumers getting connected (MEMD, 2013:4). Also, electricity usage among households in rural areas was extremely low whereby only 3.8% of the households used electricity for lighting and 1.6% for cooking yet, 81.2% of the households are located in rural areas (UBOS, 2010). This left the factors that affect performance of Uganda's rural electrification programme at household level unexplained. This necessitated an inquiry into the unknown situation but of critical nature to the nation.

1.7 Significance of the study

The successful execution of this study will provide useful references to the government, Ministry and other bodies responsible for electrifying the country, regarding the factors affecting the performance of rural electrification programmes and energy demand and enable prediction and forecast of the likely hindrance factors mainly at household level. This would then guide them in planning for rural areas regarding economic and social developments with regard to electricity infrastructure. This is based on the fact that to be able to construct a well functioning electrical grid that can supply rural areas with reliable energy, it is important to have models that can describe the factors deemed to affect performance of rural electrification programmes. It is therefore needed for network planning and operation, power production planning, and load management and pricing.

This study will help the private investors that have interest in investing in electrification projects especially under rural electrification programme to identify possible areas for field trials of new developments. This can only be done if the factors that will bring about success of their projects and likely challenges of such areas are known.

Finally, the study will help scholars identify the factors that affect performance of rural electrification programme that are evidence based and empirically tested using econometric techniques. This can provide them with insight on what is on the ground regarding reasons for performance or failure of some rural electrification projects in Uganda.

1.8 Scope of the study

1.8.1 Geographical scope

This study covered Rukungiri district located in South-western Uganda and targeted sub counties supplied with electricity generated from Kisiizi mini-hydro power project. This scope was chosen because it comprised of areas that are supplied with power generated from Kisiizi mini-hydro power project under Uganda's rural electrification programme.

1.8.2 Content scope

The content scope of the study focused primarily on the factors affecting performance of rural electrification programme mainly at household level in Uganda. These factors included; rural housing characteristics, household size, income level, connection costs/charges and price of electricity. The study also focused on electricity consumption per capita as a measure of performance of rural electrification programme.

1.8.3 Time scope

The study covered the period from 2001 to 2012 following Rural Electrification Strategy and Plan which was later extended to 2012. This scope was chosen because the rural electrification programme had a target of achieving 12% rural electrification rate by 2012.

1.9 Operational definitions of terms and concepts

Rural Electrification: Rural electrification is defined here as the process by which access to electricity is provided to households or villages located in the isolated or remote areas of a country. Rural electrification rate on the other hand refers to the rate at which rural households connect electricity.

Performance of rural electrification: An improvement in access to electricity by households in rural areas, electricity consumption per capita, connection rate, electricity coverage, reliable, efficient and good metering system that minimizes losses and customer exploitation.

Household: A group of persons who normally live and eat together. It is a family living in the same house or compound and eating together. It comprises of a man, wife, children, relatives or maids and workers if any.

Household size: Basing on UBOS (2010), household size refers to the number of usual members in a household. Usual members are defined as those who have lived in the household for at least 6 months in the past 12 months. However, it includes persons who may have spent less than 6 months during the last 12 months in the household but have joined the household with intention to live permanently or for an extended period of time. According to this study however, the same definition was maintained but the reference period for one to be a usual member is 3 months not 6 months according to the above definition.

Household Income: UBOS (2006) defines household income as receipts by households in both cash and kind. It consists of receipts that accrue to the members of the households from their employment and/or enterprises, gifts among others. However, according to this study, household income refers to the amount of money earned by the household head through salary and any other source.

Price of Electricity: According to UBOS (2006), price of electricity is regarded as electricity tariff and is defined as the price of a unit of electricity consumed. However, according to this study, price of electricity refers to rating of electricity tariff whether it is too high, high, fair, low or very low basing on the amount paid for electricity estimated in a year.

Electricity consumption per capita: Average electricity consumption per household member in a year measured in Kilowatt-hours (kWh).

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter highlights the interrelations between rural housing characteristics, household size, income level, connection costs/charges, price of electricity and other factors affecting performance of rural electrification programme in developing countries with similar characteristics like Uganda, from the reviewed literature in relation to the study objectives.

2.1 Theoretical review

This study was based on the theory of demand and supply. Using a standard neo-classical model of demand it is assumed that factors traditionally included in demand models such as price and income of the household affect electricity demand (Kate *et al*, 2006). Other factors included; connection costs and other household characteristics like household size and housing characteristics. Electricity was taken to be a normal good where by an increase in household wellbeing has a positive relationship with electricity usage and consumption and vice versa. In this case, any factors that cause variations in electricity demand, supply and usage may influence performance of rural electrification programme.

2.2 Housing characteristics

The Uganda National Household Survey 2009/10 defined a dwelling unit as a building or a group of buildings occupied by a household as separate living quarters. It can be a hut, a group of huts, a single house, a group of houses, an apartment and several one-room apartments among others. A dwelling unit was classified as Detached if an entire house or block was occupied and used by one household; Tenement or ”Muzigo” if a different household used each compartment on a block or house. Other types of houses included

Flat/Apartment, boys' quarters, garage etc. the findings reveal that overall, 58 percent of the households reside in detached dwelling units while 18 percent resided in tenements. These findings reflect a three percentage point decrease and increase for detached dwellings and tenements when compared with the 2005/06 findings respectively (UBOS, 2010).

UBOS (2010) further reveals that regional differentials showed that majority of the households in the Western region resided in detached houses (84%); 69 percent of those in the Northern region resided in huts while 70 percent of households in Kampala resided in tenements. Comparison of the findings over the two survey periods show that there was an increase in the proportion of households that resided in tenements in Kampala from 64 percent in 2005/06 to 70 percent in 2009/10.

The same UNHS 2009/10 Survey showed that 76 percent of households lived in owner-occupied dwellings while 18 percent rented the houses they resided in. Over the two survey periods there was a slight drop in the proportion of owner occupied houses as well as a slight increase in the proportion of households that rented. Across regions, close to 90 percent of the dwellings in the Eastern and Northern regions were owned by the households while 70 percent in Kampala were rented.

In analyzing determinants of electricity demand in Sydney, it was realized that living in a detached house added around 1,500 to a household's annual consumption (around $330). However, there was no data on the size of dwellings especially the floor space, so the number of bedrooms was used as a proxy for size. It was found out that each bedroom added an additional 600 kWh to 900 kWh per annum or about $140 to $200. Also, it was realized that the more people who lived in a household, the higher the household's electricity consumption. An adult added about 20% more consumption than a child, i.e., about 900 kWh per annum compared to about 750 kWh per annum (IPART, 2012).

However, to explain why an adult added more to a household's electricity consumption than a child, the study only based on the adults likelihood of having a 2nd fridge. There are many more reasons to explain the above which this study ignored for example adults having more income than the children may consume a lot of electricity. This study also did not put much emphasis on electricity consumption per capita. It mainly put emphasis on age composition.

Battles & Hojjati (2005) revealed that the number of housing units affects the amount of electricity that is consumed at home basing on U.S. households. These however did not look at how this can affect performance of rural electrification programmes and its not clear if this could be the same case with developing countries like Uganda..

2.3 Household size

According to UBOS (2010), the Uganda National Household Survey 2009/10 revealed that the average household size in Uganda has been estimated at 5.0 and it has remained more or less the same when compared with previous surveys. The results also indicated that the average household size is bigger in rural at 5.0 than in urban areas at 4.0 and this is consistent with the findings from the previous surveys. Generally, apart from Central region where the average household size decreased from 5 to 4, the rest of the regions remained the same when compared to 2005/06. The household size in Central region has consistently been lower than in other regions over the last three years.

Wokje & Linda (2011) revealed that household gas and electricity consumption is strongly related to socio-demographic variables such as income and household size. Large households with higher incomes use more energy and so does households that are larger in size. In other words opportunities and constraints seem to determine how much energy a particular household uses yet some studies have examined attitudinal variables only without including socio-demographics in relation to energy consumption. However, the two writers noted that household size and income were better predictors of household energy use and indeed found out that household size was positively associated with energy use but did not focus on their impact on performance of rural electrification programme.

Battles & Hojjati (2005) noted that the amount of electricity used in U.S households is affected by many social and structural factors such as: income, age of householders, size of home, population characterized by number of people in households, age of home and equipment. In addition, weather, appliance energy standards, and energy-saving programs influence the use of electricity hence consumption. The writer noted that electricity use is affected by changes in population size, the size of homes and the size of the homes which is mostly affected by income.

2.4 Household income, electricity demand and rural electrification

According to Santamouris (2006), energy consumption of households is strongly related to the family income. Research has shown that the higher the income, the higher the energy consumption of the household. The specific relation between the household income and the energy consumption of homes varies from country to country as a function of their economic and technical characteristics.

Enrique *et al* (2010) explains the reasons why closing the electricity access gap remain an unfinished agenda. He notes that most rural communities as well as many peri-urban areas are characterized by a very high percentage of poor households. Demand for electricity is usually limited to residential and some agricultural consumers and many households consume less than 30 kilowatt-hours (kWh) per month. The combination of these factors results in high costs of supply for each unit of electricity consumed hence high costs of supplying electricity to rural and peri-urban households which affects performance of rural electrification programme.

The above view on poor households is evidenced by UBOS (2010) which reveals that 7.5 million people (24.5%) of the population are still absolutely poor, hence their income is below a dollar per day and are below the poverty line. Also, 13.2 million people (42.9%) are non-poor but insecure hence risk falling below the poverty line and only 10 million people (32.6%) fall in the middle class.

According to IEA (2004), electricity access remains heavily concentrated in upper income classes as well as urban areas in many developing countries. However, even in Uganda, many households remain yet to be connected or not sure whether they will be connected, and those without electricity predominantly live in the country's poor areas. Ranganathan, (1993) and ESMAP, (2000) noted that much research exists on the possible benefits of rural electrification and its impact on income generation especially for the poor persons. However, little empirical study has been carried out to verify a significant relationship between household income and performance of rural electrification programme. There is a necessity to clearly understand how household income affects performance of rural electrification programme.

Naeem et al (2010) used Multinomial Logistic Model to estimate the Determinants of Household's Demand for Electricity in District Peshawar. The results of the regression indicated that income significant impact on households' demand for electricity. However, the household income was grouped into quartiles which had no clear yardstick for the grouping. The grouping may be subjected to bias hence the income level needs to be studied for households as a whole. The study also did not capture the impact of income on performance of rural electrification programme.

Holtedahl & Joutz (2000) investigated the residential demand for electricity in Taiwan as a function of household disposable income, population growth, the price of electricity and the degree of urbanization. An error correction model was used to separate short and long-term effects. In the long run, the income elasticity is unitary elastic. The own-price effect is negative and inelastic. The short run income and price effects were small and less than the long-run effects in an error correction framework. However, the paper used urbanization as a proxy variable to capture economic development characteristics and electricity-using capital stocks that were not explained by income. However, urbanization does not clearly bring out the relationship between income and performance of rural electrification programme.

According to Kate et al (2006), a higher income household is likely to use more electricity than a similar household with lower income. Income was said to be highly inelastic across all models of electricity demand. However, this seemed to be over stated as if it could really apply to all models of rural electrification in all countries.

Boukary, (2003) used multinomial logit model to analyze the sociological and economic variables of household energy preferences for cooking in Ouagadougou. The analysis reveled that the inertia of household cooking energy preferences were due to poverty factors such as low income, poor household access to electricity for primary and secondary energy, low house standard, household size and high frequency of cooking certain meals using wood fuel as cooking energy. His findings further showed that the domestic demand for wood-energy was strongly related to household income. The firewood utilization rate decreased with increasing household income which could affect performance of rural electrification programme.

Ferguson et al (2000) noted that the level of income has a relationship with wealth and hence electricity demand. It was found out that for developed countries, there is a strong correlation between increases in wealth over time and increases in energy consumption. Moreover, there is a stronger correlation between electricity use and wealth creation than there is between total energy use and wealth. However, it should be noted that income itself is wealth and this does not specify whether the relationship is negative or positive.

Ziamba (2008) studied the determinants of household demand for electricity in South Africa and concluded that the demand for electricity was largely affected by household income. However, the study found that there was no effect of changes in price of electricity on its demand.

According to Wokje & Linda (2011), household energy use may be particularly predicted by socio-demographic variables like income while psychological variables have little impact. They argued that socio-demographic variables influence the possibilities and constraints that people face which in turn affect energy use. For example, high income groups can afford bigger houses and more appliances and as a consequence use more energy. Their findings revealed that Households with higher incomes tended to use more energy than households with lower incomes. However, it should be noted that the use of more energy may have an impact on performance of rural electrification programme which was not clearly specified.

2.3 Connection costs/charges

The issue of electricity affordability is recurrent in the context of rural electrification, as the target groups are usually the rural poor. This said rural households are usually very willing to pay for access to energy services. When they do not have access to electricity, they often contribute much of their time and revenue to buying or collecting energy sources for their day-to-day needs (Barnes, 2007).

Sabah and Markandyab (2007) explored the affordability, access and investment regarding electricity services by estimating the subsidies required and the policy actions needed to increase the take up of rural electrification programs (REP) in Kenya. They noted that affordability is particularly considered to be one of the main obstacles to the adoption of modern energy in the case of the residential sector. They found out that rural households not only have limited access to modern energy sources at reasonable rates but also incur high expenditures on traditional fuel sources. This exacerbates the in affordability of household fuels and electricity.

Grid electricity connection costs pose a barrier to rural electrification since electrification programmes often do not benefit the poorest of the poor, since they cannot afford high upfront costs (World Bank, 2008b). This is the same with solar home system (Jacobsen, 2007). However, it should be noted that People living in remote areas are usually poorer than those living in urban or peri-urban areas and technological off-grid solutions require higher initial investments. In most cases, subsidies are required to cover initial investment or even operating costs (AGECC, 2010).

Contrally to the subsidies, Alexandra (2010) maintains that connection costs should be eliminated or spread over time so as to minimize any upfront hindrances to being connected and electricity tariffs should be affordable but not necessarily subsidized. Electrification costs should be kept under control by reducing transmission and distribution losses, reduction of losses due to electricity theft to ensure suppliers' longer-term viability and the use of low-cost technologies keeps costs of electrification under control.

High connection costs explain why it usually takes years for all the targeted consumers to connect after the grid electricity has been extended to their communities. Rural and often peri-urban households cannot afford to pay the high cost of providing electricity to their villages. In particular, many households are unable to pay the connection fee (Enrique at al, 2010). He attributes this challenge to low population density which means that electricity distribution costs are shared by relatively few people which results in high costs for each unit of electricity consumed. It is noted that building extensive central grid distribution systems with tens of kilometers of medium voltage and low voltage lines to light a few light bulbs in rural households is expensive. As a result, rural electricity systems invariably have much higher investment costs per consumer/household and per kWh of sales than urban systems.

Basing on MEMD (2013), connection costs is a challenge to rural electrification programme in that connection rates often remain low long after an electrification project is completed even up to a period of two years. In areas where schemes have been constructed, only about 10% of originally projected consumers get connected due to affordability issues. However, this finding was not estimated by econometric means which the researcher sought to find out.

According to Charles Kirubi *et al* (2008), connection costs make rural electrification efforts benefit the rich instead of the poor. This is attributed to high initial connection charges and the bureaucracy and politics mediating electricity access, that grid-based rural electrification had reached the rich more than the poor. As such, commonly articulated policy objectives of achieving income re-distribution and social-equity through rural electrification have not materialized. Recall that equity consideration is crucial according to Uganda’s rural electrification strategy and plan.

2.4 Price of electricity, billing and payment system

There is a belief that for rural people to benefit from rural electrification programme, the price should be extremely low to be afforded by average households. However, to Barnes and Foley, rural electrification tariffs set at realistic levels do not prevent households from making significant savings in their energy costs as well as obtaining a vastly improved service. Charging the right price allows the electricity company to provide an electricity supply in an effective, reliable, and sustainable manner to an increasing number of satisfied consumers. In Costa Rica, the price of electricity is set through a regulatory process but it is high enough for the cooperatives to make a modest profit (Barnes & Foley, 2004).

In Uganda, Electricity tariffs in the past were high due to very low or no investment in power generation and distribution coupled with a very low operational efficiency (MEMD, 2002). However, even after investment in power generation has increased, electricity tariffs seem to remain high for average Ugandans. Could the suggestion of charging a price higher than the supply cost explain why Uganda seems to be experiencing an increase in electricity charges? This necessitated further study to critically establish if price of electricity significantly affects electricity consumption and performance of rural electrification programme.

Barnes & Foley (2004) further argue that rural electrification only makes sense in areas where there is already a demand for electricity-using services such as lighting, television, refrigeration and motive power. In the absence of a grid supply, these services are obtained by spending money on kerosene, LPG, dry-cell batteries, car battery recharging and small power units, all of which are highly expensive per unit of electricity supplied. However, this criterion is criticized on the fact that it may not cater for rural equity considerations i.e. the idea of extending electricity to marginalized areas which may not meet demand requirements yet all areas are believed to have equal opportunities under Uganda's rural electrification strategy and plan.

The above criticism is supported by Obermaier (2010) who argues that successful rural electrification programs must simultaneously tackle the issues of expanding electricity access and enabling the new consumers to increase their electricity consumption. This observation explicitly takes into account rural equity considerations because all new electricity consumers ought to benefit from new connections, not only rural elites or large-scale users.

The World Bank supports the view that the price of electricity should ensure that costs are recoverable. This is based on the view that economic value of rural electrification continues to be realized. The Bank maintains that the economic case for investments in rural electrification is proven (IEG, 2008). This is a clear re-assessment of the above Bank's position arrived at over a decade ago. The policy shift is in part informed by a growing body of evidence in regard to the value of rural electrification. It was emphasized that cost recovery tariff levels are achievable such that the value of rural electrification benefits to households is above the average long-run supply costs to boost investment in the energy sector.

Charles Kirubi *et al* (2008) analysed the Kenyan experience of rural electrification and realized that as an incentive to recover the costs, systems/projects below 3 MW are now permitted to operate with minimal government regulation and investors can charge tariffs that cover operating costs and yield a return on investment. Similar laws and incentives exist in Tanzania and Uganda. The long-term sustainability and effectiveness of rural electrification programs seem to critically depend on the degree of cost recovery realized by a particular program/investment. This meant that charging tariffs that at least cover operation and maintenance costs is essential.

ESMAP (2003) reveals that for residential customers, the willingness to pay for modern energy to power lighting and television should exceed the average long-run electricity supply costs. This analysis of willingness to pay is however complicated by the fact that rural households rely on a mix of energy sources such as fuel wood and charcoal for cooking, kerosene and dry-cell batteries for lighting and auto-type batteries for television (Masera *et al*, 2000).

Enrique *et al* (2010) regards limited capacity of households to pay for electricity service as a disincentive to investment in rural electrification. To attract these investments in rural electrification requires a system of tariffs and subsidies that ensures sustainable cost recovery while minimizing price distortions. However, such a revenue-generation scheme is absent in many countries. Most often, tariff subsidies are designed to favor the large majority of consumers including the well-off while failing to provide utilities with incentives to invest in rural electrification. What makes it worse is that such ill-designed tariff schemes are found particularly in Sub-Saharan Africa, where subsidies applied to residential consumers are highly regressive (Foster *et al*, 2010).

The effective recovery of customer payments allows electricity companies to supply reliable and sustainable power. Lack of payment for electricity use not only weakens the financial stability of the electricity provider (World Bank, 2000), but also discourages investors to join in on the rural electrification efforts because of uncertain revenues. Adequate metering, billing and payment recovery are fundamental to a sustainable electrification system. When meters do not function correctly and are not properly read or billing is incorrect, then the customer's actual consumption will not be paid for.

Adding to these technical or organizational challenges is petty corruption at the interface with customers, including bribes paid to or requested by meter readers. To tackle these issues, measures such as the creation of franchisees (India), the part-time recruitment of farmers for meter reading (China), or the use of prepaid meters (South Africa and Brazil) as well as stricter management rules such as random controls all help to improve the recovery of customer payment, a necessary condition for successful rural electrification efforts (Alexandra, 2010).

Furthermore, Alexandra (2010) believes that effective metering, billing and payment recovery ensures the long-term viability of the electricity supplier and therefore of the electrification process as a whole. He suggests that communities should be involved in the tariff-setting process to secure better and more adequate tariff systems. This implies that local communities should be involved in setting the prices if good performance of rural electrification programme is to be realized.

Amusa *et al* (2009) analyzed the determinants of aggregate demand for electricity in South Africa by using bounds testing approach in an autoregressive distributed lag framework during the period 1960 to 2007. The results showed that demand for electricity was greatly affected by changes in income. However, the study found that changes in price of electricity had no effect on the demand for electricity. The study suggested that any policy of the government for bringing changes in price of electricity depends on the factors affect the demand for electricity. The study further mentioned that the government should focus on these factors while bringing any change in the price of electricity in South Africa.

A number of econometric issues underlie the estimation of the price responsiveness of electricity demand, making this more difficult than the typical estimation of demand curves (Taylor, 1975). Unlike standard goods, consumers of electricity do not face a single price, but rather a price schedule, with decreasing or increasing block pricing. The marginal price is dependent on the amount of consumption and influences the level of consumption or demand. The use of average price as the determinant of electricity consumption is based on the assumption that consumers respond to the price obtained from their electricity bills (Branch, 1993). Both the ex post marginal and average prices are determined simultaneously with the level of consumption; thus, their inclusion as explanatory variables leads to correlation between price and the error term of the electricity demand equation.

Taylor (1975) recommends including both the marginal price of the last block consumed and the average price as predictors in the demand function, but he recommends using actual values from the price schedules and not ex post values. Additionally, explanatory variables such as the lagged dependent variable, per capita income, prices of electricity, and stock of electric appliances are likely to be endogenous and lead to simultaneity bias in the reduced form dynamic model of electricity demand.

2.5 Alternative energy source

Alternative energy source reflects the substitutability of different energy sources. For rural and remote areas in developing countries grid connection often is economically prohibitive or a potential scenario in the far distanced future. A promising alternative has evolved with the maturation of small-scale stand-alone systems (World Bank, 2008a). Micro-energy systems generate energy locally and facilitate decentralized energy generation (Phillip & Schäfer, 2009).

According to Sabah and Markandyab (2007), one way of reducing the consumption of cheaper fuels such as kerosene, firewood and charcoal by the non-electrified households is to provide them with electricity. However, if the non-electrified households are to make such an energy usage shift, they would require electricity subsidies so as to keep their energy expense levels the same. One measure of the affordability of electricity to the rural non-connected households would be to ask how they could afford to buy electricity and still maintain their present energy consumption levels. For example, to do so they could reduce their consumption of firewood, kerosene and candles to release some money for electricity.

In the rural transition from traditional to modern energy sources Rural electrification based micro systems, such as biogas digesters, solar photovoltaic systems and micro hydro mini-grids, play a key role as they offer cost-efficient alternatives to grid extension and an environmentally friendly source of modern energy according to Agbemabiese (2009); World Bank (2008a); and REN21(2010). The technology predominantly used for off-grid electrification is solar PV in the form of SHS, which are also the focus of the case study presented in this thesis. In many developing countries, sunlight is really an abundant resource making and attractive cost-effective technology although photovoltaic technology still requires the highest investment cost compared to other commercially deployed Rural electrification technologies according to Adib *et al* (2001); IEA (2008b) and van der Vleuten et al (2007).

Uganda is heavily dependent on its dwindling biomass resources for its domestic energy needs. Biomass is used for cooking and heating in households. In 2002, biomass energy in the household sector was 241 PJ. In some parts of Uganda firewood consumption exceeds production, resulting in pressure on the natural vegetation and causing soil erosion and silting. Charcoal is mostly used in the urban areas. It is the most favourable fuel because it has a higher calorific value than firewood and it is easier to store (Sebbit, *et al*, 2004).

Most rural households are using three-stone fire stoves which are very cheap but with efficiency rating as low as 9%. In the urban areas a metallic charcoal stove is the most commonly used appliance in households. The efficiency of these stoves is rated at about 23%

while those stoves with clay linings are rated at about 34% (Sebbit, et al, 2004). This implies that most Ugandans could be using these as alternative energy sources.

2.6 Electricity usage and consumption

According to Ray Holland, et al (2001), electricity provides only some of the rural energy needs of remote communities. It can usefully substitute for candles, kerosene or batteries used for lighting, radios and television, and power machines and appliances to increase the productivity of production activities. It is rarely used to substitute for thermal applications like cooking. They noted that typical rural electricity applications include: radio/TV, lighting; fans and refrigerators; ironing; clinics, schools, shops, street lights; workshops; crop processing.

However, even with grid electricity, it is rare for electricity in rural areas to be used for cooking other than heating small quantities of water. Off grid electrification is often limited to lighting and communication (radio/TV) especially for solar PV and household battery-based systems. The other services will often not be met or will continue to be met from other energy sources, such as wood, kerosene, Liquid Petroleum Gas or diesel engines. They attribute this to the cost of both the electrical appliances and the running costs. However, some of the noted aspects do not appear in rural areas for example by the time a village has streets to light, then such a village is no longer rural but urban or peri-urban.

Alexandra (2010) believes that rural households are often able to pay for their electricity consumption. In developing countries, per capita electricity consumption is usually very low. In Rwanda, the per capita electricity consumption is one of the lowest in the world and concentrated in the main cities: The capital Kigali alone accounts for more than 70% of the total national low voltage electricity consumption. Investments in new generation or network capacities have been very limited in the past, such that energy sector reform advanced only slowly (Gunther et al, 2010). However, they explained low electricity consumption mainly as a result of supply constraints, the hilly and landlocked character of the country making it difficult and expensive to provide energy to rural areas hence ignoring the role played by household income level and alternative energy sources and the general impact on performance of rural electrification programme.

Wokje & Linda (2011) realized that household energy use or consumption may be particularly predicted by socio-demographic variables while psychological variables have little impact. Arguably, socio-demographic variables influence the possibilities and constraints that people face, which in turn affect energy use for example, high income groups can afford bigger houses and more appliances, and as a consequence use more energy. He includes attitudes towards energy conservation and perceived behavioral control as the psychological variables. However, the intentions to reduce energy use seem to be more strongly related to psychological variables, probably because intentions to reduce energy are voluntary in nature and may be less constrained by contextual factors as is energy use.

The energy policy for Uganda recognises the existence of low electricity consumption as evidence of energy poverty. It recognises that energy poverty can be found in the low levels of consumption of modern energy forms like electricity and petroleum products, the inadequacy and poor quality of electricity services and the dominant reliance on wood fuel sources. Yet, all modern economies are energy dependent. This means that if economic prosperity has to be achieved and sustained and living standards for the majority of Ugandans improved, a paradigm shift in policy and planning for energy supply and consumption is necessary (MEMD, 2002).

The above policy emphasizes planning that benefits the rural population rather than only addressing supply side issues like it used to be in the past. However, this policy does not indicate the level of electricity consumption as an indicator of performance of rural electrification programme. It only recognises that the role the Energy supply improvement in the rural areas is likely to play in poverty eradication.

2.7 Funding/financing

Adib *et al* (2001) notes that of more recent, rural electrification programme have tended to be successful after rural electrification projects integrate private industries and build up market infrastructures, instead of purely relying on development aid. This partly stresses pull of funds from the private sector rather than depending on development Aid. Experience with off-grid solar home system electrification has shown that strong linkages to the local private sector are most promising to establish sustainable business models and delivery mechanisms. Financing mechanisms and functioning after-sales services for operation and maintenance are key to the long-term project success. Financing should integrate local institutions, such as private or public banks, which in turn provide funds to private companies, NGOs or MFIs offering an energy product portfolio (Susanne, 2011).

Alexandria (2010) suggests that sustained government support and long-term funding will guarantee a more effective implementation of electrification objectives, and the elimination of any misuse of electrification funds in favour of other objectives as one of the preconditions to successful rural electrification policies. This suggests that the performance of rural electrification programmes could depend on government funding.

2.8 Community participation in rural electrification programmes

Full involvement of the rural communities in the electrification efforts throughout the decision-making process increases their sense of ownership and brings support to utilities' efforts to encourage customers to use electricity wisely once they are connected (Alexandria, 2010). Therefore, involving these communities in the tariff-setting process will secure better and more adequate tariff systems. This implies that local communities should be involved in setting the prices if good performance of rural electrification programme is to be realized.

Enrique et al (2010) suggests involving local communities in the planning process of rural electrification programs. The review of case studies shows clearly that rural electrification programs benefit greatly from local community participation. The involvement of local communities from the start can help improve the design for example Peru, Vietnam, gain local support e.g. Bangladesh, mobilize contributions in cash or in kind (e.g. Nepal, Thailand), and increase local ownership, contributing to operational sustainability. In fact, many of the successful experiences have made combined use of top-down and bottom-up initiatives.

According to Charles Kirubi *et al* (2008), Community involvement through village organizations is very crucial for success and performance of rural electrification programme. This is especially true for successful efforts to leverage local resources and promote increased access to off-grid rural electrification. According to Kenya experience, as part of an integrated infrastructure package, GTZ/GASP, in partnership with the Mpeketoni community, started a diesel-powered micro-grid in 1994 at an initial capital cost of Ksh3.0 million (US$40,000). The local community, including entrepreneurs, farmers, and institutions, contributed about 30% of the initial capital cost in cash and labor, while GTZ/GASP contributed the balance in kind in the form of generators. However, the situation of local communities contributing in Uganda seems to be rare.

2.9 Institutional structures and Political dimension

For rural electrification programme to be successful, there should be creation of transparent and dedicated institutions such as rural electrification agencies or coordinating agencies and/or a rural electrification fund, largely autonomous and responsible for implementing the country's rural electrification strategy (Barnes & Foley, 2004). Such agencies ensure that funds are allocated directly to rural electrification and not reallocated over time to various national priorities. Their political nature should guarantee the durability of efforts independently of any other political or social goal. They should also develop the necessary standards and guidelines for the implementation of rural electrification programmes. For example, the establishment of the Rural Electrification Board in India has proven to be an effective means of furthering electrification efforts independently of political pressures.

Alexandra (2010) recommends that the rural electrification efforts should remain independent from politicians' personal agendas. Dedicated institutional structures and independence from political agendas ensure that funds are "ring-fenced", efforts are durable and electrification objectives are not interfered with according to politicians' personal agendas. Not uncommon are cases where politicians, eager to gain their constituents' support for a renewed mandate, interfere with the electrification process. The consequences of administrative corruption hinder the development process. When political pressures interfere with the distribution planning, they cause financial difficulties to the utilities or distribution companies if they are forced to operate in a non-commercial manner or are unable to cut the power supply to non-paying customers. For this reason, rural electrification efforts should follow a predetermined, inviolable plan that involves a structured institutional setting and a political monitoring of how a rural electrification progress is recommended. This task can be undertaken by independent institutions created or designated for that purpose.

Barnes & Foley (2004) recognizes that political interference at national and local levels is often caused by use of public funds for Rural Electrification programmes. They argue that the politicians regard public funding as giving them rights to interfere, but experience shows that nothing is more damaging. Once technical and financial decision-making in the implementing agency becomes based on political string pulling, professional discipline is destroyed and the organizational structure is undermined. Waste of resources, low staff morale and operational ineffectiveness are the characteristics of rural electrification programs suffering from a high degree of political interference. However, much as it was successful in Thailand for local politicians to raise and contribute funds, so that their constituents could receive electricity before the planned time, can that be applicable to Ugandan Situation? Is this the form of political interference experienced in Uganda? It still remains inconclusive hence, need further investigation.

2.10 Summary of the literature review

After a detailed literature review, it is concluded that most of the writers concentrated on the factors that affect electricity demand and did not put much attention on how this could affect performance of rural electrification programme. These include; Kate et al (2006); IPART (2012); Holtedahl & Joutz (2000); Ferguson *et al* (2000); Ziamba (2008); Enrique et al (2010); (Taylor, 1975); Amusa *et al* (2009). It should be noted that there are different factors which affect electricity demand but may not necessarily affect performance of rural electrification programme when subjected to empirical studies. This study is therefore different from the previous work due to focus on performance of rural electrification programme, study area since very few similar studies if any have been conducted in Uganda, sample selection procedure and in use of Non linear model as an econometric technique. Moreover, housing characteristics and household size are used as explanatory variables which may not have been studied in Uganda and this will be a valuable contribution to the literature.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the methods and procedures that were used in the study. The research methodology encompassed the research design, target population, sampling procedures, data collection methods and instruments, data management and analysis and presentation as well as anticipated limitations to the study.

3.1 Research Design

A cross sectional research design was used in the study because it gathers data from a cross section of a population and there is no time dimension. Data was collected at one point in time and the groups identified for the study were purposively selected based upon existing differences in the sample. This design was chosen because it is simple and least costly alternative to use with larger area coverage. Cross sectional research design also allows for a wider range of the sample to be studied at the same time and more data is covered within a shorter period of time (Sekaran, 2003). This is because cross-sectional research design is not geographically bound and can be used to estimate the prevalence of an outcome of interest because the sample is usually taken from the whole population. It is also very appropriate for investigation of the effect of specifically introduced variables on a phenomenon. Both qualitative and quantitative approaches were applied to analyze the interviews and the questionnaires.

3.2 Study Area

The study was conducted in Rukungiri district in south western Uganda. Rukungiri district boarders Kabale district in the south, Ntungamo in the south East, Mitooma in the east, Rubirizi in the north and Kanungu district in the west. It covered the sub-counties, parishes and villages covered by Kisiizi mini-hydro power project. The study area was chosen because the district acts as a model in generating mini-hydro electricity to other western districts especially with power generated from a small water fall in Kisiizi.

3.3 Study Population

3.3.1 Target population

The study focused on households connected to Kisiizi mini-hydro power project managed by Kisiizi Power Company Limited (KHPL) and households that are not connected in sub counties and parishes of Rukungiri district. The target population comprised of approximately 300 households in villages connected to grid electricity through the rural electrification programme. The 300 hundred households were targeted because it was regarded as the maximum capacity for Kisiizi mini-hydro power project basing on its capacity of 0.3MW (KHPL, 2011). Thus, the target study population was 400 people including those without electricity and key informants.

3.3.2 Accessible population

Accessible population was about 160 households connected to grid electricity, 54 households without electricity but residing in the same area and 29 key informants. The households were selected from six out of seven villages that accessed grid electricity while key informants were selected from the target villages, district and even at national level. The six villages represent 85.7% of the target villages while 160 households represent 53.3% of the households connected to electricity which according to Sekaran (2003), 20% of the total population is just a good representation.

3.4 Sampling Procedures

3.4.1 Sample size and selection

UBOS (2006a) considers a sample as the selected portion of a population drawn to provide information on the population as a whole or units of interest. The study involved selection of a sample size of 113 households supplied with grid electricity from Kisiizi mini-hydro power project, 54 households without electricity but residing in villages with electricity and 29 key informants. This meant the total sample size was 196 respondents selected from the six villages of Kisiizi lower, Kisiizi upper, Omukyondo, Rubirizi, Ibanda and Nyarushanje. Six key informants were selected outside Rukungiri district but in institutions responsible for scaling rural electrification programme.

Purposive sampling was used to select households without electricity and key informants, simple random sampling used to select the villages to be covered by the study while systematic random sampling was used to select the households with electricity from Kisiizi Power Company. Each village and household in the latter categories had equal chances of being selected. The sample size was determined by using tables for sample determination advanced by Krejice & Morgan (1970) at 5% level of precision as summarized in table 3.1.

Table 3.1: Summary of sample selection

Population category	Target population	Sample size	Sampling method
Households with electricity	160	113	Systematic random sampling
Households without electricity	54	54	Purposive sampling
Power company workers	4	4	Purposive sampling
Social workers from the area	8	8	Purposive sampling
Other key informants	20	17	Purposive sampling
Total	**246**	**196**	

Other key informants included workers from Rukungiri district Local Government, MEMD, REA, ERA, UMEME. The sample size was generated from the accessible population by sampling techniques presented in subsequent discussions. The 113 households with electricity were selected from villages of Kisiizi lower, Kisiizi upper, Omukyondo, Rubirizi, Ibanda and Nyarushanje with each village contributing 19 households apart from "Omukyondo" which contributed only 18 due to having low population with access to grid electricity service. The reason for the selection of only 113 out of 300 from the six villages was because electricity consuming population was homogeneous which made the researcher believe that the views of the sampled population would represent the views of the majority of the electricity consumers. Also, 9 households without grid electricity were selected from each village proportionate to the households with electricity.

3.4.2 Sampling techniques

Non probability and probability sampling techniques were used in the study. Under non probability sampling, purposive sampling was used to select households without electricity, key informants like power company workers, social workers from the area and other key informants from REA, MEMD and local government staff whereas convenience sampling was used to select the six villages out of seven that accessed electricity. On the other hand, simple random sampling and systematic random sampling techniques under probability sampling techniques were used to select villages and households with electricity respectively. This sampling technique was preferred because it is none biased and gave villages and households equal chances of being selected. The key informants were purposively selected due to their positions and responsibilities and the specific information that the researcher needed from them. However, households without electricity were purposively selected due to lack of sufficient time to do listing and failure to access valid and reliable listings from LC1 chairpersons. The sample size was determined by using sample determination tables advanced by Krejice & Morgan (1970) at 5% level of precision.

3.5 Data collection methods

The methods that were used in data collection include;

3.5.1 Interviewing

This was a structured interview where each respondent was asked the same questions in the same order as they appeared in the questionnaire. The researcher and field interviewers conducted these interviews. This method was appropriate because it covers a large number of respondents in a short time, it is more economical and the researcher is allowed much freedom to ask in case of need to probe hence collecting accurate and reliable data. The method also enables the respondents to ask questions that they may not understand.

3.5.2 Observation

Under this method, the researcher would observe and record without asking the respondent. This was mainly used in identifying observable characteristics of the housing unit like rooftop material and exterior walls if the house wasn't plastered.

3.5.3 Focus group discussion

This method supplemented interviewing and it combined both structured and un-structured interviews between the researcher and the key informants. The researcher grouped some key informants especially local community leaders and would ask questions on factors affecting performance of rural electrification programme. This method was preferred because of its capacity to yield detailed data through probing. It also guarded against non responses because the researcher's presence motivated the respondents to participate.

3.5.4 Document Analysis

Search for information about factors affecting performance of rural electrification programme was obtained from existing documents at REA, KHPL, UMEME, UBOS, internet and libraries among others.

3.6 Sources of data/information

The study used both primary and secondary data; primary data included people's responses to questionnaires and the raw data from the field while secondary data was collected on rural electrification rates from already existing literature, journals and News letters published by REA, KHPL and UMEME.

3.7 Data collection Instruments

3.7.1 Questionnaires

This was the key tool for data collection by the researcher. The researcher and field interviewers administered the questionnaires to save time and reduce on misinterpretation of some questions. Two types of questionnaires were used and these included household questionnaires and key informant questionnaires. The household questionnaires were structured with most questions closed ended and few open ended whereas the key informant questionnaire was semi-structured and comprised mainly of open ended questions. The reason for the type of household questionnaire was to save time and make it easy to analyse the data with back up information provided by key informants. This instrument was chosen because it can collect data within a very short time from a large section of the population and the data can easily be manipulated by statistical packages to generate meaningful information.

3.7.2 Interview guide

This guided the researcher to conduct the interview with the key informants in a consistent and organized manner. It comprised of issues listed down in the research questions and the key informants provided their views on issues highlighted while the researcher spontaneously recorded the responses on a piece of paper.

3.7.3 Documentary review checklist.

Review of relevant documents was done to provide information to the researcher on the factors affecting performance of rural electrification programme. The main source of Information was analysis of vital documents such as policy documents, newspapers, journals, newsletters, libraries, reports and internet.

3.8 Reliability and validity of instruments

3.8.1 Validity

Validity refers to the ability of an instrument to measure what it is intended to measure. The validity of the questionnaire and interview guide was ensured by carrying out a thorough review by the researcher, experts and also by peers through pre-testing. Pre-testing was done to determine if the questionnaire and interview guide generated the desired information. This meant that key adjustments were made on the data collection tools basing on pre-test findings.

3.8.2 Reliability

Reliability refers to the ability of the instrument to measure consistently what it is intending to measure. To ensure reliability of the tools and the data, three Field Interviewers were selected and trained to administer questionnaires to the respondents. The training provided ensured that the Interviewers understood the instruments in the same way. Pre-testing of instruments by the interviewers was done to establish internal consistency and dependability of the tools and the data to be collected. Using Cronbach's Alpha statistic to test reliability, a value of 0.7080 was obtained which is acceptable for surveys according to Kline, P. (1999). This value meant that 70.8% of the items in the questionnaire were consistent and reliable implying that they are related to each other.

3.9 Procedure of Data Collection

The researcher got an introductory letter from the university which introduced him to the district authorities. The district authorities were then asked to provide an introductory letter to the KHPL and Local Council chairpersons. The LC 1 chairpersons then guided the researcher to the sampled households. On visiting households in the sampled villages, each household head was briefed on the purpose of the study to build a rapport, introduced the study tools including the questionnaire and assured them to feel free to give all the relevant information required. The researcher assured respondents of utmost confidentiality against third parties accessing the information provided. The questionnaires were then administered and filled in by field interviewers since the number was quite big. Alpha Cronbach reliability test was used to test if the items in the questionnaire were consistent, reliable or whether they were related to each other.

3.10 Data Management

3.10.1 Coding of questionnaires

Coding of questionnaires involved assigning codes to responses to open ended questions. Similar or correlated responses were assigned similar codes. This aimed at transforming responses into the formats acceptable by statistical packages for analysis and making it quantitative. During the process of coding, cross checking and editing the data collected by Field Interviewers was done to weed out any errors existing in the filled questionnaires.

3.10.2 Data entry

Coded data from the questionnaires was then entered in Microsoft Excel spread sheets such that it was ready for analysis. The reason for selecting this software was to permit importation into STATA software package. Excel spread sheets also permit manipulation by any other data analysis software.

3.10.3 Data cleaning.

After entering the data, data cleaning was done to remove any errors that occurred during entry. This was done by identifying outliers within the data entered and unique entries. The data was imported into STATA software package for analysis. Most of the data cleaning was done after the data had been imported into Stata.

3.11 Data Analysis

Data analysis combined three stages of analysis. These included; Univariate analysis, Bivariate analysis and Multivariate analysis.

3.11.1 Univariate Analysis and Bivariate Analysis

Univariate analysis involved analyzing the individual determinants performance of rural electrification programme as highlighted in the objectives of the study. Frequency and percentage distribution tables and figures were used in this stage of analysis by single variable tabulations to analyse the independent variables and the dependent variable. On the other hand, bivariate analysis involved analyzing the relationship between the independent variables and the dependent variable. The Pearson correlation analysis tests were used at this stage of analysis. However, univariate and bivariate stages were combined to ensure a clear flow of presentation.

3.11.2 Multivariate Analysis

At this stage of analysis, the researcher identified only variables which had significant relationship with the dependent variable with P-value less than 0.05. The Pearson correlation analysis was used to examine the nature of relationships between the dependent variables and independent variables. The Least Squares regression method was used to carry out the analysis since continuous data was generated for the dependent variable.

3.11.3 Diagnostic tests

To check the normality of the data, histogram and the Kernel Density plots were used on the candidate variables. The researcher also used Breusch-Pagan test for heteroscedasticity. This tested the null hypothesis that the variance of the residuals is homogeneous. The researcher based on the size of the p-value to reject or accept the null hypothesis. A p-value ≤ 0.05 would imply that the variance is not homogeneous hence presence of heteroscedasticity.

To check for multicollinearity, the researcher used the Variance Inflation Factor (VIF). A mean VIF greater than 10 would permit the researcher to investigate further by omitting a variable and including another at a time until good results with mean VIF at least less than 4 were obtained.

The researcher also carried out tests for model specification errors. Specifically, the link test was carried out if the model was specified correctly. The link test creates two new variables, the variance of prediction, **_hat**, and the variable of squared prediction **_hatsq**. If the model is specified correctly only **_hat** predictor should be significant with P-value less than 0.05. Furthermore, Ramsey's RESET test was carried out. To test for omitted variables in the model. This tested a null hypothesis (H_0) that the model has no omitted variables. The P-value less than 0.05, would enable the researcher to conclude that there are omitted variables in the regression model hence need for further investigation.

Finally, the F-test and t-values were used as a statistical measure of the strength of the relationship between the dependent variable and each independent variable. The larger the t-value, the more confident the researcher was that the value of the coefficient is, on average, reliable. A t-value of at least 2 (in absolute terms) meant the researcher would be confident that the explanatory variable is related to the dependent variable at the 95% level of confidence. The R^2 was used to test the goodness of fit of the model. The F-test was used to determine the overall significance of the model.

3.12 Model specification and Estimation

This involved estimation of the factors affecting performance of rural electrification programme by appropriate econometric techniques. The researcher initially was to use a linear modal in analyzing the data and determining the coefficients. However, the researcher used a log linear modal in analyzing the data and in determining the coefficients. This was because of data transformations performed on the variables to take a log form to fulfill the assumption of normal distribution and independence of variables to allow the use of Ordinary Least Squares Regression method since the data collected for the dependent variable was continuous. Before the transformations, the econometric model for the factors affecting performance of rural electrification programme was then specified as follows;

$$\mathbf{PREP} = \beta_0 + \beta_1 HOUSC + \beta_2 HHSIZE + \beta_3 INCOME - \beta_4 CCOST - \beta_5 PRICE + U_i$$

After the transformations necessary to fulfill the conditions of normal distribution of the variables as earlier noted, the model also changed to include natural logs on some of the variables and was then specified as follows;

$$\mathbf{InPREP} = \beta_0 + \beta_1 HOUSC + \beta_2 InHHSIZE + \beta_3 INCOME - \beta_4 InCCOST - \beta_5 InPRICE + U_i$$

Where PREP=Performance of Rural Electrification programme, HOUSC=Housing characteristics; HHSIZE=Household size; INCOME=Household Income; CCOST= Connection costs; and PRICE=Price of electricity. Also, $\boldsymbol{\beta}_o$ *is* the constant; *βs* are the coefficients of each explanatory variable and U_i refers to random errors. The latter are unknown parameters representing the threshold values and are estimated with *βs.*

$\boldsymbol{\beta}_o$ represented the magnitude of performance of rural electrification programme independent of any factor deemed to affect rural electrification programme.

$\boldsymbol{\beta}_1$ showed the effect of housing characteristics on performance of rural electrification programme.

$\boldsymbol{B}_2$ showed the effect of household size on performance of rural electrification programme.

$\boldsymbol{B}_3$ showed the effect of income on performance of rural electrification programme.

$\boldsymbol{B}_4$ showed the effect of connection costs/charges on performance of rural electrification programme.

$\boldsymbol{B}_5$ showed the effect of price of electricity on performance of rural electrification programme.

3.13 Ethical consideration

The researcher ensured professional conduct throughout the study to be entrusted with the information from the respondents. This was done by building a rapport and clearly explaining to the target groups and individuals that the aim of the study was strictly academic. The researcher also involved the LCs to increase trust from the respondents. The information provided through this study was treated with utmost confidentiality and was not accessed by third parties. Finally, to ensure privacy of respondents, the respondents were assigned codes rather than their names on the questionnaire.

3.14 Encountered limitations of the study

A number of challenges were encountered during the course of this study and these mainly included; Suspicions about the topic and some respondents thought the researcher worked with KHPL, the power retailing company in the area hence pretending to be a student. The respondents were worried that the study could be aimed at increasing electricity prices. However, this limitation was minimized by proper identification including presenting introductory letter from the faculty and assured the study participants of utmost confidentiality of their information provided.

The beneficiaries of Kisiizi mini-hydro power project i.e. the target population were spread in different parishes in the district which made it difficult to trace those sampled. The situation was made worse by the terrain and mode of public transport used in the area that involved using over loaded pickups with cargo, passenger and even birds and animals. However, the researcher resorted to using bodabodas in most areas which were very costly since this study was individual and self sponsored.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents the results obtained from the field interviews and questionnaire responses generated during this study.

Data was collected and analysed with the guidance of the study objectives and presented in three main stages namely, univariate analysis, bivariate analysis and multivariate analysis. Different sections namely, housing characteristics, household size, income level, connection costs and price of electricity, billing and payment system. Grid electricity consumption as a measure of performance of rural electrification programme was incorporated in the earlier mentioned stages. The results of the study are presented in terms of tables, graphs, Pearson correlations and regression analysis as shown in the subsequent discussions.

4.2 Response rate and methods of analysis

A total of 196 questionnaires were distributed to the sampled Households with and without electricity and key informants. 100% of the households with and without electricity responded to the Field Interviewers hence their response rate was 100% respectively. However, out of 29 questionnaires that were distributed to the key informants, only 21 (72.4%) were retrieved hence response rate of 72.4%. The poor response rate for key informants was attributed to their misconception of the intention of the survey that it intended to evaluate Performance of Rural Electrification Programme despite several explanations by the Researcher. The overall survey response rate was 90.8%.

4.2 Background information of respondents

The background characteristics of the respondents were measured by sex, age, marital status, education and occupation and how their status has affected the performance of rural electrification program as table 4.2 below summarizes.

Table 4.2: Percentage distribution of respondents by background characteristics

Variable	Response	Frequency	Percentage (%)	Cumulative percentage
Sex	Male	70	49.1	41.9
	Female	97	58.1	100
	Total	**167**	**100**	
Age	Less than 20	3	1.8	1.8
	20-30	76	45.5	47.3
	30-40	48	28.7	76
	40-50	19	11.4	87.4
	Above 50	21	12.6	100
	Total	**167**	**100**	
Marital status	Single	17	10.2	10.2
	Married	122	73.1	83.2
	Widow/widower	16	9.6	92.8
	Separated/divorced	13	7.2	100
	Total	**167**	**100**	
Education	No education	24	14.4	14.4
	Primary	59	35.3	49.7
	O-Level	36	21.6	71.3
	A-Level	2	1.2	72.5
	Certificate	23	13.8	86.2
	Diploma	20	12	98.2
	University	3	1.8	100
	Total	**167**	**100**	
Occupation	Formally employed	27	14	16.2
	Self Employed	119	71	87.4
	Informally Employed	3	7	89.2
	Unemployed	16	10.8	100
	Total	**167**	**100**	

Source: **Field data 2013**

The majority respondents 97 (58.1%) out of 167 were females and only 70 (49.1%) were males. This was attributed to the nature of occupation by male counterparts. Most males were involved in running businesses like retail shops, bars and hotels that were mainly based in trading centres. The respondents' age mainly ranged from 20 to 40 years (74.2%). However on the marital status, majority respondents (73.1%) were married, 10.2% were single, 9.6% were widows/widowers and 7.2% were separated / divorced. This was attributed to the nature of African culture where household members start independent households after getting married.

Under education category, the biggest number of respondents 59 (35.3%) completed primary level. This was followed by secondary level 38 (22.8%) i.e. 36(21.6%) + 2(1.2%) and the least category falling under University with only (1.8%) and no education category at 14.4%. This has an effect on the quality of households and their ability to pay and use electricity in their proximity.

4.2.1 Relationship between education level and performance of rural electrification programme

In order to examine whether education of respondents had any association with performance of rural electrification programme, a correlation analysis was run. A significant relationship would be realized if P-value of the analysis is less than 0.05 at 5% level of significance.

Table 4.3: Correlation between education level and performance of rural electrification programme

	PREP	Significance level (P-Value)
PREP	1.0000	
Education level	0.3224	0.0005

Source: Field data 2013-Stata output

From table 4.3, it was revealed that at 5% level of significance, there is a positive correlation between education level and performance of rural electrification programme (Pearson correlation (r) =0.3224; P=0.0005<0.05). The positive relationship was attributed to most educated respondents knowing how to use electricity for different activities compared to the uneducated that only used it for lighting. The educated respondents also possessed many household appliances/electronics like television sets, computers, refrigerators, kettles and flat irons among others which consume a lot of electricity. This implies that an increase in education level is positively associated with performance of rural electrification programme.

In regard to occupation of the respondents from table 4.1, majority of them 119 (71.3%) out of 167 were self employed followed by 16.2% formally employed, 10% unemployed while 1.8% were engaged in informal employment. This could have been attributed to the increase in business start-ups associated with rural electrification since most of them were engaged in retail businesses located along electricity lines some of which depended solely on electricity.

4.3 Housing characteristics of the respondents

The housing characteristics in this study were limited to exterior walls, and occupancy tenure of dwelling unit and number of rooms. The observation method under this section was mainly used. However, where the researcher was uncertain, questions would be asked to the respondent. The findings of this study revealed that the number of respondents who stayed in their own houses was equivalent to those who lived in rented houses at 47.9%. Only 3% lived in free houses mainly provided by relatives and 1.2% remained skeptical about ownership of the houses in which they lived. However, most respondents lived in houses with few rooms for example, 40.7% respondents lived in double roomed houses. This was followed by 19.8% and 19.2% respondents in houses with three and four rooms respectively.

This seems to contradict the findings of UNHS 2009/10 Survey which showed that 76% of households lived in owner-occupied dwellings while 18 percent rented the houses they resided in and yet over the two survey periods there was a slight drop in the proportion of owner occupied houses as well as a slight increase in the proportion of households that rented.

4.3.1 Exterior walls of the respondents' housing units

The exterior walls under this study included thatched/straw, mud and poles, bricks, bricks with plaster, bricks with mud, stones and timber.

Table 4.4: Percentage distribution of respondents by exterior walls of the main housing unit

Exterior walls	Frequency	Percentage (%)	Cumulative Percent
Mud and poles	79	47.3	47.3
Bricks with cement	17	10.2	57.5
Bricks with plaster	65	38.9	96.4
Bricks with mud	6	3.6	100.0
Total	**167**	**100.0**	

Source: Field data 2013

From table 4.4 above, majority of the respondents 79 (47.3%) lived in houses built out of mud and poles and then bricks with plaster at 65(38.9%). These were followed by houses built out of bricks with cement (10.2%) and the least number being bricks with mud at (3.6%). The high percentage of people staying in houses built out of mud and poles could be attributed to the level of income in the villages being low to afford bricks and cement, the availability of trees from family and friends and community solidarity in helping one another during the initial stages of semi-permanent house construction.

4.3.2 Relationship between housing characteristics and performance of rural electrification programme

The relationship between these two variables was measured by carrying out Pearson correlation tests. The relationship would be significant if P-value is less or equal to 0.05. The findings are presented in table 4.5 below.

Table 4.5: Correlation between housing characteristics and performance of rural electrification programme

Variable	Correlation	Significance level (P-Value)
PREP	1.0000	
Exterior walls	0.2257	0.0162

Field data 2103-Stata output

From the table above, it was discovered that there is a significant correlation between exterior walls and performance of rural electrification programme (Pearson correlation=0.2257; P=0.0162<0.05). This is a positive correlation implying that an improvement in the exterior walls increases performance of rural electrification programme. This could be attributed to easiness to connect electricity to houses with strong and permanent exterior walls for example houses made out of bricks with plaster and bricks with cement. Such houses are also considered to be safer when electricity is connected compared to houses with mud and poles, and bricks with mud. However, it was noted that households with houses whose exterior walls were made out of mud and poles and have electricity at least had their exterior walls plastered. This increased their strength hence improved for electricity connection. The above results were supported by one key informant who noted;

> If houses are not permanent, wiring is not secure. We usually check out for strength of exterior walls and try to inquire if the roof is leaking. It has been very difficult to wire houses which do not have initial provisions for electricity connection. If you connect a house that is not strong, you put the life of the occupants at a high risk of being shocked by power especially during rainy seasons.

The above view of the Key Informant therefore reveals that the nature and characteristics of the housing unit are very critical for one to qualify to have electricity connected or not hence could affect the connection rate hence affecting performance of rural electrification programme.

4.4 Household Size of Respondents

The household size was measured by number of people living in the households. This was done by counting the number of members who have stayed in the household for at least a period of three month excluding visitors. However, members who had lived with the household for a period of less than three months but with intentions of staying permanently were also included. These included newly married couples and children who return from boarding schools among others.

Table 4.6: Percentage distribution of respondents by household size

Number of people in the Household/members	Frequency	Percentage (%)	Cumulative Percent
1-2	42	25.2	25.2
2-4	67	40.1	65.3
4-6	29	17.3	82.6
6-8	21	12.6	95.2
8-10	8	4.8	74.9
Total	**167**	**100.0**	

Source: Field data 2013

From table 4.6 above, 67 (40.1%) respondents had between 2 and 4 members in their households followed by 42 (25.2%) respondents with household members ranging between 1 and 2 household members. Also, 29(17.3%) and 21(12.6%) respondents had households with size composition of 4-6 and 6-8 household members respectively. Only 8(4.8%) respondents had 8 to 10 members in their households. No respondent lived in a household with more than 10 members. However, it was realized that most respondents have other residences that house other members that were not included in the study by the definition of the household member according to this study. This implies that the researcher could not certainly conclude that people in Rukungiri had small or big families basing on this study.

4.4.1 Relationship between household size and performance of rural electrification programme.

To establish the relationship between household size characterised by the number of household member, Pearson correlation test was carried out. The results are presented in table 4.7 below.

Table 4.7: Correlation between household size and performance of rural electrification programme

	PREP	Significance level (P-Value)
PREP	1.0000	
Household size	-0.3582	0.0001

Source: Field data 2013-Stata output

The Pearson correlation analysis in table 4.7 shows that there is a negative significant relationship between household size and performance of rural electrification programme (Pearson correlation= -0.3582; P=0.0001<0.05). This is an indirect relationship implying that an increase in the number of household members may reduce performance of rural electrification programme. The negative relationship between two variables could be attributed to high household expenditure associated with a big household in terms of school fees/tuition, medical care and food which render expenditure on electricity a least priority.

The above findings contradict IPART (2012), a study analyzing determinants of electricity demand in Sydney. It revealed that the more people that lived in a household, the higher the household's electricity consumption. Again, this study does not find a significant relationship between age and electricity consumption which IPART (2012) emphasized. According to their findings, an adult added about 20% more consumption than a child i.e. about 900 kWh per annum compared to about 750 kWh per annum. Contrally to them, this study finds an insignificant relationship between age and electricity consumption (Pearson correlation= -0.1828; P=0.0526>0.05).

4.5 Income level of respondents

Household income level was measured using expenditure approach since it is easier for households to tell the researcher their expenditure than their earnings. Household heads were asked how much they were spending on a number of items ranging from food and drinks, school fees/tuition, rent, energy among others between 2012 -2013. The findings are presented in table 4.8.

Table 4.8: Percentage distribution of respondents by household annual income level

Income Level (shs)	Frequency	Percentage (%)	Cumulative percentage
Below 5,000,000	48	28.7	28.7
5,000,000-10,000,000	43	25.7	54.4
10,000,000-15,000,000	33	19.8	74.2
15,000,000-20,000,000	21	12.6	86.8
Above 20,000,000	22	13.2	100.00
Total	**167**	**100.00**	

Source: Field data 2013

From table 4.8 above, 48 (28.7%) of the respondents had annual income below shs 5,000,000/= followed by 43 (25.7%) of the respondents having their annual income ranging between shillings 5,000,000 – 10,000,000. On the other hand, 19.8% of the respondents earned annual income between 10,000,000 – 15,000,000 while minority 12.6% earned annual income between 15,000,000 – 20,000,000. Only 22 (13.2%) of the respondents had annual income above 20,000,000. This implies that majority respondents associated with Kisiizi rural electrification project at least lived above a dollar per day signifying that they are above the poverty line.

4.5.1 Major source of income of households

Respondents were asked to tell their major source of income. This aimed at discovering whether it could be the nature of activity involved by the households that influences their level of income and then performance of rural electrification programme in the long run. The findings are discussed in table 4.9.

Table 4.9: Percentage distribution of respondents by the major source of income

Major source of Income	Frequency	Percentage (%)	Cumulative Percent
Salary	31	18.6	18.6
Sale of non-agricultural products	12	7.2	25.7
Shop/Retail business	71	42.5	68.3
Receipts from services rendered & commissions	12	7.2	75.4
Rental services	4	2.4	77.8
Dividend receivable	2	1.2	79.0
Sale of agricultural products	35	21.0	100.0
Total	**167**	**100.0**	

Source: Field data 2013

Basing on the findings in table 4.9, an overwhelming majority 71 (42.5%) of the 167 respondents operated shops or retail businesses as their major source of income. This explains why majority of the respondents are located along the roads and near the hospital (Kisiizi hospital). No wander, it was noted that electricity connections go along with the road hence easier and cheaper to connect. However, 35 (21%) of the respondents sold agricultural products as their major source of income. Though majority respondents were engaged in agricultural activities, it was not their major source of income since food crops were mainly grown for home consumption. In addition, agricultural products do not attract high levels of income compared to retail shops since agriculture depends on season hence income unstable throughout the year.

Furthermore, 31 (18.6%) of the respondents had salary as their major source of income while 7.2% were involved in sale of non-agricultural products and also earning from services rendered and commissions. Sale of products according to this survey excluded products in retail shops and agricultural products. Products considered here included mats and baskets among others that were made by households themselves and sold on irregular basis. The least number of respondents (2.4% and 1.2%) depended on Rental services and Dividends receivable respectively.

To confirm whether households' decisions to consume or not consume electricity were influenced by their level of income, the researcher asked a question "Does the level of income influence the consumption of grid electricity in your household?" The respondents were to answer "Yes" or "No". The respondents are discussed in table 4.10.

Table 4.10: Percentage distribution of respondents by electricity consumption decisions influenced by income

Response	Frequency	Percentage (%)	Cumulative Percent
Yes	135	80.8	80.8
No	32	19.2	100.0
Total	**167**	**100.0**	

Source: Field data 2013

From table 4.10, majority 135 (80.8%) of the respondents agree that their decisions to consume electricity are influenced by their level of income while only 19.2% insist that their decisions are not influence by the level of income. This implies that income levels affect connection rate and even consumption for those who have connected.

4.5.2 Relationship between household income and performance of rural electrification programme

The relationship between the two variables was also tested using Pearson correlation analysis. The null hypothesis that "Household income has no significant impact on performance of rural electrification programme" would be accepted if $P>0.05$. In other words, if $P\leq0.05$, then household income has a significant impact on performance of rural electrification programme.

Table 4.11: Relationship between household income and performance of rural electrification programme

Variable	PREP	Significance level (P-Value)
PREP	1.0000	
Household Income	0.1866	0.0478

Source: Field data 2013-Stata output.

From table 4.11, there is a weak significant positive correlation between household income level and performance of rural electrification programme (Pearson correlation=0.1866; $P=0.0478<0.05$). Though weak, it is a direct relationship implying that an improvement in household income level increases performance of rural electrification programme. This could be attributed to the main source of household income for example from business since most of them emphasized that they connected electricity to run their businesses late in the night especially those with retail shops and restaurants. This was contrally to those involved in agriculture who would even testify that electricity is prestige and that they could survive and generate their income without it.

The above findings contradict Santamouris (2006) who noted that energy consumption of households is strongly related to the family income. The contradiction is on the on the magnitude of strength of the relationship between the two variables. According to this study, the relationship is very weak (Pearson correlation=0.1866; $P=0.0478<0.05$). However, the above findings in Uganda concurs with that of Kate *et al* (2008) who conducted a study in two low income rural areas of Africa and concluded that income was one of the main factors influencing household electricity consumption in Africa hence performance of rural electrification programme. Also Athukorala and Wilson (2009) showed that demand for electricity in the long run increases due to increase in household's income. Therefore, rural household income levels have an influence on the performance of rural electrification programme in developing nations.

4.6 Distribution of respondents by whether they use Grid electricity service

Under this, respondents were asked whether they use grid electricity. The response expected was "Yes" or "No". The purpose was to identify those who use electricity and to help in further investigation of factors affecting performance of rural electrification programme. The question paused to respondents was "Do you use grid electricity?" the findings were as follows.

Table 4.12: Percentage distribution of respondents by use of grid electricity

Response	Frequency	Percentage (%)	Cumulative Percent
Yes	113	67.7	67.7
No	54	32.3	100.0
Total	**167**	**100.0**	

Source: Field data 2013

From table 4.12 above, majority 113 (67.7%) out of 167 respondents used grid electricity while 54(32.3%) out of 167 were not using grid electricity. This implies that those who did not use grid electricity mainly relied on use of alternative energy sources.

4.6.1 Reasons why households do not use grid electricity

Out of 54 respondents that did not have electricity even when their households were located along grid electricity lines, 113 (88.9%) of them had interest in using grid electricity service. They attributed their failure to access this service to the reasons presented in table below.

Table 4.13: Major reasons why households do not have electricity

Major reason for not having electricity	Frequency	Percentage (%)	Cumulative percentage
Limited income	15	27.8	27.8
High household expenditure	3	5.5	33.3
High connection costs	31	57.4	90.7
House rented	5	9.3	100.0
Total	**54**	**100.00**	

Source: Field data 2013

From the above table, majority 31 (57.4%) of the households were not having electricity because of high connection costs followed by 15 (27.8%) respondents not having electricity due to limited income. The least respondents 3(5.5%) attributed their failure to use electricity to high household expenditure. On the other hand, renting the house was sighted by 5(9.3%) respondents as yet another reason. All the above reasons seem to revolve on low income of households and high connection costs. The above factors were emphasized by one of the respondents who noted that;

> I cannot afford daily meals yet I have to pay school fees for three children who are in secondary school, meet their medication on top of many other requirements. With this era of low income, how do you expect me to meet the exorbitant charges for electricity connection? I will not connect electricity until the situation changes no matter how long it takes.

From the above statement, much as some respondents were not finding difficulty connecting electricity, it reveals that the connection costs are not only high but also exorbitant in relation to the income level of households in rural areas. This seems to confirm that connection costs and income level are crucial in influencing electricity connection.

4.6.2 Alternative sources of energy used by households

All respondents were asked to mention the different alternatives of energy source and rate their reliability compared to grid electricity. The reason behind was that their reliability could impact on the quantity of electricity consumed. The findings are presented in table 4.14.

Table 4.14: Alternative energy sources used by households and their reliability compared to grid electricity

Energy source	Very reliable (%)	Reliable (%)	Fairly reliable (%)	Unreliable (%)	Cases (%)
Paraffin	29.6	27.6	26.5	16.3	58.7
Solar	33.3	33.3	33.3	0	3.6
Gas	0	100	0	0	1.2
Charcoal	57.7	28.8	7.2	6.3	66.5
Firewood	60.7	22.6	13.1	3.6	50.3
Dry cells	29.6	48.1	7.4	14.8	16.2
Candles	16.0	0	44.0	40.0	15.0

Source: Field data 2013

From the above table, charcoal is the most used alternative source by 66.5% of respondents followed by Paraffin used by 58.7% respondents. This was followed by firewood used by 50.3% respondents while Gas was the least used alternative with only 1.2% respondents but 100% reliable followed by solar with 3.6% respondents and rated as at least reliable compared to grid electricity with 66.6% (33.3% + 33.3%) responses. Regarding respondents' rating reliability of these alternative energy sources, firewood was the most reliable according to 60.7% respondents followed by charcoal according to 57.7% respondents compared to grid electricity. Overall, it is noted that at least 86.5% (60.7% + 28.8%) rated firewood as at least a reliable alternative energy source followed by firewood with 83.3% (60.7% + 22.6%). This means reliability of these two alternative energy sources compared to grid electricity could be the reason why majority households use them.

However, most respondents attributed the use of firewood and charcoal to low cost incurred in accessing them. Taking an example of firewood, most households were not incurring any cost to access it but instead would get from their own forests or bush. This means that most households spend a lot of time gathering firewood which could be used for other alternative productive activities. Also, if one was to substitute firewood and charcoal with electricity, it would mean purchasing electronics like cookers, kettles and heaters on top of the high connection costs and paying high electricity bills. This is in line with Sebbit *et al* (2004) whose research found out that most rural households were using three-stone fire stoves, which were very cheap but with efficiency rating as low as 9%. They noted that in the urban areas a metallic charcoal stove was the most commonly used appliance in households with its efficiency rated at about 23% while stoves with clay linings were rated at about 34%.

From table 4.14 still, dry cells were rated by respondents as at least reliable by 77.7% (29.6% + 48.1%) respondents. It was only being used 16.2% respondents. On the other hand, candles were the most unreliable alternative energy source according to 40% respondents as unreliable and 44% responses as fairly reliable. However, it was used by only 15% respondents. This was attributed to the risks associated with candle usage since most respondents believed that most fire cases in the country were mainly attributed to candles that were left burning in peoples dwellings.

4.7 Connection costs/charges incurred by respondents to connect grid electricity

Connection costs/charges according to this study include all upfront or initial expenses/ charges incurred to have households connected to grid electricity. Since Uganda’s rural electrification programme targeted rural and marginalized areas, majority of the people are generally poor and therefore have some difficulty having their households connected to power. If households fail to get connected to grid electricity, then rural electrification programme may fail in relation to its performance targets. Under this, the respondents with grid electricity connection were asked to mention how much they spent in the whole process of having their houses connected to grid electricity. The amount mentioned was then grouped into intervals of "1-200,000" to provide more meaning and easy interpretation. The findings are presented in table 4.15.

Table 4.15: Percentage distribution of respondents by connection costs/charges incurred to connect grid electricity

Connection/charges	Frequency	Percentage (%)	Cumulative Percent
300,000-500,000	63	55.8	55.8
500,000-700,000	4	3.5	59.3
700,000-900,000	33	29.2	88.5
1,300,000-1,500,000	6	5.3	93.8
1,600,000-1,850,000	2	1.8	95.6
Above 1,700,000	5	4.4	100.0
Total	**113**	**100.0**	

Source: Field data 2013

From table 4.15 above, majority 63(55.8%) out of 113 incurred less connection costs between Uganda shs 300,000 to 500,000 to have their houses connected. This is attributed to the government efforts of making electricity affordable to the people by reducing upfront costs/initial connection costs. This range is followed by 33(29.2%) out of 113 respondents who incurred connection costs/charges ranging between Uganda shs 500,000 to 700,000. Surprisingly, only 4 (3.5%) out of 113 respondents incurred connection costs ranging between Uganda shs 500,000 to 700,000 which is less than the latter group. However, 13(11.5%) out of 113 incurred connection charges of Uganda ahs 1,000,000 and above.

4.7.1 Rating connection costs/charges to grid electricity

The connection costs/ charges according to this study included expenses incurred to have the household connected to grid electricity. They are commonly known as upfront costs. All the respondents were asked to rate the connection costs/charges by using the scale “Too high, High, Fair, very low”. All respondents were considered because they had at least made an attempt to get connected or very inquisitive about the connection requirements including the charges. The findings are presented in table 4.16.

Table 4.16: Percentage distribution of respondents by rating connection costs

Response	Frequency	Percent	Cumulative Percent
Too high	90	53.9	53.9
High	45	26.9	80.8
Fair	29	17.4	98.2
Very low	3	1.8	100.0
Total	**167**	**100.0**	

Source: Field data 2013

From the findings in table 4.16, majority respondents i.e. 90 (53.9%) rated the cost as too high to afford followed by 45(26.9%) respondents rating it as “High”. This brings the overall percentage of respondents who rank the connection costs as at least high to 80.8% (53.9% + 26.9%). This implies that high connection costs could explain why some households are located along the grid electricity lines but take many years to get connected. This is in line with Enrique *et al* (2010) who insist that rural and often peri-urban households cannot afford to pay the high cost of providing electricity to their villages and in particular, many households are unable to pay the connection fee. However, 29(17.4%) of the respondents ranked the initial connection costs as fair while only 3(1.8%) respondents regarded these costs as very low hence affordable to majority households. This rating was supported by the key informant who revealed that;

> The connection costs are high depending on families. In this area, about 10% can easily afford especially the working class but for most people, it is not affordable. The installation cost is usually higher than the connection charges depending on the nature of the house. Therefore combining these two expenses makes it even more difficult for most households. Majority have really been stopped by the initial connection cost and resorted to getting electricity from neighbours who instead cheat them on recharges.

This implies that much as 17.4% and 1.8% respondents regarded connection cost as Fair and Very low respectively, these could constitute the formally employed households hence electricity connection could be very difficult for households that were not formally employed yet these constituted the majority.

4.7.2 Relationship between connection costs/charges and performance of rural electrification programme

Note that connection costs/charges was measured by the amount of money that households spent on having their dwelling units connected. The relationship was determined by carrying out Pearson correlation analysis

Table 4.17: Correlation between connection costs/charges and performance of rural electrification programme

	PREP	Significance level (P-Value)
PREP	1.0000	
Connection Cost/charges	-0.1929	0.0407

Source: Field data 2013-Stata output.

The Pearson correlation analysis presented in table 4.17 shows that there is a significant negative relationship between connection costs/charges and performance of rural electrification programme (Pearson correlation=-0.1929; $P=0.0407<0.05$). This implies that an increase in the connection costs/ charges may reduce demand for power hence negatively affecting performance of rural electrification programme. This was attributed to the low level of income by most households in rural areas hence any increase in connection charges will make electricity connection unaffordable by the poor households. This negatively affects the rural electrification penetration rate hence reducing performance of rural electrification programme.

The above finding is in line with Enrique *at al* (2010) who argued that the Rural and often peri-urban households cannot afford to pay the high cost of providing electricity to their villages especially households' inability to pay the connection fee. World Bank (2008b) also noted that grid electricity connection costs pose a barrier to rural electrification since electrification programmes often do not benefit the poorest of the poor, as they cannot afford high upfront costs. The upfront cost refers to connection costs. According to Charles Kirubi, *et al* (2008), connection costs make rural electrification efforts benefit the rich rather than the poor.

Connection costs impact on performance of rural electrification programme by reducing the connection rate. This is in line with MEMD (2013) which revealed that connection rates often remain low long after an electrification project is completed even up to a period of two years. In areas where schemes have been constructed, only about 10% of originally projected consumers get connected due to affordability issues. However, this finding was not estimated by econometric means.

MEMD (2013) connection costs is a challenge to rural electrification programme in that connection rates often remain low long after an electrification project is completed even up to a period of two years. In areas where schemes have been constructed, only about 10% of originally projected consumers get connected due to affordability issues. However, this finding was not estimated by econometric means which the researcher sought to find out.

4.8 Price of electricity, billing and payment system

According to the law of demand and supply, the price charged for a normal good like electricity has an impact on the consumption and supply behavior of customers just like any other normal commodity. This means the price of electricity may have an effect on performance of rural electrification programme. The mode of billing and payment system is also crucial for success of rural electrification programme including the type of meter used and its ownership. The price of electricity was determined by the amount of last payment for grid electricity service with regard to the period it covered and household perception on the price level. The findings are presented in table 4.18.

Table 4.18: Percentage distribution of respondents by the amount paid for grid electricity service

Price level	Frequency	Percentage (%)	Cumulative Percent
1-4,000	14	12.4	12.4
4,000-8,000	25	22.1	34.5
8,000-12,000	29	25.7	60.2
12000-16,000	5	4.4	64.6
16,000-20,000	23	20.4	85.0
Above 20,000	17	15.0	100.0
Total	**113**	**100.0**	

Source: Field data 2013

From table 4.18 above, majority 29(25.7%) of the respondents paid an amount for electricity ranging between Uganda shs 8,000 to 12,000. This was closely followed by 25(22.1%) and 23(20.4%) respondents paying an amount in the range of Uganda shs 4,000 to 8,000 and shs 16,000 to 20,000 respectively. The lowest number of respondents equivalent to 5(4.4%) paid an amount ranging between 12,000 and 16,000 while on the contrally, 15% paid the highest amount above Uganda shs 20,000.

4.8.1 Respondent perception of the price level of electricity

To clearly estimate how the households perceived the price levels, the researcher asked the respondents to rate the price of electricity to find out whether it is “Too high, High, Fair, Low and very low”. The findings are presented in table 4.19.

Table 4.19: Percentage distribution of respondents by rating price level of electricity

Response	Frequency	Percentage (%)	Cumulative Percent
Too high	16	14.2	14.2
High	20	17.7	31.9
Fair	62	54.9	86.7
Low	13	11.5	98.2
Very low	2	1.8	100.0
Total	**113**	**100.0**	

Source: Field data 2013

From table 4.19, it was discovered that majority 62(54.9%) respondents perceived the price level of electricity as fair. Only 20(17.7%) of the respondents insisted that the price level of electricity was high while 14.2% rated electricity price as too high. This implies that the total percentage of respondents who rated the price as at least high was 31.9% (17.7% + 14.2%). However, this percentage was still much outweighed by 54.9% of respondents who perceived the price level as fair and only 1.8% of the respondents perceive the electricity prices to be very low.

The above findings imply that the price charged by KHPL was realistic and recovered the costs incurred, associated with an effective billing and payment system and at the same time considering affordability. An increase in price level increases revenue generated by power companies basing on the law of supply which in turn increases capacity to make repairs and maintenances in time, pay workers and make more investments in the energy sector. This view concurs with Obermaier (2010) who argues that successful rural electrification programs must simultaneously tackle the issues of expanding electricity access and enabling the new consumers to increase their electricity consumption through charging realistic prices.

4.8.2 Relationship between price of electricity and performance of rural electrification programme

The effect was measured by testing the correlation between the price of electricity and performance of rural electrification programme using Pearson correlation analysis to test a null hypothesis that "There is no significant relationship between price of electricity and performance of rural electrification programme".

Table 4.20: Correlation between Price of electricity and performance of rural electrification programme

	PREP	Significance level (P-Value)
PREP	1.0000	
Price of electricity	0.7110	0.0000

Source: Field data 2013-Stata output.

From table 4.20, there is a strong positive correlation between price of electricity and performance of rural electrification programme (Pearson correlation=0.7110; P=0.0000<0.05). This means that we fail to reject the alternative hypothesis that price of electricity has a significant effect on performance of rural electrification programme. This implies a direct relationship between the two variables meaning that an increase in the price of electricity may lead to increase in performance of rural electrification programme. This is in line with the law of supply which states that "an increase in price of a commodity increases the supply of that commodity" hence increasing the revenue generated by the supplier.

The implication of this theory and finding is that an increase in the price of electricity increases the revenue generated by the power companies which enhances their efficiency in service delivery. This revenue can be used to cover company expenses like salaries paid to staff, fuel to supervise activities in different areas and making repairs and maintenance in time. This means they can be able to recover the initial costs incurred during establishment of the power plants and distribution. Therefore, price for power may positively contribute to performance of the supplier. One of the key informants provided justification for high prices and noted that;

> A high price is needed to purchase customer connection materials, import pre-paid meters, pay Value Added Tax (VAT) to Uganda Revenue Authority (URA), pay workers salaries and their National Social Security Fund (NSSF) contributions, buying spares and general maintenances.

All these expenses seem to be beneficial to government since it needs to generate revenue through taxes, employees of power companies through wages as well as increasing access to electricity and improving efficiency in electricity service delivery.

The above findings concur with the findings of Amusa *et al* (2009) who analyzed the determinants of aggregate demand for electricity in South Africa. It is only the connection cost that affects electricity demand for electricity in this case just like his study found out that changes in price of electricity had no effect on the demand for electricity. The findings of this study are also in line with Barnes & Foley (2004) who noted that charging the right price allows the electricity company to provide an electricity supply in an effective, reliable, and sustainable manner to an increasing number of satisfied consumers. World Bank (2000) also revealed that the effective recovery of customer payments allows electricity companies to supply reliable and sustainable power. Lack of payment for electricity use not only weakens the financial stability of the electricity provider. This is only possible if the right price is charged.

However, it should be noted that the positive relationship between electricity price and performance of rural electrification programme can only be enhanced by an effective pricing and billing system. The above argument was also echoed by one of the key informants who noted that;

> Pre-paid meters make it impossible to default and there is no inconvenience of going to disconnect and reconnect those who have failed to pay electricity bills. They help customers control their consumption and can budget well since they often observe the units reducing on their meters. The electricity is used according to what one can afford.

This was noted in the area covered by this study where 84.1% respondents could admit that it was the pre-paid meters that attracted them to connect grid electricity since they could pay the amount of their choice rather than reading meters by service providers and then generate electricity bills. This argument is supported by Alexandra (2010) who believes that effective metering, billing and payment recovery ensures the long-term viability of the electricity supplier and therefore of the electrification process as a whole.

4.8.3 Metering, billing and payment system

The billing and payment system is fundamental in rural electrification programmes since it determines the level of efficiency for the power utility companies. Most of the losses are incurred due to the choice of billing and payment system. The researcher found out that 52% of the respondents use shared meter while 44% use their own meter. Only 4% of the respondents did not have meters. It was noted that majority 89% respondents used pre-paid meter and only 7% of the respondents used post paid. This was attributed to the new strategies of utility companies trying to phase out the post paid meters and rolling out pre-paid maters. Regarding reliability of pre-paid meters, 84.1% of the respondents found the pre-paid meter reliable compared to post paid meters and only 7.1% of the respondents found pre-paid meters unreliable. This was attributed to the fact that households pay any amount of their choice depending on the level of disposable income at that particular time and what they want to use electricity for. Some households would pay for electricity when they have functions or when expecting visitors. However, only 48.6% respondents understood the pricing and billing system hence more household training may be needed.

4.9 Grid electricity consumption per capita

The amount of electricity consumed by household depends on what households use electricity for. All the respondents with electricity used it for lighting at 100% followed by phone charging by 83.2% respondents. The use of electricity for ironing accounted for 12.8% of the total respondents followed by television by 36.3% respondents. Only 8.8% of the respondents used electricity for cooking. Refer to appendix VIII for details.

However, Grid electricity consumption was measured in kilowatt-hour (kWh) per capita per annum for households connected to grid electricity. The findings of quantity of electricity consumed are presented in table 4.21.

Table 4.21: Percentage distribution of respondents by Kilowatts per capita consumed per annum

Electricity consumption per capita (kWh)	**Frequency**	**Percentage (%)**	**Cumulative percentage**
0-25	23	20.4	20.4
25-50	37	32.7	53.10
50-75	17	15.0	68.1
75-100	15	13.3	81.4
100-125	9	8.0	89.4
125-150	1	0.9	90.3
Above 150	11	9.7	100.0
Total	**113**	**100.00**	

Source: Field data 2013

From table 4.21 above, 37(32.7%) respondents consume between 25 – 50 kWh per capita followed by 23(20.4%) consuming between 0 – 25 kWh per capita. These were the lowest electricity consumers. Only 15% of the total respondents consume between 50 – 75 kilowatts per capita while 13.3% respondents consumed between 75-100 kWh per capita. It should be noted that 18.6% (8%% + 0.9% + 9.7%) consumed above 100 kWh per capita.

The above findings confirm that Electricity consumption is very low with 68.1% respondents consuming below the national average of 75kWh per capita (NDP, 2010:30) and extremely lower than Africa's average of 578kWh per capita and the world's average of 2572kWh per capita according to MEMD (2011a). This concurs with Enrique *et al* (2010) who explained the reasons why closing the electricity access gap remain an unfinished agenda and noted that many households consume less than 30 kilowatt-hours (kWh) per month implying 360kWh per annum. From the above findings, 92.3% of respondents consume less than 300kWh per annum which is far less than 360kWh suggested by Enrique *et al*. This implies high costs of supply for each unit of electricity consumed hence high costs of supplying electricity to rural and peri-urban households which affects performance of rural electrification programme.

4.10 Multivariate analysis

The researcher identified only variables which had significant relationship with the dependent variable with P-value less than 0.05. This was based on the Pearson correlation analysis that was used to examine the nature of relationships between the dependent variables and independent variables.

4.11 Diagnostic tests

4.11.1 Tests for normality of the data

To test the normality of the different variables, Kernel density plots and histograms were used on all the candidate variables. These results revealed that data transformations were necessary hence variables were transformed into log form. The normality test on the transformed variables showed an improvement in normality. The details of Kernel density plots and histograms for variables before and after transformations are attached in Appendix IX.

4.11.2 Tests for heteroscedasticity

Heteroscedasticity refers to a situation where the variance of successive error terms is not constant for different observations. It exists when there is existence of a relationship between the error term and at least one or more independent variables. To test for heteroscedasticity, the researcher used Breusch-Pagan/Cook-Weisberg test against a null hypothesis "H_0: Constant Variance". The decision was based on the P-value of the analysis. The P-value less than 0.05 shows that the variance is not homogenous hence presence of heteroscedasticity while a P-value greater than 0.05 reveals presence of heteroscedasticity. On testing the hypothesis however, the calculated P-value was 0.6998 which is greater than 0.05 implying constant/homogeneous variance. This made the researcher fail to reject the null hypothesis that the model has constant variance hence absence of heteroscedasticity.

4.11.3 Tests for multicollinearity

Multicollinearity is used refers to the presence of a linear relationship among the explanatory variables of the model such making it difficult to measure the separate effects of each of the explanatory variables on the dependent variable. To test the presence of multicollinearity, the researcher used the variance inflation factor (VIF). Computationally, it is defined as the reciprocal of tolerance i.e. $\frac{1}{1-R^2}$. The researcher desired a lower level of VIF, as higher levels of VIF are known to affect adversely the results associated with a multiple regression analysis. A value of mean VIF greater than 10 signifies a problem hence permits the researcher to investigate further. The results of the VIF test are presented in table 4.22.

Table 4.22: Variance Inflation Factor (VIF) test for multicollinearity

Variable	VIF	1/VIF
INCOME	1.12	0.890774
lnPRICE	1.10	0.905713
lnHHSIZE	1.04	0.964538
lnCCOST	1.02	0.976120
HOUSC	1.02	0.983146
Mean VIF	**1.06**	

Source: Field data 2013

From table 4.22, the Mean VIF of 1.06 is very good for research since it is far less than 10, a value that has commonly been recommended as the maximum level of VIF for example by Hair, Anderson, *et al* (1995); Kennedy (1992); Marquardt (1970); Neter, *et al* (1989). The VIF of 1.06 is also far less than 5, a recommended maximum VIF by Rogerson (2001) and even VIF of 4 recommended by Pan and Jackson (2008).

4.11.4 Tests for model specification errors

A model specification error can occur if one or more relevant variables are omitted from the model or more irrelevant variables are included in the model. If relevant variables are omitted from the model, the common variance that they share with included variables may be wrongly attributed to those variables and the error term may be inflated. However, if irrelevant variables are included in the model, the common variance they share with included variables may be wrongly attributed to them.

4.11.4.1 The link test for specification errors

The link test is based on the idea that if a model is properly specified, one should not be able to find any additional independent variables that are significant except by chance. The link test creates two new variables, the variance of prediction, **_hat**, and the variable of squared prediction **_hatsq**. If the model is specified correctly only **_hat** predictor should be significant with P-value less than 0.05 as presented in table 4.23.

Table 4.23: The link test for model specification errors

lnPREP	Coef.	Std. Err.	t	P>|t|
_hat	1.625211	.4542081	3.58	0.001
_hatsq	-.0763074	.0548991	-1.39	0.167
_cons	-1.236008	.923685	-1.34	0.184

Source: Stata output

From table 4.23, only **_hat** predictor is significant with a P-value=0.001<0.05 hence the model is specified correctly.

4.11.4.2 Ramsey's Regression Specification Error Test (RESET)

To test for omitted variables in the model, Ramsey RESET test was carried out. This tests a null hypothesis (H_0) that the model has no omitted variables. If the P-value is less than 0.05, then the researcher concludes that there are omitted variables in the regression model hence need for further investigation. However, the test revealed a P-value=0.0620>0.05 implying the model had no omitted variables hence no specification errors.

4.12 Model Estimation and specification

4.12.1 Model estimation

This involved estimation of the factors that affect performance of rural electrification programme by econometric means. The researcher used a mixture of lin-log and log-lin model to determine the coefficients since three independent variables were transformed to assume a natural log while two variables (Housing characteristics and income level) were not transformed to fulfill the assumption of normal distribution. The econometric results helped to determine the extent of relationship between measured and considered variables and performance of rural electrification programme. The independent variables considered in this analysis include; housing characteristics (HOUSC), household size (HHSIZE), income (INCOME); Connection costs (CCOST); and Price of electricity (PRICE). The model estimation results are presented in table 4.24.

Table 4.24: Model estimation Results

Source	**SS**	**df**	**MS**	Number of obs	=	113
Model	61.3484613	5	12.2696923	F(5, 107)	=	48.04
Residual	27.3304406	107	.255424678	Prob > F	=	0.0000
Total	**88.6789019**	**112**	**.79177591**	R-squared	=	0.6918
				Adj R-squared	=	0.6774
				Root MSE	=	.5054
lnPREP	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf. Interval]**	
HOUSC	.1121203	.0588579	1.90	0.059	-.7823311	-.4584165
lnHHSIZE	-.6339819	.0810458	-7.82	0.000	-.7823311	-.4584165
INCOME	.0616083	.0354386	1.74	0.085	-.0160666	.1253666
lnCCOST	-.2147675	.1014115	-2.12	0.037	-.4240947	-.017396
lnPRICE	.6292673	.0530146	11.87	0.000	.5256124	.7382493
_cons	1.545079	1.500446	1.03	0.305	-1.41446	4.604858

Source: Field data 2013-Stata output

4.12.2 Model specification

The econometric model for the factors affecting performance of rural electrification programme was then specified below with an aim of testing the hypotheses.

lnPREP =1.545079 + 0.1121203**HOUSC** – 0.6339819**lnHHSIZE +** 0.0616083**INCOME –** 0.2147675**lnCCOST +** 0.6292673**lnPRICE + U_i**

Where PREP=Performance of Rural Electrification programme; HHSIZE=Household size, INCOME=Household Income level; CCOST=Connection costs; and PRICE=Price of electricity. From the model, β_o=1.545079; β_1=0.1121203; β_2 = -0.6339819; β_3 =0.0616083; β_4= -0.2147675; β_5=0.6292673. β_o **is** the constant while βs are the coefficients of each explanatory variable and U_i refers to random errors. The latter are unknown parameters representing the threshold values and are estimated with βs. U_i covers all the other factors that are not included in the model.

Regarding model interpretation, β_o=1.545079 represents the impact on performance of rural electrification programme independent of any other variable. However, this value is not significant at 5% level of precision since P-value = 0.305>0.05.

On the impact of housing characteristics on performance of rural electrification programme, β_1=0.1121203 shows that housing characteristics have a positive insignificant impact on performance of rural electrification programme. This means that a unit improvement in housing characteristics may increase performance of rural electrification programme by 0.11%. It also means that a unit decrease in housing characteristics reduces performance of rural electrification programme by 0.11%. The impact however is insignificant with P-value =0.059>0.05 implying that changes in housing characteristics may have no significant impact on performance of rural electrification programme.

Regarding the effect of household size on performance of rural electrification programme, β_2= -0.6339819 shows that household size has a strong negative significant effect on performance of rural electrification programme. This implies that an increase in household size by 1% may reduce performance of rural electrification programme by 0.63%. It also implies that a 10% increase in household size may reduce performance of rural electrification programme by 6.3%. Note that the effect is very significant with P-value = 0.000<0.05 at 5% level of significance. However, a reduction in household size by 1%, could increase performance of rural electrification programme by 0.63% while a 10% reduction in household size could increase performance of rural electrification programme by 6.3%.

On the impact of income level on performance of rural electrification programme, β_3=0.0616083 shows that household income has no significant impact on performance of rural electrification programme. The implication of β_3 is that a unit increase in the level of household income may lead to an increase in performance of rural electrification programme by 0.06%. On the other hand, a unit reduction in the level of household income may lead to reduction in performance of rural electrification programme by 0.06%. However, the impact is insignificant since P-value = 0.085>0.05 hence changes in household income may not have a significant impact on performance of rural electrification programme. The implication of this is that High income households can afford connection, bigger houses and more appliances, and as a consequence use more energy. This is in line with Wokje & Linda (2011).

Furthermore, regarding connection costs/charges, β_4 = -0.2147675 reveals that connection costs have a negative significant relationship with performance of rural electrification programme. This finding implies that a 1% increase in the connection charges may reduce performance of rural electrification programme by 0.21% while a 10% increase in the connection charges may reduce performance of rural electrification programme by 2.1%. This impact is very significant since P-value = 0.037<0.05 at 5% level of significance. On the other hand, a reduction in connection charges by 1% increases performance of rural electrification programme by 0.21% whereas a 10% reduction in connection charges may increase performance of rural electrification programme by 2.1%. This implies that high connection costs often do not benefit the poorest of the poor, as they cannot afford high upfront costs (World Bank, 2008b).

Finally, on the effect of price of electricity on performance of rural electrification programme, β_5=0.6292673 shows that the price charged under rural electrification programme has a strong positive significant effect on performance of rural electrification programme. The interpretation of this is that a 1% increase in the price of electricity may result in an increase in performance of rural electrification programme by 0.63% while a 10% increase in price of electricity may lead to an increase in performance of rural electrification programme by 6.3%. This effect is very significant with P-value = $0.000<0.05$ at 5% level of significance. This finding is supported by the fact that the effective recovery of customer payments allows electricity companies to supply reliable and sustainable power. Lack of payment for electricity use not only weakens the financial stability of the electricity provider but also discourages investors to join in on the rural electrification efforts because of uncertain revenues. This concurs with World Bank (2000); Enrique et al (2010); and Alexandra (2010).

4.13 Goodness of fit of the model

To measure the goodness of fit of the model, the coefficient of determination (R^2) was used. R^2 measures the extent to which the independent variables explain the variations in the dependent variable. From table 4.24, the model specified above by the researcher exhibits $R^2 = 0.6918$. This means that housing characteristics, household size, Income, connection costs/charges and price of electricity explain up to 69.18% of the variations in performance of rural electrification programme. This means that other factors not included in the model account for only 30.82% of the variations in the performance of rural electrification programme. Therefore, since R^2=69.18% which is over 50%, then the model is relatively a better fit for explaining factors affecting performance of rural electrification programme in Uganda.

4.14 Overall significance of the model

To test the overall significance of the model, the F-statistic was used. The F-statistic tells whether the regression model as a whole explains a significant amount of variation in the dependent variable. The computed F-statistic lies in the critical region with P-value less than 0.05 for the model to be considered statistically significant. From table 4.24, the computed F-value of 48.04 lies between 5 and 107 which is the critical region and its P-value = 0.0000<0.05 hence, the model is statistically significant in explaining the variations in performance of rural electrification programme.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the conclusions and recommendations of the study are presented. The summary presents important findings and conclusions involve a summary of the most significant issues found out in the study whereas recommendations are proposed priority actions that could be undertaken by the agencies and institutions involved in electrification to improve performance of rural electrification programme.

5.2 Summary of findings

The summary of main findings is presented according to hypotheses stated on each specific objective to answer the research questions. The findings are summarized as follows;

5.2.1 Rural housing characteristics and performance of rural electrification programme

The study found out that majority 47.3% of the respondents lived in houses built out of mud and poles while 38.9% houses were constructed with bricks and then plastered; 10.2% houses built out of bricks with cement and the least number being bricks with mud (3.6%). 40.7% respondents lived in double roomed houses. There was also a positive significant relationship between housing characteristics and performance of rural electrification programme (Pearson correlation=0.2257; P=0.0162) which made the researcher fail to accept the null hypothesis that rural housing characteristics have no significant relationship with performance of rural electrification programme. However, housing characteristics had a marginally insignificant positive impact on performance of rural electrification programme (β_1=0.1121203; P=0.059>0.05) an indication that rural housing characteristics have a positive insignificant impact on performance of rural electrification programme.

5.2.2 Household size and performance of rural electrification programme

The researcher aimed at assessing the relationship between household size and performance of rural electrification programme. The findings showed that 40.1% respondents had between 2 and 4 household members followed by 25.2% respondents with members ranging between 1 and 2; and 17.3% and 4.8% respondents had households with size composition of 4-6 and 6-8 household members respectively. There was a very strong negative significant relationship between household size and performance of rural electrification programme (Pearson correlation = -0.3582; $P=0.0001<0.05$) hence the researcher failed to accept the null hypothesis that Household size has no significant relationship with performance of rural electrification programme. The regression analysis further showed that household size had a strong negative impact on performance of rural electrification programme ($\beta_2 = -0.6339819$; $P=0.0000<0.05$). Hence, there is a negative significant relationship between household size and performance of rural electrification programme.

5.2.3 Household income level and performance of rural electrification programme

Under this, the researcher intended to examine the impact of household income level on performance of rural electrification programme. Majority 42.5% of the respondents operated businesses mainly retail as their major source of income and 54.5% of the respondents could raise annual income of at least Uganda shillings 10,000,000. The regression analysis revealed that household income had no significant impact on performance of rural electrification programme ($\beta_3=0.0616083$; $P=0.085>0.05$) making the researcher fail to reject the null hypothesis that Household income has no significant impact on performance of rural electrification programme. However, there was a minor positive significant relationship between household income level and performance of rural electrification programme (Pearson correlation=0.1866; $P=0.0478<0.05$). Therefore, the income level of households insignificantly impacts positively on performance of rural electrification programme.

5.2.4 Connection costs and performance of rural electrification programme

Under connection costs, the researcher set out to establish the extent to which connection costs/charges impact on performance of rural electrification programme. Majority 55.8% respondents incurred connection costs between Uganda shs 300,000 to 500,000 to have their houses connected while 29.2% respondents incurred connection costs/charges ranging between Uganda shillings 500,000 to 700,000. Also, 80.8% respondents ranked the connection costs as high. No wander, the results of the results of the regression analysis revealed that connection costs/charges had a negative significant impact on performance of rural electrification programme (β_4= -0.2147675; $P=0.037<0.05$) which made the researcher fail to accept the null hypothesis that Connection costs/charges have no significant impact on performance of rural electrification programme. However, the extent of the impact seemed to be small since a 10% increase in connection costs reduces performance of rural electrification programme by 2.1% basing on β_4. The relationship between the two variables was also negative and significant (Pearson correlation=-0.1929; $P=0.0407<0.05$). Hence, the connection costs/charges significantly affects performance of rural electrification programme negatively to a small extent.

5.2.5 Price of electricity and performance of rural electrification programme

Finally, the study intended to examine the effect of price of electricity on performance of rural electrification programme. It was revealed that Majority (54.9%) respondents rated the price level of electricity as fair and only 17.7% of the respondents insisted that the price level was high. The mode of billing and payment system made it easier to afford prices since 89% of respondents used pre-paid meters and 84.1% of the respondents rated pre-paid meters reliable compared to post paid meter. The Pearson correlation analysis showed that there was a very strong positive relationship between price of electricity and performance of rural electrification programme (Pearson correlation=0.7110; $P =0.0000<0.05$). The impact of price on performance of rural electrification programme was also strong, positive and significant (β_5=0.6292673; P=0.0000<0.05) hence the researcher failed to accept the null hypothesis that Price of electricity has no significant effect on performance of rural electrification programme. This means that the price of electricity positively affects performance of rural electrification programme.

5.3 Conclusions

Rural housing characteristics insignificantly impact positively on performance of rural electrification programme. This implies that an improvement in the housing characteristics particularly using strong building materials and plastering exterior walls of dwelling units increase wall strength making electricity connection cheaper, easier and safer.

Also, household size significantly and negatively affects performance of rural electrification programme. An increase in the number of household members increases general household expenditure that makes electricity expenditure a least priority which reduces revenue generated by power utility companies. Increase in household size also increases population size which puts pressure on scarce electricity generated. The quantity of electricity generated in Uganda is not sufficient to match the population growth rate. This leads to high demand for electricity exceeding supply which leads to increased load shedding and inefficiencies.

Furthermore, household income level insignificantly impacts positively on performance of rural electrification programme. An increase in income level increases the household capacity to pay for initial electricity connection and sustainably clear electricity bills to the service provider. Households with high income can also afford to buy electricity appliances like refrigerators, Music systems, computers and even starting businesses like welding. These increase revenue sources of power utility companies.

Connection costs/charges significantly affects performance of rural electrification programme negatively. This means that an increase in connection charges makes majority of the households incapable of affording upfront connection costs hence finding it difficult to have their dwelling units connected to grid electricity, since most people in rural areas are low income earners and at times below the poverty line.

The price of electricity charged significantly and positively affects performance of rural electrification programme. This implies that the price of electricity charged ensures that costs are recoverable since effective recovery of customer payments allows electricity companies to supply reliable and sustainable power to an increasing number of satisfied consumers. This is only ensured by charging the right price. This concurs with Barnes & Foley (2004), World Bank (2000); Enrique et al (2010); and Alexandra (2010).

5.3 Recommendations

Basing on the study findings and analysis, the study suggests a number of recommendations to improve performance of rural electrification programme.

Households through power utility companies should be encouraged to build houses with strong exterior walls with provisions for electricity wiring and improving the already existing structures by plastering. This can be done by Power utility companies engaging the masses into discussions about the advantages of using some building materials and increasing the strength of walls in regard to easiness, safety and cost effectiveness in the connection process. This can reduce on the expenses incurred in wiring since high expenses are often incurred in breaking the existing structures/walls to do wiring and then repairing.

Since an increase in the number of household members reduces performance of rural electrification programme, population control measures like family planning enacting strong population control policies. It can also be done by encouraging households heads to educate their household members especially females. This can be done by government providing an enabling environment by strengthening universal education programmes, providing more education facilities like classrooms, increasing the number and motivating teachers. However, this should be accompanied by high job creation strategies.

Furthermore, since an increase in household income increases performance of rural electrification, government should prioritize development strategies that increase income generations among households and at the same time promote rural electrification. These include agriculture and infrastructure development strategies in terms of roads that will facilitate trade by enabling transportation of rural households' produce and other tradable goods and at the same time facilitate transportation of electricity transmission materials like electricity poles, wires and reduce the costs of monitoring the established grid electricity systems caused by poor road network.

Government should subsidize the price of electricity meters by reducing taxes on companies importing them. This means the government can recover the revenue lost on subsidization from the economic activities promoted by rural electrification strategies like welding, grinding mills, and other rural processing industries that will develop. The reduction in the cost of the electricity meter will reduce the connection costs/charges and increase affordability by households. This strategy is important since the study noted that most households were discouraged by the cost of electricity meter. Note that a reduction in the cost of connection cost increases the connection rate and reduce meter sharing among households which has been a hindrance to using appliances and electronics that use a lot of electricity.

The rural electrification agencies should develop a mode of payment for electricity connection where by households pay in installments or make the period of payment longer for example six months or even one year. This is because most households generate income over a longer period of time especially those involved in business and agriculture which depends on season. Recall that most households can afford to pay electricity bills but fail by initial connection costs.

The government should roll out the use of pre-paid meters since it allows poor households to consume what they can afford during the period of scarce income. This will allow households to pay at their own convenience and at the same time reduce the cost of reading electricity meters in case of post paid meters. The pre-paid meters also reduce the negative household perception on the prices charged since most respondents seemed to be comfortable with the means of payment rather than mind about the price charged.

Since an increase in price of electricity increases performance of rural electrification programme from the supply side, government and other rural electrification agencies/companies should make efforts to determine a price level that is just enough to enable power retailing companies generate enough revenue and at the same time affordable by most households. Incentives to recover the costs should be provided for systems/projects below 3 MW by permitting them to operate with minimal government regulation, and investors can charge tariffs that cover operating costs and yield a return on investment. This will enable the power retailing companies to increase efficiency by making repairs and maintenances needed in time and paying staff salaries and wages. However, it should be noted that the benefits from the realistic prices can easily be lost by power companies' desire to maximize revenue and profits. Therefore studies into the trends of household incomes and peoples' perception on the existing price levels should consistently be carried out to mitigate this risk.

The government should also sensitize the masses on the use of the current technology like electricity for different economic activities to replace the current alternatives energy sources especially paraffin, firewood and charcoal which is even dangerous to their health. This can be done with government financial support to educate the masses on the advantages and disadvantages of using different alternative sources such that they can come up with clear choices on what type of energy to use with emphasis on electricity. This is because most households spend a lot of money that can even afford electricity connection these alternatives.

5.4 Suggestions for further research

The researcher suggests that similar researches be conducted in other areas especially those connected to the national electricity grid and mainly using post paid meters. This is because this study was conducted in an area supplied with independent grid, using mainly pre-paid meters and managed by a private company that mainly make decisions on its own. This implies that districts should also make inquiries into the factors affecting performance of rural electrification at household level such that if similar trends are found, concerted efforts may be exerted to improve performance of rural electrification programme.

Further research should also be conducted to find out the factors explaining the remainder of 30.82% of performance of rural electrification programme that is not explained by the model fit under this study. Emphasis can however be put on the factors identified by the researcher in the literature review of this study like community participation, institutional transparency and administration of responsible bodies, funding and political interference among others to come up with a concrete model to explain performance of rural electrification programme in Uganda.

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APPENDICES

Appendix I: Household Questionnaire ID No…...

Dear Respondent,

I am NIWAGIRA ANDREW a student of Master of Science in Development Economics at Uganda Martyrs University Nkozi. I am carrying out a research/study on factors affecting performance of rural electrification programme in Uganda using Rukungiri District as a case study. This study is intended to get your views on the factors affecting performance of rural electrification programme in Rukungiri District. It is purely academic and the information provided will not be used for any other purpose and will be treated with utmost confidentiality. **Thank you!**

SECTION A: <u>BACK GROUND INFORMATION</u>

Please tick, what is most appropriate to you

1 Sex

1. Male.............................. ☐ 2. Female......................... ☐

2 Marital status

1. Single ………………… ☐ 2. Married……………….. ☐
3. Widow/Widower ……... ☐ 4. Separated/Divorced …. ☐
5. Others Specify ………...

3 Education Level

1. No education.................... ☐ 2. Primary.......………..... ☐
3. O-Level............................ ☐ 4. A- Level …….................. ☐
5. Certificate........................ ☐ 6. Diploma........................ ☐
7. University........……........ ☐

4 Occupation

1. Formally employed……… ☐ 2. Self Employed.............. ☐
3. Informally employed……. ☐ 4. Unemployed................. ☐

5 If employed mention the position held...

6 Age group of household head ***(Tick appropriately years)***

1. Less than 20........... ☐ 2. 20-30............. ☐ 3. 31-40................ ☐
4. 41-50...................... ☐ 5. 51 years and above.................................... ☐

SECTION B: HOUSING CHARACTERISTICS AND HOUSEHOLD SIZE

1	2	3
Type of Main Housing Unit *(Circle appropriate code)*	**Roof top material** *(Circle appropriate code)*	**Exterior Walls** *(Circle appropriate code)*
Grass thatched hut...............1 Detached house...................2 Semi-Detached house..........3 Flat/Bungalow.....................4 Tenement/Muzigo................5 Others(*specify*..................)...6	Grass/straw...........................1 Plastic/polythene..................2 Iron sheets............................3 Asbestos...............................4 Tiles.....................................5 Concrete...............................6 Others (*specify*.................)...7	Thatched/Straw.........................1 Mud & poles.............................2 Bricks.......................................3 Bricks with plaster....................4 Bricks with mud.......................5 Stones......................................6 Timber......................................7 Others (*specify*.................)........8

4	5	6
Occupancy Tenure of Dwelling Unit *(Circle appropriate code)*	Number of rooms in the dwelling unit *(state the number)*	How many people stay in your household? *(state the number)*
Owner occupied...................1 Rented private......................2 Rented public.......................3 Free private..........................4 Free public...........................5 Others (*specify*.................)...6	☐☐	☐☐

7. Does the nature of your housing unit influence you to connect or not connect electricity?
(***Tick in one box).*** 1. Yes...........................☐ 2. No......................☐

SECTION C: <u>CONNECTION COSTS/CHARGES</u>

1. Do you use grid electricity service? 1. Yes...................☐ 2. No..........☐
If no, proceed. ***If yes skip to question 6***

2. What are the current alternative sources of energy for your household and how reliable are they compared to grid electricity? (*Use tick to rank reliability)*

Energy source	***Circle appropriate codes***	**Very reliable**	**reliable**	**Fairly reliable**	**Un reliable**
Diesel/Petrol	1				
Paraffin	2				
Solar	3				
Gas	4				
Battery	5				
Charcoal	6				
Firewood	7				
Sawdust	8				
Dry cells	9				
Others-*specify*	99				

3	4	5
Give one major reason for not using grid electricity?	Could you be interested in grid electricity service?	How much would you be willing to pay in one month?
....	Yes.....................1 No......................2 ***If yes, proceed to column 4.*** ***If no, skip to question 6***	....

6. How much in total did you spend in having the whole household connected to grid electricity? **(Ug shs)**

7. How do you rate the costs/charges of connecting the household on grid electricity service?

Rating	Too high	High	Fair	Low	Very low
Tick					

8. Please provide any comments regarding connection costs, charges and the general connection process

....

....

....

....

SECTION D: <u>PRICE OF ELECTRICITY, BILLING AND PAYMENT SYSTEM</u>

How much was the last payment for electricity? ***(In UgShs)***	For what period was the last payment? ***(in months)***	How do you rate the price of electricity? *(Circle appropriate code)*	Do you think that households understand the pricing and billing system? *(Circle appropriate code)*
1	**2**	**3**	**4**
....	Less than1 month...1 1 month.................2 2 months...............3 Over 3 months.......4	Too high................1 High......................2 Fair........................3 Low........................4 Very low................5	Strongly Agree.................1 Agree...............................2 Neutral.............................3 Disagree...........................4 Strongly Disagree............5

5. What type of meter do you use? 1. Pre-paid meter................. ☐ 2. Post paid meter........ ☐
3. No meter...................... ☐

6. If using pre-paid meter, how do you rate the reliability of a pre-paid meter compared to post-paid meter?

1. Very reliable...................... ☐ 2. Reliable...................... ☐
3. Unreliable.......................... ☐ 4. Not sure...................... ☐

SECTION E: INCOME/ EXPENDITURE

1. How much on average were you spending on the following items in the year 2012-2013?

(In Uganda shillings)

Items	Daily	Weekly	Monthly	Annual value
Food & Drinks				
Medical fees				
School fees				
Salaries/wages paid to workers				
Electricity & other energy sources				
Water				
Transport costs(hire of motorcycle/vehicle)				
Land &/or house rent				
Telecommunication (e.g. airtime)/letters				
Repair & maintenance				
Local Security/LC charges				
Entertainment e.g. watching football, outing				
Clothing				
Social contributions e.g. burial, wedding, gifts				
Soap (washing/bathing & omo)				
Others				
Savings				
1 **Total expenditure & savings**				

2. What is your **main** source of income? *(Circle only one)*

1. Salary...1
2. Sale of non-agricultural products..2
3. Income from construction work done..3
4. Shop or retail/whole sale of any products.....................................4
5. Income from services rendered, and commissions..........................5
6. Rental services...6
7. Dividends receivable..7
8. Income from sale of agric products..8
9. Income from sale of livestock..9
10. Others..99

3. Does the level of income influence the consumption of grid electricity in your household?

1. Yes........................... ☐ 2. No............................ ☐

SECTION F: GRID ELECTRICITY CONSUMPTION

1	2	3		4
What kind of electricity meter does the household have?	How often does the household pay for electricity? *(Circle appropriate code)*	For what purpose does the household use electricity? *(Circle appropriate codes)*		On average, how much did you spend on electricity monthly in the year 2012? *(in Ushs)*
			Code	
Own meter.......1 Shared meter....2 No meter..........3	Daily........................1 Weekly....................2 Every 2 week ....3 Monthly...................4 Quarterly.................5 Annually.................6	Lighting	1	....
		Cooking	2	
		Ironing	3	
		Refrigeration	4	
		Water heating	5	
		Phone charging	6	
		Radio	7	
		Television	8	
		Computer	9	
		Others *(specify)*.....	99	

From section G4 on wards, Rank whether the factors identified impact on performance of rural electrification programmes using the scale: 1=Strongly Disagree, 2=Disagree, 3=Neutral/Not sure, 4=Agree, 5=Strongly Agree.

Code		**1**	**2**	**3**	**4**	**5**
	Response	**Strongly agree**	**Agree**	**Neutral/ not sure**	**Disagree**	**Strongly disagree**
B	**Housing characteristics**					
1	The location of households near the road influences them to connect electricity					
2	The nature and type of housing unit prevents many households from connecting electricity					
C	**Connection costs/charges**					
1	Connection costs/charges prevent many households from accessing electricity					
2	The process of connection of villages and households involve a lot of bribery					
3	Households go through the same streamlined procedure/process to be connected on grid electricity.					
4	There is a lot of bureaucracy in having households connected to electricity.					
D	**Price of electricity and the billing system**					
1	Inquiries are made from households before the price of electricity is changed					
4	The pricing and billing system is transparent					
E	**Income level**					
1	The income level of households is enough to afford grid electricity					

Code		1	2	3	4	5
	Response	**Strongly agree**	**Agree**	**Neutral/ not sure**	**Disagree**	**Strongly disagree**
2	Electricity is only connected by people with high income level					
F	**Electricity consumption**					
1	Electricity consumption is very high among households					
2	Electricity consumption has been increasing among households					
G	**Community participation**					
1	Communities participate in decision making					
2	Communities are consulted before any changes in the programme regarding electricity are made.					
3	Communities were trained on how to use electricity efficiently and the billing system					
4	Communities participate in raising funds for Electrification.					
H	**Political Intervention**					
1	Politicians influence decisions on which villages should get electricity					
2	Financial decision-making in the implementing agency is based on political interference					
3	Politicians help in mobilizing funds for electrification projects					
4	Institutions responsible for electrification operate independently from politicians					
I	**Funding**					
1	Government provides sufficient funds to run rural electrification projects					
2	There is always delay in government funds for electrification					
3	Communities and well wishers contribute less funds to run activities					
J	**Transparency of institutions and project administration**					
1	There is transparency and accountability to the public in the use of funds					
2	The project administration is transparent in pricing and billing system.					

How do you rate the overall performance of rural electrification programme in Rukungiri district?

Rating	Very good	Good	Fair	Poor	Very poor
Tick					

Thank you for your precious time!

Appendix I1: Key Informant Questionnaire ID No......

Dear Respondent,

I am NIWAGIRA ANDREW a student of Master of Science in Development Economics at Uganda Martyrs University Nkozi. I am carrying out a research/study on factors affecting performance of rural electrification programme in Uganda using Rukungiri District as a case study. This study is intended to get your views on the factors affecting performance of rural electrification programme in Rukungiri District. It is purely academic and the information provided will not be used for any other purpose and will be treated with utmost confidentiality. **Thank you!**

A: <u>Background information</u>

Please tick, what is most appropriate to you

1 Gender 1. Male.............. ☐ 2. Female........................ ☐

2 Marital status

1. Single .... ☐ 2. Married...... ☐ 3.Widow/Widower .... ☐

4. Separated/Divorced .... ☐ 5. Others specify.............................. ☐

3 Education Level

1. No education................... ☐ 2. Primary........... ☐ 3. O-Level........... ☐

4. A- Level .... ☐ 5. Certificate ..... ☐ 6.Diploma............ ☐

7. University........................ ☐

4 Occupation..

5. Position..

B1. How do you think housing characteristics impact on household decision to connect electricity?
....
....
....
....

C1. Please provide comments regarding connection costs/ charges and the general connection process...
....
....
....

D1. What do you say about the prices of electricity?..
....
....
....
....

D2. Do you think households understand the pricing and billing system of electricity? Explain...
....
....
....

D1. How do you compare the reliability of pre-paid meters in relation to the post paid meters used by households?...
....
....
....

F1. Comment on the view that successful rural electrification depends on household income level...
....
....
....

G3. How do you rate electricity consumption in the year 2012?..
....
....
....
....

I1. How are communities involved in the operation of rural electrification programmes?
....
....
....
....

I2. How do you rate the participation of the community in decision making and general implementation of rural electrification programmes?...
....
....
....

J1. How are politicians involved in the implementation of rural electrification programme?
....
....
....
....

J2. What do you comment on the following regarding impact on performance of rural electrification programme?

Political intervention/ interference..
....
....
....

Funding...
....
....

Transparency of electrification institutions & project administration..
....
....
....

Thank you for your precious time

Appendix III: Interview guide:

1) Requirements for households to connect grid electricity

2) Process of electricity connection. What are some of the salient issues during the connection process?

3) Issues to do with corruption during the connection process.

4) Critical factors for the success of performance of rural electrification programme.

5) Relationship between housing characteristics and performance of rural electrification programme.

6) Comments on the level of income and electricity connection and payment of electricity bills.

7) Pricing and billing system. How favorable is the pre-payment system?

8) How do you find service delivery under rural electrification programme.

9) Suggestions to increase rural electricity access and performance ofrural electrification programme.

Appendix IV: Observation checklist

1. Sex of the respondent
2. Roof top material of the housing unit.
3. Exterior walls of the main housing unit
4. Number of rooms in the house where possible
5. Type of main housing unit

Appendix V: Documentary review checklist

2. Critical success factors for performance of rural electrification programme
3. Rural electrification rate
4. Expenditure on rural electrification programme
5. Electricity access in Uganda
6. Housing characteristics in Uganda
7. Over view of performance of rural electrification programme in Uganda
8. Electricity pricing mechanism
9. Barriers to rural electrification programme
10. Poverty levels in Uganda
11. Electricity consumption rate.
12. Electricity generation in Uganda
13. Origin of ERA & REA and their tasks
14. Regulatory framework for energy sector in Uganda-electricity act
15. Comparison between electricity consumption in Uganda and east Africa, and the rest of the world.

Appendix VI: Morgan table for determining sample size from a given population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

Appendix VII: Results of Cronbach's Alpha Statistic test for Questionnaire reliability

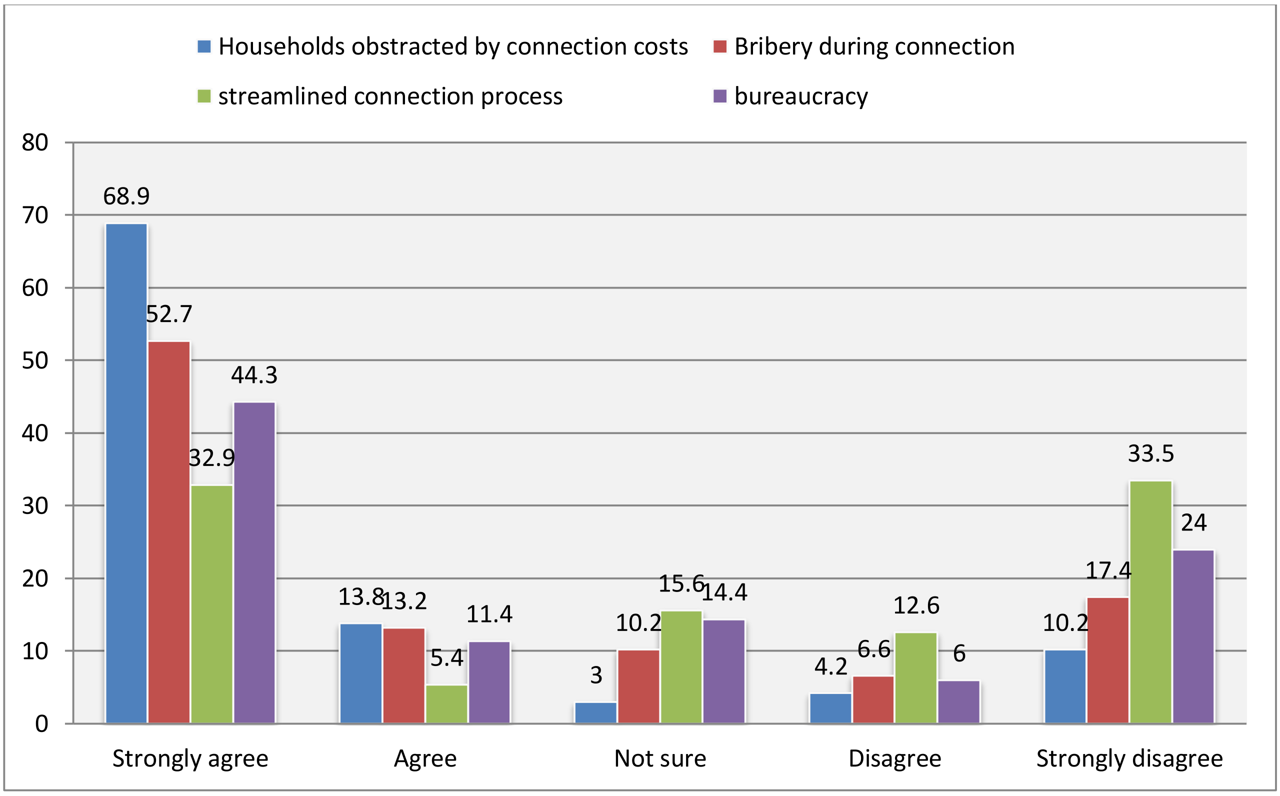
```
. alpha PREPGP OWNMTR YH TYPMTR PXGP CCGP CSTRATE HHSIZE OCCUPT HOUSTYP EXTWALL
ROOFTOP
> HOUSTYP a6 a4 a2 f2 a3 d3 d4 d6 d2 INCOME yeconspt,item
```

Test scale = mean(unstandardized items)

Item	Obs	Sign	item-test correlation	item-rest correlation	average inter-item covariance	alpha
PREPGP	113	+	0.4422	0.3349	.1626635	0.6921
OWNMTR	113	-	0.4938	0.4554	.1712645	0.6964
YH	167	+	0.3991	0.2495	.1586912	0.6956
TYPMTR	113	-	0.4838	0.4536	.1735471	0.6989
PXGP	113	+	0.4236	0.2939	.1621439	0.6950
CCGP	113	+	0.1612	-0.0063	.1824332	0.7263
CSTRATE	167	-	0.2629	0.2005	.1783578	0.7057
HHSIZE	167	+	0.5742	0.3813	.141823	0.6808
OCCUPT	167	-	0.6012	0.5463	.161002	0.6808
HOUSTYP	167	-	0.2440	0.1426	.1802608	0.7086
EXTWALL	167	-	0.2720	0.2005	.1801466	0.7095
ROOFTOP	167	-	0.2043	0.1618	.1804925	0.7059
a6	167	+	0.5295	0.4509	.1603833	0.6832
a4	167	+	0.5073	0.4224	.1687965	0.6917
a2	167	+	0.2745	0.1995	.1795014	0.7050
f2	167	+	0.5987	0.3631	.1386147	0.6822
a3	167	-	0.5214	0.3776	.1539838	0.6861
d3	113	-	0.2893	0.2136	.1737318	0.7021
d4	113	-	0.3155	0.1934	.1701674	0.7034
d6	113	-	0.2185	0.1409	.1765177	0.7057
d2	113	+	0.1928	0.0888	.1774189	0.7097
INCOME	167	+	0.2693	0.1461	.1709814	0.7043
yeconspt	113	+	0.4741	0.3908	.1635841	0.6903
Test scale					.1681395	0.7080

Appendix VIII: Households perception on the connection costs/charges and the general connection process

Figure 4.2: Percentage distribution of respondents' perception on the connection charges and process

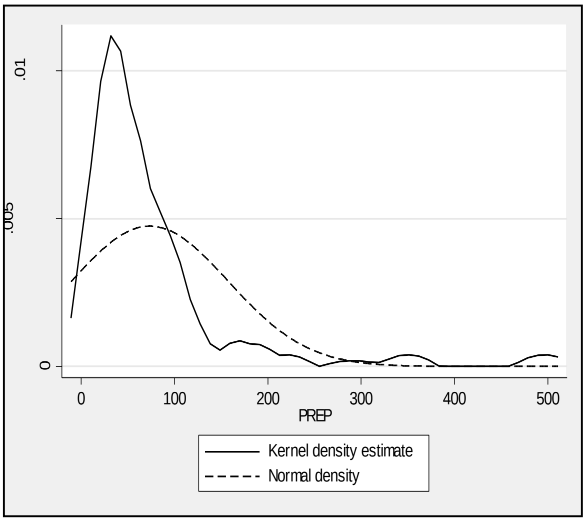


Source: Field data 2013

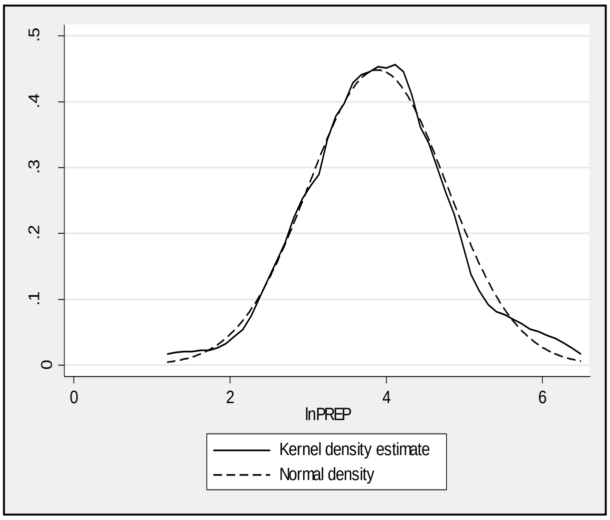
Appendix IX: Tests for Normality of candidate variables

1. Normality tests for performance of rural electrification programme (PREP)

Panel (a): Before Transformation



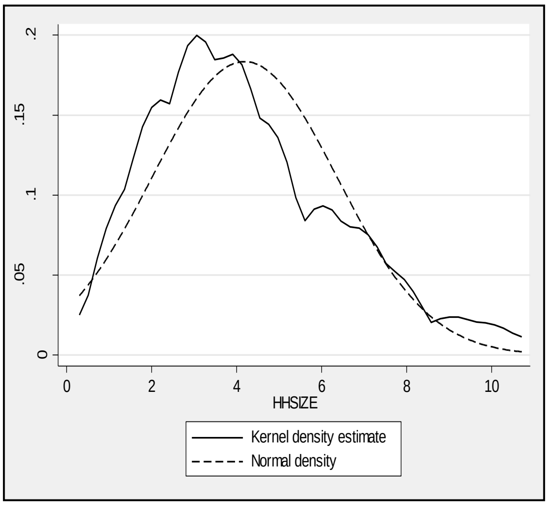
Panel (b): After transformation



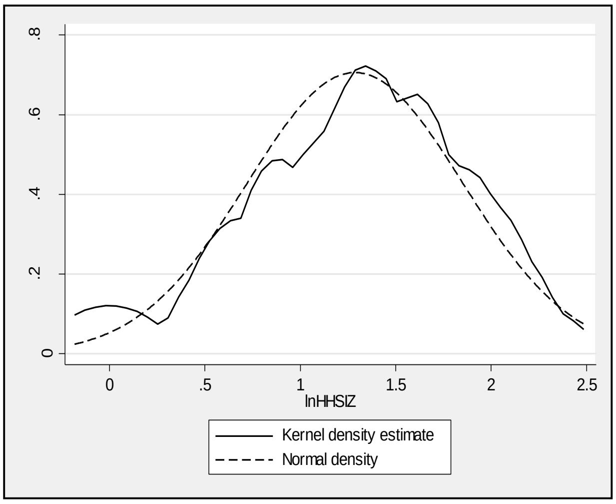
Source: Field data 2013-Stata output

2. Tests for normality of household size

Panel (a): Before transformation



Panel (b): After transformation

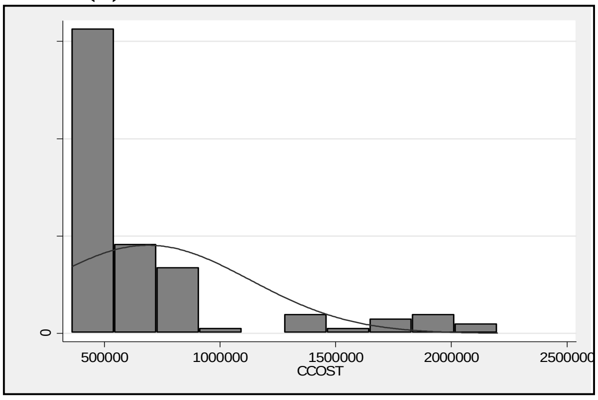


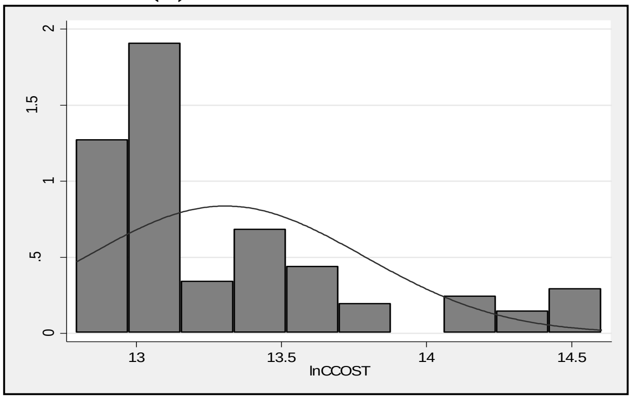
Source: Stata output

3. Testing normality of connection costs/charges

Data transformation for connection costs/charges

Panel (a): Before transformation **Pane (b): After transformation**



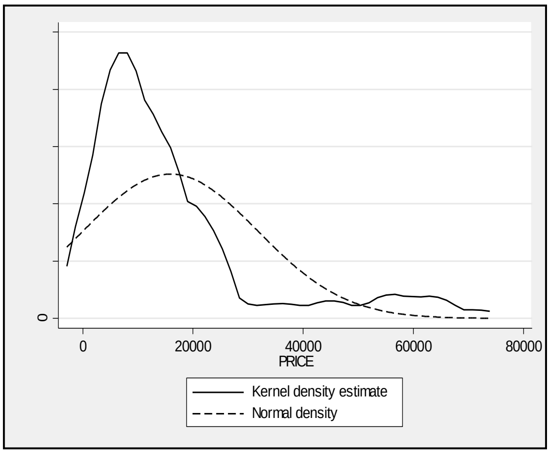


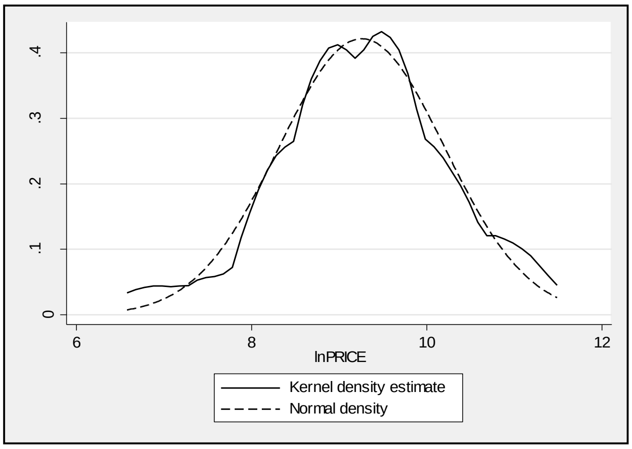
Source: Stata output

4.4.1.4 Tests for normality of price of electricity

Figure 4.9: Data transformation for price of electricity

Panel (a): Before transformation **Panel (b): After transformation**





Source: Stata output