FACTORS INFLUENCING ELECTRIFICATION OF RURAL HOUSEHOLDS IN KENYA: A CASE OF MERU SOUTH SUB-COUNTY, KENYA

BY

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DECLARATION

This research project report is my original work and has not been presented in any other university for examination.

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This research project report has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

I dedicate this research project to my wife Ruth Wambura and my son Ethan Mutuma.

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First I would also like to express my heartfelt gratitude to my supervisor Dr. Mercy Mugambi for guidance, inspiration and support. I would also like to express my special thanks to the University of Nairobi more so the Board of Post Graduate Studies for giving me the opportunity to study and the support throughout my studies. Special thanks also to the staff of the Department of Extra Mural Studies for their continuous support and guidance. To my colleague Walter, I greatly appreciate his immense support.

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ABBREVIATIONS AND ACRONYMS

EURELECTRIC	Union of the Electricity Industry
FBE	Free Basic Electricity
GOK	Government of Kenya
IEA	International Energy Agency
KIHBS	Kenya Integrated Household Budget Survey
KPLC	Kenya Power and Lighting Company
KNBS	Kenya Bureau of Statistics
NACOSTI	National Commission of Science, Technology and Innovation
REA	Rural Electrification Authority
RECL	Rural Electrification Cooperation Limited
REP	Rural Electrification Funds

ABSTRACT

This study sought to investigate factors influencing the electrification of rural households in order to come up with recommendations can help to hasten the electrification process and draw important lessons for future rural electrification projects. The objectives of this study were to establish the influence of REA's involvement on electrification of households, to assess the influence of alternative energy sources on electrification of households, to determine the influence of proximity to distribution grid on electrification of households and to determine the influence of demand of electricity on electrification of households. This study used a descriptive research design. The scope of this study was limited to Meru-South Sub County and REA's involvement, demand for electricity, alternative sources of energy and proximity to distribution grid. This research targeted members of 200 households and a sample size comprising 80 households and 12 staff from the rural electrification authority projects department were selected. To select the test sample, multi-sage sampling was be used in selecting wards and sub-divisions for the study after which simple random sampling was used to pick the households. The REA sample comprised of all staff in the projects department. Questionnaires were be used to collect data after which, data analysis was done by calculating the arithmetic mean and standard deviation of the data. In this research data was presented in tables. Research finding from this research will be utilized by implementers of rural electrification projects as well as other players and stakeholders in the electricity and energy industry. In addition to implementers, this research study will be of significance to REA as it will offer information that can be used in formulation of policies and application in relation to the area context. Further, the findings of this research study can be of significance to the government, specifically the ministry of Energy in promoting electrification projects. Three theories were reviewed in this study, but the study was grounded on the Theory of Consumption Values as it offered a better understanding on the factors influencing rural electrification of households. The main limitations that were faced by the researcher included issues of confidentiality and unwillingness of some respondents to participate in the research. Study findings revealed that the economic status of households and alternative sources of energy had the most significant influence on the electrification of rural households. From the research findings, it is clear that the amount of funding to REA, availability of alternative sources of energy, distance of a household from a transformer and ability to pay had the most significant influence on rural electrification. Based on these findings, it was recommended that there is need for the government to allocate enough funds to REA and REA must have proper electrification policies which should not only endeavour to make sure that all rural households are electrified but also the cost of electrification is affordable. Additionally, it was there is need for the government and any other concerned non-governmental bodies to sensitize the masses on the significance of using clean sources of energy such as electricity and not those that are readily available and non-renewable. Further, it was recommended that there is need for REA to ensure that it reduces through subsidizing the cost of electrification in order to encourage more connections. This research study may be of great benefit to the implementers of rural electrification projects as well as other players and stakeholders in the electricity and energy industry. To the Rural Electrification Authority (REA), the study provides information that can be used in formulation of policies and application in relation to the area context

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Despite the numerous accepted and recognized benefits derived from rural electrification, most developing nations are still struggling with low electrification rates. As per the International Energy Agency's (IEA) research studies, as of 2012 more than 1.3 billion people lacked access to electricity globally. The case was worse in rural areas, as 85% of this population lived in rural areas (IEA, 2012). As of 2013, another report by IEA showed that roughly 70% of the population of Sub-Saharan people lived without electricity as most households lacked electricity connections (IEA, 2013).

Rural electrification involves providing electrical power to rural areas. It is estimated that the absolute number of people without power was growing until the late 1980s when rural electrification programs, particularly in East Asia, outpaced the growth of human populations. Approximately 2.01 billion (equal to the world population in 1927) people in developing countries still lacked household electric power in 1990 - about 38 percent of the world's population at that time, 51 percent of the population of so-called developing countries, and 67 percent of rural parts of the developing world (Abdullah & Markandya, 2012).

In China, 100 percent of its population now has access to power, up from only 50% in 1976 and 90% in 1990. China launched the China Township Electrification Program in 2001 to provide renewable electricity to 1,000 townships, one of the largest of such programs in the world. This was followed by the China Village Electrification Program that was aimed at the electrification of a further 3.5 million households in 10,000 villages by 2010. In December 2015, China connected the remaining 39,800 Chinese to the national electric grid. In this project the government spent $324 million on infrastructure and paying workers who were involved in wiring the two extremely remote villages in Quighai province (Komiyama et al., 2012)

In Senegal, electricity sector was reformed in 1998. Since then, the country has implemented several electrification initiatives. For instance, The Senegalese Rural Electrification Action Plan was launched in 2002 with the aim of maximizing investment from the private sector. Although this is the case, a study by Mawhood and Gross (2014) indicated that the Action

Plan has faced considerable political and institutional barriers, notably institutional opposition, wavering ministerial support and lengthy stakeholder negotiations, as well as the inherent difficulties of implementing an innovative policy framework over years. On the other hand, although the Action Plan has been very successful at attracting private finance, the political/institutional challenges it has faced reflect the experiences of reform-based electrification schemes across Sub-Saharan Africa. This highlights the importance of designing initiatives to fit the local policy environment.

Just like any other developing country, Kenya has not been left behind as concerns providing of electricity to its citizens. Kenya's rates below the SSA average with 14% overall connection and a breakdown of 42% and 4% for urban and rural areas respectively in the year 2000 (Kenya National Bureau of Statistics - KNBS, 2000). As of 2010, Kenya had an overall national electrification rate of 23%, with rural energy access to the grid about 5% and urban access at 50%. The Kenyan Government is working to rapidly increase electrification rates in both urban and rural areas. Part of its national Vision 2030 is to create a globally competitive and prosperous nation with a high quality of life by 2030 (Institute of Economic Affairs, 2015). The importance of rural electrification in Kenya is spelt out in the Government's Sessional Paper Number 4 on Energy, May 2004 (Mwihaki, 2014). This policy sought to lay the foundation upon which cost-effective, affordable and adequate quality energy sources would be made available on a sustainable basis. As a result, this Paper led to the creation of the Rural Electrification Authority (REA), which was established and charged with the responsibility of accelerating the pace of rural electrification in the country.

As per the 2009 National Census, Meru-South- Sub-County (the former Meru South District) was grouped among sun-counties with the least electricity networks. As of 2009, only 4.8% households had electrical connections (KNBS, 2009). Immediately after the census, REA initiated numerous programs that were aimed at promoting rural electrification through grid extension in this region. As of 2013, electricity accessibility had increased in this region although at a very slow pace. Despite of all these and other efforts that have been put forth in order to improve and increase the supply and use of electricity in this sub-county, very low levels of electricity adoption has persisted in this region as most households still treasure the traditional sources of energy (REA, 2013).

1.2 Statement of the Problem

Like most countries in sub-Saharan Africa (SSA), Kenya is not an exception in facing energy dilemmas. As per the International Energy Agency (IEA) research studies, Kenya's electrification is below SSA's threshold of 15.8% overall access and 3.8% access in rural areas. This is the scenario despite the amount of funding that REA receives for rural electrification and numerous initiatives aimed at electrifying rural areas (KPLC, 2006). It is worth noting that, although REA has been in the forefront in making sure that rural areas are electrified, its spread across all regions and sub-counties is not uniform as there are areas that more connected than others (Abdulla and Markandya, 2007).

Meru-South Sub-County is one of the sub-counties with low levels of access and adoption of electricity according to (Commission on Revenue allocation Fact sheet, 2011). Although the inception and implementation of numerous electrification programs by REA have seen this sub county receive its share of the programs, still very few urban centres and homes have been connected. For example, by 2011, only major town centres such Chuka, Kibua, Ceera, Ndagani, Kiangondu, Mukuuni, and Itugururu had electricity connections (Commission on Revenue allocation Fact sheet, 2011). Additionally, most rural households in this sub-county have not been connected to the grid as there are less than 2500 homesteads that have been supplied with electricity. In this sub-county, firewood is the most dominant source of energy, because as per the 1999, more than 130,000 households were using firewood as their primary source of energy (District Environment Action Plan, 2011). On the other hand, although this county has two hydro-electricity generating plants (one in Chogoria along Maara River and along Tungu River near Kaanwa market), most of these are not beneficial to the local residents as its power has to be transmitted to the main grid before distribution. It is against this backdrop that this study aims to investigate the factors influencing rural electrification of households in Kenya using Meru South Sub-county as a case study as it is one of the counties with significantly low rural electrification coverage.

1.3 Purpose of the study

The purpose of this study was to investigate factors influencing the electrification of rural households in Kenya with focus of Meru South Sub County

1.4 Objectives of the Study

This study was guided by the following objectives:

i. To establish the influence of Rural Electrification Agency's involvement on electrification of rural households in Meru-South Sub-County.
ii. To assess the influence of alternative energy sources on electrification of rural households in Meru-South Sub-County.
iii. To determine the influence of proximity to distribution grid on electrification of rural households in Meru-South Sub-County.
iv. To determine the influence of economic status of households on electrification of rural households Meru-South Sub-County.

1.5 Research Questions

The research questions of the study were:

i. In what ways does REA's involvement influence the electrification of rural households in Kenya?
ii. How does alternative energy sources influence the electrification of rural households in Kenya?
iii. What is the influence of the proximity to the distribution grid on electrification of rural households in Kenya?
iv. How does the demand for electricity influence the electrification of rural households in Kenya?

1.6 Significance of the Study

This research study may be of great benefit to the implementers of rural electrification projects as well as other players and stakeholders in the electricity and energy industry. To the Rural Electrification Authority (REA), the study provides information that can be used in formulation of policies and application in relation to the area context. The findings of this study can also be used by the Government and the Ministry of Energy to promote rural electrification program

(REP) projects in rural and urban areas and ensure their completion by acting on the recommendations

1. 7 Delimitation of the Study

Although there are many factors that influence the electrification of households in Kenya, the study was delimited to REA's involvement, demand for electricity, alternative energy sources, and proximity to the distribution grid.

Additionally, although rural electrification of households have been done throughout Kenya, the scope of this study was households in Meru-South Sub-County. Respondents of the study were users and non-users of electricity in Meru South Sub-County.

1.8 Limitations of the Study

One limitation that was faced by the researcher was the unwillingness of some respondents to participate in the research. To mitigate this, the researcher with the help of the research assistant distributed the questionnaire while trying to create a rapport with the interviewees.

Another limitation that was faced was the issue of confidentiality as some respondents were reluctant to give information. To mitigate this, the researcher assured all subjects of this study that the information was for academic purposes only and all given information was to be treated confidentially.

1. 9 Assumptions of the Study

The study assumed that there was demand for household electrification in Meru South Sub-County although there were factors that affected the realization.

1. 10 Definition of significant terms

Alternative Sources of energy: Refers to other sources of energy that complement electrical power.

Biomass Energy Refers to a form of renewable energy from living and recently living plants and animals, which can be used as fuel

Connection Cost: Refers to the initial cost charged to a customer to have him/her connected.

Electric Grid: Refers to an electrical grid is an interconnected network for delivering electricity from suppliers to consumers

Electrification of Rural Households: Refers to the provision of electrical energy to rural households

Operational Costs This are expenses that are associated with the operation of an entity

Population Density: The number of people living per unit area.

Project completion: This is the last stage in the project whereby all the activities have been undertaken in meeting the project's technical specification while at the same time attaining a high level of satisfaction on the part of the stakeholders. The project must be physically completed and meet the time, cost and quality criteria.

Project failure: project is considered a failure when it has not delivered what was required in line with expectations.

Return on Investment: is the benefit to an investor resulting from an investment of some resource.

1.11 Organization of the Study

The study is organized into five chapters. The first chapter is introduction and it presents the background of the study, statement of the problem, research objectives, research questions, significance of the study, delimitation of study, limitation of the study, basic assumptions of the study, definition of significant terms and organization of the study. Chapter two provides the review of the literature pertinent to the research topic Factors Influencing Rural Electrification in Households in Kenya". The third chapter presents the research methodology, which include the research design, target population, sampling technique, research instruments, data collection procedures, data analysis technique, ethical considerations and operational definition of variables. Chapter Four examines data analysis, presentation and interpretation. Chapter Five presents the summary of findings,discussions, conclusions, recommendations and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the empirical and theoretical literature review relevant to the factors influencing the electrification of households in Kenya. The chapter will review three theories and their importance to this study. Rural electrification concept literature review is presented in the four factors (REA's involvement, alternative energy sources, proximity to distribution, and demand for electricity) affecting rural electrification of households. Additionally, the chapter will present theoretical and conceptual framework. The last section of this chapter will present the gaps arising from the studies of previous researchers in this area and summary of the literature review.

2.2 Rural Electrification

This section examines the empirical literature review on previous studies relating to the influence of the independent variables of this study (REA's involvement, demand for electricity, alternative energy sources, and proximity to the distribution grid) on the dependent variable electrification of households in Kenya.

2.3 REA's Involvement and Electrification of Households

The Rural Electrification Authority was formed in the year 2006 with a primary goal of accelerating the speed at which rural electrification projects were implemented. Previously this function was undertaken by the Ministry of Energy, which closely worked with other concerned ministries. In Kenya, rural electrification is one of the ways the government is using to uplift the living standards of its people, more so the geographically and economically disadvantaged communities. As research studies show, roughly 16% of Kenyans have access to electricity, and this translates to very few households having access to electricity. As result, REA has always has been in the forefront in making sure that homes are connected with electricity. Although this is the case, evidence of the poor electricity networks between homesteads in Kenya is prevalent; hence, an indication that REA's policies have yielded little. For instance, a research study by Karekezi et al. (2011) on rural homesteads in Kenya showed that, although REA is actively involved in the collection of data on electrification of households, rarely does the organization

specifically base its research on rural areas. The same is evident in other countries as most policies of organizations that are mandated with this function rarely put the required emphasis on the need for policies and programs that promote the electrification of rural areas (IEA, 2011). Although this is the scenario in most counties, it is worth noting that, electricity access is increasingly at the forefront of some governments' preoccupations, especially in some sub Saharan countries. As a consequence, a lot of rural electrification programs and national electrification agencies have been created in these countries to monitor more accurately the needs and the status of rural development and electrification.

For instance, currently Costa Rica has been able to expand its electrification capacity to almost 100% as a result of sound electrification monitoring programs and good policies (Barnes et al., 2005). Further, as research studies show, Bangladesh has also not been left behind in its endeavour to ensure its citizens have access to electrical energy due to good rural electrification policies. This is because, currently it has a balanced approach towards electrification and most of its citizenry has access to electricity. In Africa, one of the areas with the highest number of connections is North Africa. Countries like Tunisia have a rural connectivity of up to 95%, and this makes it one of the countries with the highest number of household connections. The success of Tunisia towards rural electrification is attributed to commitment from all concerned stakeholders, a well formulated and integrated and implemented rural electrification framework and an organized institutional approach that is supported by a good tariff policy (Cecelski et al., 2006).

In addition to good policies, a research study on Ghana's rural electrification program revealed that long term planning and proper monitoring are some of the primary factors that have helped Ghana to achieve great strides in this sector (Kemausuor et al., 2012). In another study in rural electrification in South Africa, Bekker et. al. (2008) discovered that good technological development coupled with proper monitoring and offering of appropriate corrective measures in case rural electrification projects stall are some of the factors that have greatly promoted the growth of rural electrification networks in South Africa. In Kenya, the situation is completely opposite because although over time the government has always pumped more funds and emphasis on electrifying rural areas, as research studies show most of these efforts have been futile because of the slow progress. Such has been attributed to the poor policies and sometimes

hostile operating environment politically. Most of the Kenyan leaders always endeavour to please people from their localities by trying to divert resources to non-approved electrification projects and this has been one of the primary factors that have hindered this initiative. Another factor that has hindered REA from achieving its rural electrification mandate is corruption and poor monitoring as most of its electricity distribution projects are left to third party contractors whose quality of work is wanting (Barnes et al., 2005).

On the other hand, the rural electrification market is a complex system that is made up of the economic, technical, financial, institutional, social, environmental and political aspects. Each of these contributes differently to the wellbeing or success of any electrification ventures although the greatest influence comes from the institutions which fund and create policies that govern the entire process (Barnes et al., 2005). In Kenya, rural electrification is partially funded by the Rural Electrification Funds (REP) that are obtained from electricity users countrywide, and partly by subsidies from the government. Although these two sources of funding exist, sometimes they are not able to cover all operational and other costs of rural electrification ventures, a factor that has made some of the primary rural electrification initiatives such as "Umeme Pamoja" to stall in some regions (Kenya Integrated Household Budget Survey (KIHBS), 2007). As a result, financial viability of the financing organization is a must. Before extending a power line to an area, the suppliers normally do a financial viability of such a project as the distribution costs are determined by the balance between cost and revenues that are expected from such a project. As a result, because some rural areas have a very low number of people, sometimes connecting such areas is not viable as the operating expenses are higher than income that may be expected from such connections (Zhang & Kumar, 2011).

2.4 Alternative Energy Sources and Electrification of Rural Households.

Kenya has a diverse sources of energy; both renewable and non-renewable. Some of the most common sources of energy include biomass (wood fuel and charcoal), wind, solar, geothermal, biogas, and coal. Although all these sources of energy exist, it is worth noting that the exploitation on large-scale of renewable energy in Kenya, apart from geothermal and to some extent, cogeneration of electricity, has largely remained low as most individuals prefer to use the traditional sources of energy as they are cheap and easily available. In addition to biomass (wood fuel and charcoal), other sources of energy that are commonly used in Kenya, more so in rural

areas include solar and wind energy. In most rural households, most alternative that are used have a direct link with the socio-economic status of such households (Mbuthi, 2007).

In rural areas, most people can easily afford biomass energy as most homesteads are surrounded by woodlands, farmlands, forests and bush lands; hence, the 45% of dependability on forests for provision of this and 93% dependability on biomass as a source of energy in Kenya. Globally, more than 80% of the rural population in developing countries use traditional fuels such as wood fuel and kerosene. As a result of these, most people opt to use these sources of energy as these individuals associate electricity with more spending (Ministry of Energy, 2013). On the other hand, Kenya relies heavily on imported petroleum products, which include gas that is used in most homes (GOK, 2002). In addition to petroleum products including gas, about 83% of the urban residents have access to kerosene and almost 76% use it for cooking and 61% for lighting. As a result of the common nature of kerosene in most households, kerosene is one of the energy sources with a very effective distribution chain that ensures that it reaches the most remote of places. This has been enabled by numerous kerosene retailers who buy kerosene for resale in small quantities, which most rural households can afford. Due to this, it has become a greater challenge to move people from using it to using cleaner sources of energy (Government of Kenya, 2007).

On the other hand, as research studies show Kenya receives an estimated 4 to 6 kWh per square meter per day of solar insolation. This is equivalent to about 300 million tonnes of oil per day. Although only a tiny fraction of this resource is harnessed for commercial and household use including crop and animal products' drying, water heating, water pumping and lighting, and entertainment, still there is quite a number of individual who prefer this to electricity due to costs (Karekezi & Kithyoma, 2005; GOK, 2007). In addition to this, solar PV technologies are normally used as the main source of off-grid electricity in urban and rural areas, more so those that are far from the main electricity grid lines. As of 2004, it was estimated that more than 120, 000 units of solar PV systems had been disseminated in Kenya. Most of these were distributed by institutional and corporate entities (Ministry of Energy, 2004).

In addition to firewood, kerosene and solar energy, some communities in Kenya are served by wind energy, although it harnessing is at the lowest levels. In rural areas, this form of energy is normally used to pump water. Additionally, in some areas wind energy is used for lighting and

other process that require low amounts of electricity. For example, there some electricity generating generators that have been installed in Ngong Hills Nairobi, Marsabit, and some parts of North Eastern. From this, such energy is transmitted to the national grid, after which it is distributed. This basically means that, although these areas are able to generate their own electricity, most of them do not enjoy its benefits as it has to go through the national grid before it is distributed back to these areas by Kenya Power and Lighting Company (Karekezi and Kithyoma, 2005). Moreover, there is also geothermal energy which feeds quite a number of megawatts to the national grid. In Kenya, this form of energy is mainly used for electricity generation and to some level for greenhouse heating. It is worth noting that, geothermal energy is arguably, the most successfully exploited renewable energy source/technology in the country. The country's experience in the development of the technology has not only made Kenya a market leader in geothermal related issues in the region, but also a world leader. Its implementation started in the early 80's with a 45 MW installation and has gradually grown with time to produce about 130MW of electricity; about slightly over 10% of the total electricity generated in the country (KPLC, 2006).

The availability of numerous sources of energy has a great effect on the electrification of rural households, as most individuals have a tendency of selecting a source of energy that is mostly available and cheap. As research studies show, although most rural households use biomass as their main source of energy, there is quite a number who have started to adopt the usage of LPG gas. Although this is the case, it is worth noting that most of the households that have adopted the usage of LPG are much better social-economically; hence, the transition. Otherwise, the availability of biomass sources of energy had made most rural households to stick to their traditional sources of energy. In addition to biomass, kerosene is another commonly used source of energy in rural areas because of its availability. Most rural households use kerosene for lighting and cooking. For instance as of 2009, a research study by The International Bank for Reconstruction and Development: World Bank (2009) in Cambodia found out that, more that only 6% of rural households have access to electricity. Of these, 80% depended on kerosene as their primary source of lighting fuel and over 90% used biomass energy for sustenance. Another study by Heltberg (2003) in a number of developing countries such as Brazil, Ghana and India found out that the use of kerosene in most households came second after biomass fuels as these two were the most available sources of energy.

Closely associated with availability is the affordability of alternative energy sources. Although electrical energy can be cheaper once it is installed, unless the cost of installation is subsidized, most of the time rural households are unable to afford it. Most traditional sources of energy are cheap to obtain; hence, most households tend to prefer them. Additionally, as research studies show, most rural households have a belief that it is not easy to deplete traditional sources of energy; hence, their high dependency on them. To most of these individuals, the concept of clean sources of energy is not a factor as traditional sources of energy are free; hence, there is no direct cost is incurred (Fankhauser & Tepic, 2005). In a research study that was carried out by (Markandya & Abdullah, 2012) in Kisumu, Kenya, it was found that most electrified households showed an increased spending of almost 54% on energy over what their non-electrified neighbours spent. As a result of these, sometimes although electricity is a clean form of energy, it is expensive; hence, most rural households tend to avoid using it and for those that use it, they normally use it for lighting only.

The affordability of rural electrification is dependent on the capital cost and the periodic payments that households are supposed to remit (Schillebeeckx et al., 2013). Although most governments have tried to subsidize these costs for its citizens most of the time, because of the low social economic status of most households, some cannot afford to pay even the subsidized amounts. For instance, in study that was carried out to ascertain factors that have impaired the electrification of rural Thailand, Pellegrin and Tasciotti (2012) found out that, although the Thailand government has tried to cut on procurement, materials and transportation costs in order to make electricity affordable, still most rural households are unable to afford it as a result of their level of poverty. Closely associated with the connection costs, are costs of wiring and power tariff. Most of the gadgets that are need for wiring a house are expensive; hence, to most rural households affording that is a problem as most depend on subsistence farming for sustenance (Asian Institute of Technology, 2004).

2.5 Proximity to the Distribution Grid and Rural Electrification of Households.

An electrical grid is an interconnected network that delivers electricity to users. Some of the main components of the grid include the generating substations, transmission lines, demand centres and distribution lines that deliver electrical energy to customers. Depending on the generating point, Power stations may be located near or far from homesteads. It is worth noting

that, although some power sources are near homesteads, electric power generated form such power houses cannot be distributed after generation as it has to go through the National Grid before it is distributed to homesteads (EURELECTRIC, 2003). As research studies show, most policy makers in this sector assume that homesteads occur far from the generation centres (off-grid), a fact that is wrong as some are within the generation locality but they have to wait until the generated power goes through the national grid before they enjoy it. As a result of this, there are areas where electricity is generated but the surrounding neighbourhoods are not connected as the costs associated with such is high when it has to be transmitted from the national grid. To deal with this challenge, the International Energy Agency has always advocated the use of mini-grids and small, stand-alone off-grid solutions as this will help to make sure that even the remotest places are connected with electricity (IEA, 2012).

In addition to distance from the grid, distance of the household from the transformer is another primary factor that has greatly affected rural electrification of households (Andreas, 2006). Transformers act as distribution centres because from the national grid, electricity has to go through a step down transformer that is normally located near homes. As such, transformers basically act as access points from which electricity can be distributed conveniently (Andreas, 2006; Rural Electrification Authority, 2013). When a new connection is to be made, first the distance from the transformer has to be ascertained as this is what will determine the upfront cost of connection. As research studies show, most of the rural households that are near the transformer always get a subsidized cost while those that are over 0.6 KM to the grid pay more with every extra kilometre. It is worth noting that, before a transformer is installed in a locality, the spatial distribution of households is first done in order to determine a central place for such installations. Sometimes this may be ignored if there are urban centres within the locality of concern as urban centres are normally given priority information (Wang & Luo, 2005).

As a result of this, most local areas are usually left out depending on the results of the spatial distribution. For example, a research by Andreas (2006) in India revealed that there were great spatial differences in rural electrification rates as some areas had more connection as they were accessible. Another research by Ogalo (2011) in Nyamarambe Division, Kisii-Kenya, proved that areas that are accessible also have more connection as compared to those that were considered inaccessible spatially. Another research by Kembo (2013) in Machakos County

revealed that most of the rural homesteads that had electricity connection are those which were near the transformer and urban centres.

Extending an electrical grid is one of the costly ventures most distributors of electricity have cited. For example, a study by Kenya's REA on the cost of electrifying all public institutions in Kenya proved that without enough funds, the dream of extending the grid to some inaccessible areas is far from being reached because of the involved costs. This is because the entire extension process involves the purchase of high-voltage lines, secondary distribution transformers, single and three-phase low-voltage lines, and drop-down lines for last-mile connections, all of which are very expensive and most rural households cannot afford to pay for this. What even makes it worse is that most rural areas are very remote; hence, additional costs associated with transportation, surveying and design, and temporary shutdowns are very high. Another research by Hisaya and Yuko (2011) on rural electrification in Bilha, India proved that the location of a place is one of the primary determinants of a rural household's electricity connection. As a result, the same study suggested the need for the government to consider other options such as trying to decentralize of the distribution channels by getting rid of the central grids.

2.6 Economic Status and Electrification of Rural Households.

In in the residential sector in most rural settings, affordability is one of the primary factors that determine the ability to pay for a dependable form of energy. As research studies show, most of the individuals living in rural areas are poor and vulnerable; hence most of them mostly depend on traditional sources of energy for sustenance. In a research that was carried in households in Kisumu, IEA (2008) found out that, although most individuals were willing to be connected with electricity, most lack the required amount of funding to cover the capital and operating costs.

Further, as most research studies show, in the 21st century, since most individual associate the shift to use of electricity to a shift to using a clean source of energy, most rural households are normally ready to pay for the service. Although this is the case, the cost associated with its installation is high hence, most opt to keep using their traditional methods. Although this is the case, it is worth noting that even in some households that are assumed to be well off economically, still the use of traditional sources of energy such as firewood is rampant. This is the case as most of these households use electricity for lighting and powering other gargets that

depend on electricity for their working. Considering this, it is not wrong for one to say that, although most rural households are willing to pay for connections but not able to pay for electrification, the use of local sources of energy may not change soon due to stagnant level of income for most rural households (Townsend, 2000).

Another primary factor that affects the demand for electricity is the level of information, education and social learning that individuals have in terms of the advantages that come with the use of electricity. Although all over the world, most governments have endeavoured to educate their citizenry on the significance of adopting safer and clean sources of energy, till adoption at household level is very poor (Christensen et al., 2012). In addition to this, even in cases where individuals have access to the electricity grid, it is not guaranteed that that the surrounding people are willing to get connected as some people are normally misinformed of the benefit and cost that comes with this form of energy. For instance a research study by the Independent Evaluation Group (2008) that was sponsored by the World Bank, proved that, ignorance and misinformation was one of the primary reasons that had hindered the proper electrification of rural household in The Lao Republic, Asia. In addition to this, other research studies in sub-Saharan Africa have also proved that lack of information on the alternative sources of energy has been one of the primary impediments towards rural electrification (Heltberg 2003; Schlag et al., 2008; Whitfield, 2006).

On the other hand, a research study by Bernard (2012) on developments in rural electrification in sub Saharan Africa in the last thirty years found out that a household's attitude and perception determines electricity adoption. In some households, although it is a clean form of energy, most households perceive electricity as an expensive source of energy and somehow a luxury (Peters et al., 2009). Further, sometimes due to a poorly defined billing system, a slow rate of installation and other factors that undermine connectivity, most households tend to take electricity as an un-productive investment. Although this is the scenario in some households, other research studies have shown that there is quite a good number of rural households that hold a positive attitude towards access to electrification. For example a study by Mwihaki (2015) in Naivasha found out that, more than 85% of the respondent believed that electricity had more advantages as compared to the traditional sources of energy they have been using over time.

Moreover, attitudes held by the business community towards power access also greatly influences the demand for electricity. Most of these groups associate electricity with numerous livelihood opportunities, which they believe can help to transform societies and people's livelihoods. For instance in a research study that was done in Naivasha Kenya, it was found that most residents associated electricity with the thriving flower farms and other income generating activities; hence, most wished they had connections (Schmidt, 2014). On the other hand, a research study that was done by Schmidt (2014) in San Francisco Libre, Nicaragua proved that most people in rural areas associated electricity with societal empowerment as most believe the employment opportunities that come with electricity had promoted youth empowerment as most of them had quit crimes and were engaged in productive activities.

2.7 Theoretical Framework

This is a review of three theories and their relevancy to this study and they include the Agency theory, Traditional Economic Theory and The Theory of Consumption Values.

2.7.1 The Agency Theory

The Agency theory is a supposition that tries to offer an explanation of the relationship that exists between the main decision makers and those who are given power to run entities for owners of entities. This theory was proposed by Alchian and Demsetz (1972) and it is primarily concerned with offering solutions to problems that may arise in an agency. That is, these theory endeavours to solve problems that may exist between the principals who in most cases are shareholders and an organization's executives. The two primary issues that this supposition addresses include: the issues that may come up when the needs or goals of the principal and the agent differ and the issues that may come up when the principal and the agents hold different outlooks of a risk. This like scenario mostly arises as the agent and principal may each be motivated towards different actions (Lan & Haracleous, 2010).

As per this theory, in labour and capital markets that are that are imperfect, managers will always try to find ways of maximizing their own utility at the expense of the corporate shareholders. In most case sometimes agents may opt to operate in their own self-interest instead of doing what is best for the entity they are running. This in most cases happens because of asymmetric information as most agents may be aware of the probability of an idea succeeding or a venture being a success as they are the experts in the principal-agent relationship. In addition to this,

agents may also have the power to influence an outcome and avoid taking responsibility for that or sometime they may go contrary to the wishes or wants of shareholders. On the other hand, some agents may have some self-interested managerial behaviour that may include the use of some corporate resources in form of perquisites without the principals knowing because of the powers they are sometimes accorded by the principals (Fama & Jensen, 1998).

This theory generally tries to understand why behaviour or decisions made by different members of an entity vary. That is, it basically provides an explanation on why the differences in behaviours or goals among members who came together for a common goal may eventually vary, more so as concerns their attitude towards risk. It is worth noting that, this theory concentrates more on the incentives given to agents, the cost of the incentives and the likely outcome of behaviours and actions that result due to these incentives being put into use. In most scenarios, agency problems normally arise due to inefficiencies and incomplete information or in scenarios where is there is some degree of uncertainty (Eisenhardt, 2000).

Although this theory may be applicable in the rural electrification of household ventures as the work of the rural electrification distribution networks are normally given to agents by funders and primary stakeholders, sometimes the primary goal of such contracts may be deviated by those tasked with implementing them. This in most cases may occur due to varying interests of the parties that may be involved in the distribution. Although this theory tries to provide an understanding on how the principal and executives' relationship may affect the success of a venture, it is limited to the nature of relationship that exist between these two parties. As a result it fails to include other factors that may lead to the success or failure of a project.

2.7.2 Traditional Economic Theory

The Traditional Economic theory argues that people will always make decisions depending on the utility function that is associated with the selected course of action. When doing this most people always take into consideration relevant constraints and inclinations that have been gauged appropriately with the primary goal of maximizing profits from any of selected options. The Theory was first proposed by Ronald Coase in 1937, although since then it has been modified. It works on the assumption that people have information and always have the potential of understanding this information as they are rational decision makers. Additionally, this theory assumes that in most cases people have well defined preferences and these preferences rarely

change over time. Most proponents of this theory agree that it is rational for most individuals to always look at the utility function as a way of measuring success or efficiency of a taken decision. This is the case mostly because without profit or a better outcome, the probability of most individuals embracing an idea is zero (Mullainathan & Thaler, 2000).

For the attainment of socio-economic needs, this theory is very practical as most individuals always seek maximum satisfaction from any venture, good or even services that they seek to enjoy. For example, when it comes to rural electrification of households' projects, individuals always look at it as a way of enhancing their lives and expanding their socio-economic status as it is always associated with more return on investments. Although this is the case, empirical findings normally disagree with this theory as there are numerous factors that determine the nature of decisions and options opted by individuals. Most critiques of this theory argue that it is not always that man is economically rational when making certain decisions. For example, in terms of information issues and the decision making process, there is the concept of ambiguity aversion. That is, as much as most individuals always put the utility function first, most people have a habit of avoiding when the relevant information is ambiguous or not clear. Further, sometimes most individuals tend to disproportionately endorse the status quo with little consideration of the benefits that come with such endorsements. On the other hand, in some decision making processes, some people normally make use of the heuristics. That is, although the utility function may come to play, the bigger influencer of the decision taken is preference of a future unknown outcome that may be determined by self-control, emotions and awareness (Starmer, 2000; Sugden, 2008).

This theory is relevant to the topic of rural electrification of households as it offers insights into human behaviour and their overall decision making process. When dealing with people and their demands for services more so those rural areas where most facilities are not available; hence, the introduction of one completely transforms the socio-economic fabric of that society, a lot needs to be taken into consideration. For example, it is worth considering how other factors such as lack of adequate information, limited cognitive resources and even how other external factors such as political ones influence the outcome of a decision making process. Nevertheless, although this theory somehow offers an understanding on how decisions are arrived at, it

assumes that people are perfectly rational and always choose options that help them to maximize happiness, which in some cases is not the case.

2.7.3 Theory of Consumption Values

Theory of Consumption Value is a supposition that tries to explain why consumer opt to buy or use a certain product, brand or even why they will choose to pay for a certain service. This theory was developed by Franco Modigliani and his student, Richard Brumberg in the 1950's in their endeavour to understand people's consumption behaviours. There are three main primary propositions that are accepted in this theory namely: consumer choice is a function of multiple consumption values, all the consumption values make a greater contribution to a person's choice and the consumption are independent of one another. As per this theory, when choosing which product or brand to buy or which service to subscribe to, most consumers will always consider the functional, social, emotional, conditional and epistemic values that are associated with such a product or service (Sheth, Newman, & Gross 1990).

The functional values of a product include its appearance, performance, quality and the cost of acquiring such, while the emotional value encompasses the nature of feelings that accompany the use of a certain product or service. The social value is associated with the nature of social gains that people get from the use of a certain product or service, while the conditional value results due to variations in consumer behaviour. This in most cases change from time to time depending on the prevailing conditions. On the other hand, epistemic values include the innovative and creative attributes of a product or a service (Seda & Burcu, 2013).

Traditionally, the functional value was considered the most significant of all values as it underlies the economic utility function. However, with time this has been overturned due to the significance that is associated with all values. For example, the social value makes some people to spend on products that are assumed to be of great social value such as jewellery. This is the case because most people normally get social values by association which is based on social-economic backgrounds or cultural-ethnic groups. It is worth noting that, while most individuals try to maximize the benefits that are associated with all the values that define the Theory of Consumption Values, most of the time it is not practical to maximize all the values; hence, there is always a trade-off between the values or even compromise one value for another (Camerer & Loewenstein, 2004).

Although overtime this theory has been criticized by some scholars as one with normative bias as it does not focus on explaining actual economies, it succeeds in demonstrating the social optimality if one examines the real world empirically. This is the case because, in most scenarios individuals will choose to consume a product or enjoy a service which satisfies their specific needs and in most cases that which conforms to their social status. Further, although other scholars have criticized its assumption of most individuals being rational in their actions, this does not mean that it ignores other aspects of human behaviour, as the "economic man" is never different from real people. In most scenarios most individuals are inclined into picking options with an aim of reaping maximum benefits from such options as long as they conform to the wider social issues that surround them (Starmer, 2000).

Therefore, although this theory has its deficiencies; hence, the criticisms, it offers primary insights into numerous economic phenomena more so on people's behaviour in terms of selecting products and services to use. In my view therefore, the theory of Consumption Values, the Agency Theory, and the Traditional Economic Theory are pertinent to the study on the factors influencing rural electrification of households as they focus on the primary factors that affect the subscription to a certain product or service. However, for the purpose of this study, the Theory of Consumption Values is more applicable and relevant as it offers insights into values that determine people's decision making process as concerns choosing and selecting products to consume or services to subscribe to.

2.8 Conceptual Framework

The framework of this study is as presented in figure 1. It represents the relationship between the independent variables, dependent variables and moderating variables.

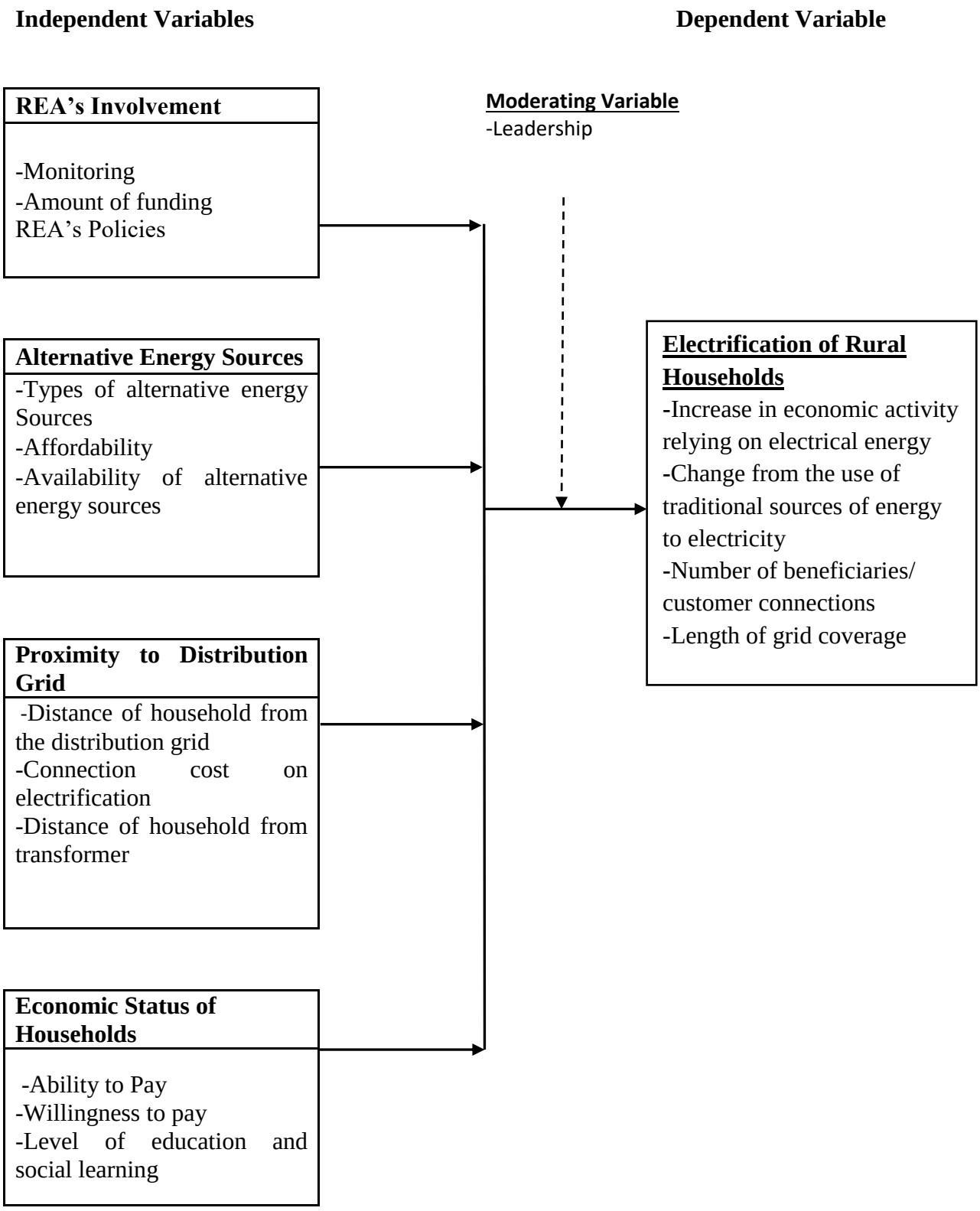

Fig 1. Conceptual Framework

In this study, the independent variables are REA's involvement, demand for electricity, alternative energy sources and proximity to the distribution grid. The indicators of the REA's involvement are REA's policies, monitoring and amount of funding, while the indicators of demand of electricity are ability to pay, willingness to pay, level of education and social learning and household attitude and perception. Additionally, the indicators of alternative energy sources are types of alternative energy sources, affordability and availability of alternative energy sources, while those of proximity to the distribution grid are distance of household from the distribution grid , connection cost on electrification and distance of the household from the transformer.

2.9 Research Gaps

The exhaustive review of past literature both theoretically and empirically has highlighted a number of gaps which the present study will try to answer. In the literature review of this study, although the factors affecting the rural electrification of households include REA's involvement, demand of electricity, alternative sources of energy and proximity to the distribution grid, most researchers have only dwelt on few indicators of these factors. For instance, although three studies: Karekezi et al. (2011), IEA, (2011) and Cecelski et al., (2006) proved that poor implementation policies and lack of stakeholder support can make the process of rural electrification hard, this researchers failed to consider other factors that may affect such a process. Further, although a study by (Zhang & Kumar 2011) and (Christensen *et al.,* 2012) proved that lack of enough funds and proper education and training are some of the primary factors affecting rural electrification, their studies fail to show how these factors link with other factors such as the willingness of people to pay,

Additionally, although most research studies have tried to look at quiet a number of fac that influence rural electrification, some fail to offer proper measures that can help to mitigate some of these impediments by critically looking at how the impediments can be mitigated. As a result, this research will endeavour to establish the connections that exist between different factors and their indicators in order to offer a sound and lasting solutions to this rural electrification problem.

On the other hand, although there are numerous studies that have been done on this topic, there is no documented study that is based on the stated factors in the Kenyan context; hence, this study will try to bridge this gap in order to offer solutions that can work in the Kenyan context.

2.10 Summary of Literature Review

A summary of the literature review is presented in Table 2.1

Table 2.1: Summary of the Literature Review

Author	Topic	Methodology	Findings	Research gaps
REA's Involvement and Electrification of Households				
Karekezi et al. (2005)	The Impact of Power Sector Reforms on the Poor in Eastern Africa	A qualitative approach (exploratory study using case studies) was used in this study	Agencies involved in the electrification of rural households do not even keep track of data on rural electrification, hence most of time rural people are never consulted on rural electrification	Although the research comprehensively discusses the influence of poor policies on electrification, it does not discuss how this connects to other factors that influencing the electrification of rural households.
Barnes et al. (2004)	The Urban Household Energy Transition Energy, Poverty, and the Environment in the Developing World	A descriptive research design was used in this research	Costa Rica has been able to expand its electrification capacity to almost 100% as a result of sound electrification monitoring programs and good policies	Although the study tried to analyse how the existing policies and continuous monitoring affects the electrification of rural households, it does not look at other factors such as the how the availability of alternative sources of energy affect rural electrification adoption
International Energy Agency (IEA) (2011)	Energy for All, Financing Access for the poor, Special Excerpt of the World Energy Outlook 2011	A descriptive research design was used in this research	The study established that lack of proper electrification policies is one of the primary factors that have hindered the electrification	This study discusses policies adopted by governments and how they affect the electrification of rural electrification but fails to connect how such policies to relate to other factors such as the economic status of rural households and how this influences the electrification of rural households

Bekker et, al. (2008)	South Africa's rapid electrification Programme: Policy, institutional, planning, financing and technical innovations	Case studies and descriptive research design were used in this study	Technology development played a significant role in reducing the real cost of connection due to good implementation policies	In this research, other policy issues such as monitoring and their influence were not discussed
Zhang, X. & Kumar, A. (2011).	Evaluating renewable energy-based rural electrification program in western China: Emerging problems and possible scenarios	This research used exploratory factor analysis using surveys	The cost of extending power lines to some areas and how close such areas are close to power lines significantly affects electrification of rural households	This study failed to con
Alternative Energy Sources and Electrification of Rural Households.				
Mbuthi (2007)	Gender Audit of Energy Policy and Programmes in Kenya.	The study employed a multi-prong process involving desk study, use of checklists, structured interviews, case studies, focus group discussions and validation workshops.	Gender sensitive energy planning has not been undertaken in Kenya due to poor policies and the alternative sources of energy used in most rural households depends on the families level of income	Although this research reviewed how poor implantation policies and how the income of most rural households affects electrification, it fails to connect this to how the terrain and proximity of transformers affect electrification of rural households
Ministry of Energy (MoE). (2013).	Scaling-up Renewable Energy Program (SREP): Project Document for Mini-Grids Development in Kenya.	This study used case studies and descriptive research design	Most rural households use traditional fuels such as wood fuel and kerosene as this are assumed to be cheaper when compared to electricity	Although this study how the availability of alternative sources of energy affects electrification of rural households, it fails to connect this to other factors that affect rural electrification.
Government of Kenya (2007)	Economic Survey 2007.	This research used exploratory factor analysis using surveys on 400 Jordanian citizens	Kerosene is the most used alternative sources of energy as it has a good distribution network in rural areas	The study dwelt on only the influence of alternative sources of energy; hence, ignoring other factors.
Karekezi and Kithyoma, 2005).	Sustainable Energy in Africa: Cogeneration and Geothermal in the East and Horn of Africa – Status and Prospects, Nairobi	The study involved desk studies, use of case studies and exploratory research designs	Most localities where electricity is generated lack connections as the generated power must go through the national grid hence most still use traditional sources of energy	The study failed to establish how proximity to the national grid influences the electrification of rural households, although electricity is generated in that locality.

Pellegrin & Tasciotti (2012)	Rural Electrification Now and Then: Comparing Contemporary Challenges in Developing Countries to the USA's Experience in Retrospect.	This study used case studies	High electricity connection costs is one of the factors that significantly influence the electrification of rural households	Although the researcher explored the influence of connection costs on electrification process, the research fails to establish how this is affected by the ability and willingness of rural households to pay the same
Proximity to the Distribution Grid and Rural Electrification of Households.				
International Energy Agency (IEA) (2012).	World Energy Outlook 2012 – Measuring progress Towards energy for all: power to the people	The case study methodology based on a recent real-life cases was used in this study	Proximity to an electric grid is one of the factors that affects the electrification of rural households	This study ignored other factors that affect the electrification of rural households such as the economic status of rural households
Andreas, (2006)	Regional disparities in electrification of India. Do geographical factors? . Centre for Energy Policy and Economics	Exploratory research design was used in this study.	Distance of the household from the transformer is another primary factor that has greatly affected rural electrification of households	This study only explores how proximity to the transformer; hence, it ignores how this relates to distance to the electrical grid affects rural electrification
Wang & Luo (2005)	Bringing affordable, high-quality solar lighting to rural China	Exploratory research design and case studies were used for this study	Proximity to the distribution grid and distance of the household to the transformer are the two factors that influence electrification of rural households	In this study the connection cost was not studied as one of the factors that affect electrification of rural households
Ogalo (2011)	Factors Influencing Electricity Distribution in Nyamarambe Division, Kisii County, Kenya	A survey design approach in combination with mixed methodologies were used	Areas that are accessible also have more connection as compared to those that were considered inaccessible spatially	This study dwelt on only proximity to the distribution and ignored other factors that influence electrification of rural households
Economic Status and Electrification of Rural Households.				
International Energy Agency (IEA). 2008).	World Energy Outlook 2008	Exploratory research design and case studies were used for this study	Affordability is one of the primary factors that determine the ability to pay for a dependable form of energy.	The study centred on how economic factors affect the electrification of rural households; hence, ignoring other factors that affect rural electrification
Townsend (2000)	Energy access, energy demand, and the information deficit	Exploratory research, case studies and descriptive	Ability to pay and willingness to pay are some of the major economic factors of a	In this study, the level of education and social learning was not studied as one of the economic

		research design were used for this study	household that influence the electrification of rural households	factors that affect electrification of rural households
Christensen et al., (2012)	Enhancing access to electricity for clean and efficient energy services in Africa.	The case study methodology was used in this research	People's level of information, education and social learning in terms of the advantages that come with the use of electricity significantly influence rural electrification	Although economic factors that influence rural electrification were studied, the study ignored other factors such the proximity to the electrical grid and people's ability to pay for electricity
Schmidt, (2014).	Sustainable rural electrification in developing countries A field study assessing changes of load curve characteristics in San Francisco Libre, Nicaragua	User based and informal interviews were used in addition to descriptive research design	Attitudes held by the business community towards power access also greatly influences the demand for electricity	This study only concentrated on economic factors; hence, it ignored other factors that affect the implementation of e-government projects

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter will focus on the research design, target population, sample size and sampling procedure, research instruments, pilot study, validity and reliability of instruments, data collection procedures, data analysis techniques, ethical considerations and operational definition of variables.

3.2 Research Design

Research design is the approach that is used for collecting data in a way that will ensure that the needed information is obtained (Cooper & Schindler, 2000). A descriptive research design using a questionnaire was used in this study. This is in agreement with Mugenda and Mugenda (2003) who observe that a descriptive research design allows one to present data collected from multiple methods such as surveys and document review to provide the complete story. This method can help to discover out what, where, and how of an occurrence. The method was used as it gave the researcher an opportunity of collecting information about the correct status of the population under study.

3.3 Target Population

The target population of this study was 200 households that were systematically selected in Meru South Sub County. This population comprised households of electricity adopters and non-adopters. As Mugenda and Mugenda (2003) argues, the population under study is supposed to have all the observable characteristics as the obtained data will help to make a generalization from the results. Further, Burns and Grove (2003) add that the selected population is supposed to meet certain criteria for inclusion in a study.

3.4 Sample Size and Sampling Procedure

3.4.1 Sample Size

Sample size has an effect on how the sample findings accurately represent the populations (Burns & Bush, 2009). The sample frame included all the households that were either adopters or non-adopters of electricity. The sample size comprised of 80 households and 12 staff from the rural electrification Authority projects department.

3.4.2 Sampling Procedure

A number of sampling procedures was used to select the required respondents and locations. Multi stage random sampling procedure was used to select wards and sub locations after which first stage sampling was used to select wards in the sub county. After this, second stage sampling was used to select an approximate target of half the number of sub locations in each ward. In Karingani ward, three sub locations were selected (Rukindu, Njaina and Ndagani,), and in Magumoni ward three sub-locations were randomly selected and this were Kangoro, Kinoru and Kanthiri Rubate. Finally in Igamba Ng'ombe ward three sub locations were selected namely: Kanthanje, Mutino and Kamonka. Considering that the population in the study area varied, the number of households was proportionally determined using the number of households in each sub location. To ensure that each house had an equal chance of being selected, systematic sampling was used to get the households from each of the selected sub-locations. This systematic sampling was done zone-wise using footpaths as boundaries of zones. In these zones, the 3rd house, to either left or right of the footpath was picked for interviewing. The selected sample size satisfied the condition of sampling which, according to Cooper and Schindler (2003) should be at least 30% of the target population in order to be representative enough to allow for generalization of characteristic under investigation. In this research, the multi-stage sampling technique was chosen because this method helped the researcher to come up with a more representative sample of the population as a large area and population was involved.

3.5 Research Instrument

This section examines the various research instrument that were used to collect data. A closed questionnaire was used to collect data and it was chosen due to its uniformity in providing research data and enhancing privacy amongst respondents. There were two different questionnaires used to gather data; one was issued to REA staff while the other one was issued to residents of Meru South Sub County.

3.5.1 Pilot Study

As per Mugenda and Mugenda (2003), a pilot study normally offers a mechanism of testing the research design, methods and any other instruments before the real research is done. It entails doing a test on a pre-test sample using the research instruments that will be used in the real research. According to Kraemer (2006), a pilot study is a mini-version of a full-scale study or a

trial run done in preparation of the complete study. In this research, a pilot study was done two weeks before the actual study in order to pre-test research reliability and validity of instruments and capture any potential weaknesses before the actual study. During the pilot study, the interviewees were explained the significance of the study, after which 10 questionnaires were administered after assuring the respondents of their confidentiality. After a week the same questionnaires were administered again but without any notification for checking of variations in responses. The pilot study was important as it helped to identify and fix any problems that were in the questionnaire. This was in line with Connelly (2008), that the sample should be 10% of the sample projected for the larger parent study.

3.5.2 Validity of Instrument

Validity is basically the degree to which a research instrument measures what it is supposed to measure. Validity helps to establish how genuine, the appropriateness and usefulness of a results of a research study (Nachmias & Nachmias, 1996). In this study, content validity was used to test the validity of the instruments. In order to test validity, five questionnaires were issued to the supervisor for assessment of the specificity and clarity of the questionnaires. After this, the provided guidance and recommendations were used to correct the questionnaire.

3.5.3 Reliability of Instrument

Reliability analysis measures the extent to which the research instruments are without bias and the consistency of results over time using an identical data collection method (Revelle & Zinbarg, 2008). In this study, reliability of research instruments was tested using the Test-retest method as it as it gave the researcher an easy method of communicating to respondents. To test reliability, the same questionnaire was administered twice to the same respondents after allowing an interval of two weeks between the first and second administering. According to Mugenda and Mugenda (2003), a reliability coefficient of 0.7 and above is considered acceptable. To Calculate the Cronbach's Alpha Coefficient, the data from the pilot study was analysed using the statistical package SPSS whereby a Cronbach's Alpha Coefficient of 0.8 was obtained.

3.6 Data Collection Procedures

Two weeks after the pilot study, the actual data collection was done. Before the real actual study, a research permit was sought from National Council for Science and Technology (NACOSTI) so as to carry out the study in Meru-South Sub-county. Permission was also sought from the

University of Nairobi and two days before the actual study, permission was sought from the administrators of Meru-South Sub-County so as to collect data in Meru Sub-County. After permission was granted from all quarters, five research assistants were trained a day before the actual research day to help in data collection. Data for this study was collected through drop and collect system with a letter of transmittal from the researcher. Each questionnaire was numbered for the purpose of matching returned, completed and those delivered to the respondents. To increase the response rate, follow ups were done via telephone calls.

3.7 Data Analysis Techniques

Data analysis gives a mechanism of coming up with inductive conclusions from data and distinguishing the issue under study from statistical for fluctuations that are in the research data (Manikandan, 2011). After data collection, coding of the data was done followed by cleaning of the data and data entry. After this was complete, summarizing using the research questions was done using the statistical package SPSS. Data analysis was followed by tabulating of the output using the arithmetic mean and standard deviation in tables. The arithmetic mean as a measure of average and the standard deviation as a measure of dispersion was used as they are consistent with the descriptive research design which was used in this research study.

3.8 Ethical Considerations

To make sure that presented a true picture of the factors influencing the electrification of rural households, clearance for data collection was got from the University of Nairobi, the National Commission for Science, Technology and Innovation and the Meru South Sub County was sought. In addition to this, the researcher assured respondents of their confidentiality. On the other hand, the research assistants were trained on ethics of data collection.

3.9 Operational Definition of Variables

Different variables were measured using different approaches. Table 3.2 outlines the relevant measures and their corresponding operational definitions.

Table 3.1 Operationalization of Variables

Independent Variables				
Objective	**Indicators**	**Scales of Measurement**	**Research Design**	**Data Analysis Tool**
-To establish the influence of Rural Electrification Agency's involvement on electrification of rural households in Meru-South Sub-County.	Policies Monitoring Amount of funding	Nominal Nominal Nominal	Descriptive	Mean Standard deviation
-The asses the influence of alternative energy sources on electrification rural households in Meru-South Sub-County.	Types of alternative energy Sources Affordability Availability of alternative energy sources	Nominal Nominal Nominal	Descriptive	Mean Standard deviation
-To determine the influence of proximity to distribution grid on electrification of rural households in Meru-South Sub-County.	Distance of household from the distribution grid Connection cost on electrification Distance of household from transformer	Nominal Nominal Nominal	Descriptive	Mean Standard deviation
-To determine the influence of demand of electricity on electrification of rural households Meru-South Sub-County.	Ability to Pay Willingness to pay Level of education and social learning Household attitude and perception	Nominal Nominal Nominal Nominal		Mean Standard deviation
Dependent Variables				
Variable	**Indicators**	**Scales of Measurement**	**Research Design**	**Data Analysis Tool**
-Electrification of rural households	Increase in economic activity relying on electrical energy -Number of beneficiaries/ customer connections -Length of grid coverage	Nominal Nominal Nominal Nominal		Mean Standard deviation

CHAPTER FOUR
DATA ANALYSIS, PRESENTATIONS AND INTERPRETATION

4.1 Introduction

The research objective was to investigate factors influencing the electrification of rural household in Meru South Sub-County. This chapter presents the research analysis, results and the discussion with regard to the objectives of the research study. The analysis is presented in mean and standard deviations while the findings are presented in tables.

4.2 Questionnaire Return Rate

The response rate was of keen interest to the study considering that a sample of 80 households as the respondents from a target population of 200 households. Out of the 80 questionnaires that were issued to respondents in Meru South Sub-County, 74 questionnaires were returned and out of the 12 that were issued to REA's offices, 11 were returned. This represented a response rate of 92.1% which was adequate for analysis and conforms to Mugenda and Mugenda (2003) stipulation that in a research a response rate of over 70% is acceptable for generalization of results.

Table 4.1 Questionnaire Return Rate

Meru South Sub Rural Households	No. of Issued Questionnaires	No. of Returned Questionnaires	Percentage
Meru-South Rural Households	80	74	92.5
REA	12	11	91.7
Average			**92.1**

4.3 Profile of Respondents

For REA, the respondents' information that was sought in this research study included position in REA and length of service with REA. For Meru-South Sub-County, the respondents' information that was sought in this research include the ward of the respondents, sub-location of the respondents, the size of a respondent's household, and their primary source of energy.

4.3.1 Meru South Sub-County Profile of Respondents

The Respondents information that was sought in this research include the ward and sub-location of respondents, the size of the respondents' household and the respondents' primary source of energy.

4.3.1.1 Respondents Ward of Residence

In order to analyse the inter ward regional distribution of electricity, respondents were asked to stat their location of residence. The results are shown in the Table 4.2

Table 4.2 Respondents'' Ward of Residence

Location	Frequency	Percent	Cumulative Percent
Igamba Ngombe	25	36.2	36.2
Karingani	25	36.2	72.5
Magumoni	19	27.5	100
Total/Average	**69**	**100**	

From the findings, it was revealed that 36.2% of the respondents were from Igamba Ngombe ward, 36.2% were from Karingani, and 27.5% were from Magumoni.

4.3.1.2 Respondents' Sub-Location

In order to analyse the spread and distribution of electrification in sub-locations that were under study, respondents were asked to state their home sub-locations. The result are shown in Table 4.3

Table 4.3 Respondents Sub-Locations

Location	Sub-Location	Frequency	Percent	Cumulative Percent
Magumoni	Kangoro	8	11.6	11.6
	Kinoru	7	7.2	52.2
	Kantiri Rubate	8	8.7	31.9
Igamba Ingombe	Kanthanje	8	11.6	23.2
	Kamonka	9	13	44.9
	Mutino	8	11.6	63.8
Karingani	Ndangani	9	11.6	75.4
	Njaina	9	13	88.4
	Rukindu	8	11.6	100
	Total	**69**	**100**	

From the study findings, it was revealed that 11.6% of the respondents were from Kangaro sub location, 7.2% were from Kinoru sub-location, 8.7% were from Kantiri Rubate 11.6% were from

Kanthanje, and 13% were from Kamonka. Additionally, the results revealed that 11.6% of the respondents were from Mutino sub-location, 11.6% were from Ndangani sub-location, 13% were from Njaina sub-location and 11.6% were from Rukindu sub-location.

4.3.1.2 Size of Household

In order to determine the household size as well as the regional heterogeneity of electricity use patterns, respondents were asked to state the size of their households. Results are presented in Table 4.4

Table 4.4 Respondents' Size of Household

No of Years	Frequency	Cumulative Percent
Less than 3	9	13
3-5 People	31	58
5-7 People	24	92.8
Over 7 People	5	100
Total	**69**	

Research findings revealed that 13% of the households had less than three occupants, 44.9% had between 3 to five occupants, whereas 34.8% had between five and seven occupants. In addition, the results revealed that 7.2% of the households had over 7 occupants. From this, it is clear that most of the households that were picked for this research had between five and seven occupants.

4.3.1.3 Primary Source of Energy

In order to determine if respondents used clean and renewable sources of energy and check how many homes had adopted the use of electricity, respondents were asked to state their primary source of energy. Results are presented in Table 4.5

Table 4.5 Respondents' Primary Source of Energy

Source of Energy	Frequency	Percent	Cumulative Percent
Kerosene	32	46.4	46.4
Solar	7	10.1	56.5
Biomass (Wood)	28	40.6	97.1
Electricity	2	2.9	100
Total	**69**	**100**	

As per the research findings results, 46.6% of the respondents indicated that kerosene was their primary source of energy where as 10.1% of the respondents indicated that solar energy was their primary source of energy. Additionally, 40.6% indicated that there primary source of energy was Biomass (wood) whereas 2.9% of the respondents indicated that electricity was their primary source of energy. From this it is clear that most respondents depended on Kerosene as their primary source of energy followed by biomass (wood) and very few depended on electricity.

4.3.2 REA's Profile of Respondents

The Respondents information that was sought in this research include respondents' position in REA and length of service with the organization.

4.3.2.1 Position in REA

This section of the questionnaire sought to establish how long respondents had worked with REA. Establishing respondents' length of continuous service with the organization was necessary as it revealed their level of experience and involvement with the electrification of rural households. The results are presented in Table 4.6

Table 4.6 Respondents Position in Rural Electrification Authority

Position	Frequency	Percent	Cumulative Percent
Chief Engineer	1	9.1	9.1
Chief Project Engineer	3	27.3	36.4
Project Engineer	4	36.4	72.7
Project Manager Engineer	3	27.3	100
Total	**11**	**100**	

From the research findings, most of the respondents were project engineers and chief project engineers.

4.3.2.2 Length of Service with Organization

This section of the questionnaire sought to establish the length of continuous service that the respondents had worked in REA. Determining the length of continuous service with the organization was important as it revealed their level of experience with electrification of rural households. The results are presented in Table 4.7

Table 4.7 Respondents' Length of Service with Rural Electrification Authority

Duration	Frequency	Percent	Cumulative Percent
1-3 Years	1	9	9
4-6 years	5	46	55
6 - 10 years	5	46	100
Total	**11**	**100**	

Research findings revealed that most of the respondents has worked with REA for than 4 years as 46% of the respondents has worked with REA for between four and six years where as another 46% had worked with REA for between six to ten years. This is a clear indication that majority of the respondents of REA were experienced in the electrification of rural households as most has worked in REA for more than four years.

4.4 REA's Involvement and Electrification of Rural Households

In order to establish how REA's involvement influences the electrification of rural households, respondents were asked how REA's monitoring, amount of funding and electrification policies influences the electrification of rural households. Table 4.8 shows how REA's involvement influences the electrification of rural households.

Table 4.8 Influence of REA's Involvement on Electrification of Rural Households

Factor	Mean	Std. Deviation
REA's policies on increase in economic activity relying on electrical energy	2.9	0.68
REA's policies on change from the use of traditional sources of energy to electricity	3.7	0.78
REA's policies on number of beneficiaries/ customer connections	4.1	0.89
REA's policies on Length of grid coverage	3.6	1
Monitoring on increase in economic activity relying on electrical energy	3.9	0.89
Monitoring on change from the use of traditional sources of energy to electricity	3.9	0.95
Monitoring on number of beneficiaries/ customer connections	3.8	0.96
Monitoring on Length of grid coverage	3.8	1.08
Amount of funding on increase in economic activity relying on electrical energy	4.1	0.73
Amount of funding on change from the use of traditional sources of energy to electricity	3.7	0.86
Amount of funding on number of beneficiaries/ customer connections	4.0	0.86
Amount of funding on Length of grid coverage	3.8	0.6
Aggregate Mean/ Standard Deviation	**3.8**	**0.86**

Findings from this research revealed that although REA's involvement has a significant influence on the electrification of rural households (aggregate mean of 3.8), respondents were neutral on the influence of some factors such as the influence of REA's policies on the increase of the economic activity relying on electrical energy in rural households. Among the three factors that were under study under REA's involvement, the amount of funding had the most significant influence (mean of 3.9), followed by monitoring and then REA's policies of electrification.

Among other factors, the amount of funding had the most significant influence on the change from the use of traditional sources of energy to electricity (mean of 3.7), on the number of beneficiaries or customers' connection (mean of 4.0) and on the length of the grid coverage (mean of 3.8). In addition to the amount of funding, findings of this research study revealed that monitoring of rural electrification project also had a significant influence on the success of such

projects. Findings also revealed that monitoring had a significant influence on the increase in the economic activity relying on electricity (mean of 3.9), on change from the use of traditional sources energy to electricity (mean of 3.9), on number of beneficiaries or customer connections (mean of 3.8) and on the length of grid coverage (mean of 3.8).

Further, findings of this research also revealed that although respondents were neutral on the influence of REA's policies on the increase in economic activity relying on electrical energy (mean of 2.9), they agreed that REA's policies had a significant influence on the change from the traditional sources of energy to electricity (mean of 3.7) and the number of customer connections (mean of 4.1). From this it is clear that REA's policies have a direct influence on the electrification of rural households, because with working policies, proper monitoring will be done hence more connections. If more connections are done, the number of beneficiaries are likely to increase and this in turn will lead to the increase of the number of people who depend on electricity empowerment.

4.5 Alternative Sources of Energy and Electrification of Rural Households

To determine how the availability of alternative source of energy, the affordability of the alternative sources of energy and the type of the alternative sources of energy influence electrification of rural households, respondents were asked to study how these factors influence the electrification of rural households. The results are presented in Table 4.9

Table 4.9 Influence of REA's Involvement on Electrification of Rural Households

Factor	Mean	Std. Deviation
Types of alternative energy sources on increase in economic activity relying on electrical energy	3.5	0.99
Types of alternative energy sources on change from the use of traditional sources of energy to electricity	4.1	0.82
Types of alternative energy sources on number of beneficiaries/ customer connections	4.1	0.94
Types of alternative energy sources on Length of grid coverage	3.9	1.01
Affordability on increase in economic activity relying on electrical energy	3.7	0.91
Affordability on change from the use of traditional sources of energy to electricity	3.9	0.7
Affordability on number of beneficiaries/ customer connections	4.3	0.89
Affordability on Length of grid coverage	4.1	0.86
Affordability on the increase in economic relying on electrical energy	4.2	
Availability of alternative energy sources on increase in economic activity relying on electrical energy	4.2	0.86
Availability of alternative energy sources on change from the use of traditional sources of energy to electricity	4.2	0.76
Availability of alternative energy sources on number of beneficiaries/ customer connections	4	0.86
Availability of alternative energy sources on Length of grid coverage	4	1.01
Aggregate Mean/ Standard Deviation	**4**	**0.89**

In response to the influence of alternative sources of energy on the electrification of rural households, respondents strongly agreed that alternative sources of energy had a significant influence on electrification of rural households (mean of 4.0). Among factors that relate to the alternative sources of energy, affordability of alternative sources of energy had the most significant influence (mean of 4.12) followed by the availability of alternative sources of energy (mean of 4.10) and finally the type of alternative sources of energy.

Affordability had the most influence on the increase in the number of beneficiaries or customer connection (mean of 4.3). It also had a significant influence on the increase in the activity that

relies on electricity (mean of 4.2) and on the length of the grid coverage (mean of 4.1). Further, the findings revealed that the affordability of an alternative source of energy has a significant influence on the change from the use of the traditional sources of energy to electricity.

Additionally, findings revealed that the availability of alternative sources of energy had a significant influence on the increase in economic activity relying on electrical energy (mean of 4.2). Equally, respondents strongly agreed that the availability of alternative sources of energy has a significant influence on the change from the use of traditional sources of energy to electricity. On the other hand, respondents also agreed that the availability of alternative sources of energy influences the number of beneficiaries (mean of 4.0) and the length of grid (mean of 4.0).

Further, findings of this study revealed that the types of alternative energy sources has a significant influence on change from the use of traditional sources of energy to electricity (mean 4.1) and number of beneficiaries of customer connections. Also the findings revealed that the types of alternative energy sources has a significant influence the length of the grid coverage (mean of 3.9) and on the on increase in economic activity relying on electrical energy (mean of 3.5).

4.6 Proximity to the Distribution Grid and Rural Electrification of Households

The study sought to establish how proximity to the distribution grid influences the electrification of rural households. Factors that were under study include distance of household from the distribution grid, connection cost on electrification and distance of the household from the transformer. The study findings are represented in table 4.10

Table 4.10 Influence of the Proximity to the Distribution Grid on Rural Electrification of Households

Factor	Mean	Std. Deviation
Distance of household from the distribution grid on increase in economic activity relying on electrical energy	3.4	0.9
Distance of household from the distribution grid on change from the use of traditional sources of energy to electricity	3.8	0.86
Distance of household from the distribution grid on number of beneficiaries/ customer connections	4.2	0.83
Distance of household from the distribution grid on Length of grid coverage	3.9	0.88
Connection cost on electrification on number of beneficiaries/ customer connections	3.8	0.93
Connection cost on electrification on Length of grid coverage	4.2	0.73
Connection cost on the increase in economic activity relying on electrical energy	3.9	0.68
Connection cost on the change from the use traditional sources of energy to electricity	3.9	0.86
Distance of household from transformer on increase in economic activity relying on electrical energy	4.1	0.84
Distance of household from transformer on change from the use of traditional sources of energy to electricity	3.8	0.97
Distance of household from transformer on number of beneficiaries/ customer connections	4.1	0.83
Distance of household from transformer on Length of grid coverage	4.1	0.84
Aggregate Mean/ Standard Deviation	**4**	**0.85**

The research results revealed that all factors that relate to the proximity to the distribution grid had a significant influence on the electrification of rural households, distance of household from the distribution grid had the most significant influence (mean of 4.0) followed by connection cost (mean of 3.95) and then distance of household from a transformer (mean of 3.82).

Among factors that were under study, results revealed that the distance of household from transformer had a significant influence on the increase in economic activity relying on electrical energy (mean=4.1), on change from the use of traditional sources of energy to electricity (mean of 3.8) and on the number of beneficiaries/ customer connections (mean=4.1). Further, the

findings revealed that the distance of the household from transformer has a significant influence on the length of grid coverage (mean=4.1).

Closely related to the proximity to the distribution grid is the cost of connection. Findings of this research study revealed that this has a significant influence on the number of beneficiaries (mean of 3.8) and on length of the grid coverage (mean of 4.2). Further, findings revealed that the connection cost significantly influences the increase in economic activity relying on electricity (mean of 3.9) and change from the use traditional sources of energy to electricity (mean of 3.9).

Additionally, research findings revealed that distance of household from transformer has a significant influence on the length of grid coverage (mean of 4.1) and on the number of beneficiaries or customer connections (mean of 4.1). Further, the findings revealed that the distance of household from transformer has a significant influence on the change from the use of traditional sources of energy to electricity (mean of 3.8) and increase in economic activity relying on electricity (mean of 4.1). Transformers act as distribution centres because from the national grid, electricity has to go through a step down transformer that is normally located near homes. As such, transformers basically act as access points from which electricity can be distributed conveniently. When a new connection is to be made, first the distance from the transformer has to be ascertained as this is what will determine the upfront cost of connection. As a result, if the homes are near, the cost will be less meaning more households will be connected. However, if the homes are far the cost of connection will be high making it hard for most low earning households to be able to be connected. Considering this, there is a direct relationship between the distance of a household to the transformer and the length of the grid, the number of economic activities that depend on electricity and the transformation of a society from use of the traditional sources of energy to electricity.

4.7 Economic Status and Electrification of Rural Households.

In order to ascertain how the economic status of a rural household influences the electrification of rural households, respondents were asked how the ability to pay, willingness to pay and level of education and social learning influences the electrification of rural households. The results are presented in Table 4.11.

Table 4.11 Influence of the Economic status of Households on Rural Electrification of Households

Factor	Mean	Std. Deviation
Ability to Pay on increase in economic activity relying on electrical energy	3.4	0.96
Ability to Pay on change from the use of traditional sources of energy to electricity	4.1	0.8
Ability to Pay on number of beneficiaries/ customer connections	4.0	0.84
Ability to Pay on Length of grid coverage	4.2	0.83
Willingness to pay on increase in economic activity relying on electrical energy	4.1	0.92
Willingness to pay on change from the use of traditional sources of energy to electricity	4.2	0.79
Willingness to pay on number of beneficiaries/ customer connections	4.0	0.87
Willingness to pay on increase in economic activity relying on electrical energy	4.2	
Willingness to pay on Length of grid coverage	4.2	0.92
Level of education and social learning on increase in economic activity relying on electrical energy	4.0	0.87
Level of education and social learning on change from the use of traditional sources of energy to electricity	4.1	0.8
Level of education and social learning on number of beneficiaries/ customer connections	4.0	0.94
Level of education and social learning on Length of grid coverage	4.1	0.92
Aggregate Mean/ Standard Deviation	**4.05**	**0.87**

Research findings revealed that although the economic status of a household had a significant influence on the electrification of rural households (aggregate mean of 4.03), the extent to which different factors that relate to the economic status of a household influence the electrification of rural households differ. For instance, study findings revealed that the ability to pay has a significant influence on the increase in the economic activity of a household relying on electrical energy (mean of 3.4) and on the change from the use of traditional sources of energy to electricity (mean of 4.1). Additionally, the study findings revealed that the ability to pay has a significant influence on the number of customer connections (mean of 4.0) and on the length of the grid coverage (mean of 4.2).

Additionally, findings proved that although rural households may be able to pay for connection, sometimes their willingness to pay significantly influences the electrification of rural households (mean of 4.15). The willingness to pay significantly influences change from the use of traditional sources of energy to electricity (mean of 4.2), number of beneficiaries/ customer connections (mean of 4.0), increase in economic activity relying on electrical energy (mean of 4.2), and the length of coverage (mean of 4.2).

Further, findings proved that the level of education and social learning significantly influences electrification of rural households. The research results revealed that the level of education and social learning significantly influences the increase in economic activity relying on electrical energy (mean of 4.0) and change from the use of traditional sources of energy to electricity (mean of 4.1). Additionally, findings proved that the level of education and social learning significantly influences number of beneficiaries or customer connections (mean of 4.1) and the length of the grid coverage (mean of 4.1).

4.8 REA's Influence on the Electrification of Rural Households

In order to ascertain how operations of REA directly influences the electrification of rural households, respondents were asked how different factors that relate to REA influenced electrification of rural households. The results are presented in Table 4.12

Table 4.12 REA and Rural Electrification

Factor	Mean	Std. Deviation
Most electrification projects face difficulties of finding sufficient, appropriate and continuous funding for their continuity	4.6	0.5
Monitoring is continuous during the life of REPs	4.5	0.5
Monitoring covers sufficient width, breadth and depth to generate useful information for decision making	4.6	0.5
Findings and lessons from monitoring are used to respond to emerging issues and applied in designing future programs	4.5	0.5
REA has sound policies that are adequate to support and facilitate its performance on rural electrification.	4.7	0.5
REA has the necessary technical capacity and skills to carry out its mandate	4.3	0.5
Weak capacity of leadership, governance and technical areas of development are some of the areas identified as challenges to project completion	4.6	0.5
REA enjoys the support of Government of Kenya, through the energy ministry, to provide effective services to its customers	4.4	0.5
Interference of local politicians and civic leaders is a major hindrance to rural electrification	4.8	0.4
Interference and lack of support from rural communities is a major hindrance to rural electrification	4.2	0.6
Aggregate Mean/Standard Deviation	**4.5**	**0.5**

From the Findings, it was revealed that most electrification projects face difficulties of finding sufficient, and continuous funding for their continuity (mean of 4.6). Moreover, weak capacity of leadership and governance was identified as another challenge to project completion (mean 4.6). Additionally, it was revealed that interference of local politicians and civic leaders (mean of 4.8) and interference and lack of support from rural communities were also major hindrances to rural electrification. Although this was the case, respondents revealed that REA enjoys the support of the government (mean of 4.4). Further, it was revealed that REA has a continuous monitoring program on electrification of rural households monitoring covers sufficient areas to generate useful information for decision making and in designing future programs. On the other hand, it was also revealed that REA has the necessary technical capacity and skills to carry out its mandate (mean of 4.3). As a result, it is clear that the failure of REA to deliver its mandate is due to lack of enough finance, interference from those in power and lack of adequate support from rural households.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study aimed to examine factors influencing the electrification of rural households in Meru South Sub-County. This chapter therefore presents the summary of key findings, conclusions drawn and recommendations derived from the study. The findings, conclusions and recommendations are drawn in line with the purpose and specific objectives of the study. Additionally, the chapter will also present suggestions for further studies.

5.2 Summary of Findings

This section provides a summary of the findings as presented in chapter four of the study. The response rate of Meru Sub County was 92.5 whereas the response rate of REA was 91.7%. Respondents of this research were adopters and non-adopters of electricity from Meru Sub-County and members of the project team from REA.

Although respondents agreed that REA's involvement in the electrification of rural households, findings revealed that the level to which this factors influence rural electrification of households differs. From the research findings, it is clear that the amount of funding had the most significant influence on rural electrification, followed monitoring and REA's policies.

Additionally, finding of this research study revealed that the presence of alternative sources of energy has a significant influence on electrification of rural households, among factors that were under study the availability of alternative sources of energy has the most significant influence on the electrification of rural households.

Further, from the studies, it was revealed the distance of a household from a transformer had the most significant influence on electrification of rural households, followed by the connection cost of electrification and lastly the distance of household from the distribution grid.

On the other hand, findings of this research study revealed that although the economic status of households had a significant influence on the electrification of rural households, under this the

willingness of the consumers to pay for electricity had the most significant influence followed closely by the level of education and social learning. The ability of a household to pay had the least influence on the electrification of rural households.

It is worth noting that, among all the factors that were under study, the availability of alternative sources of energy and the economic status of a household had the most significant influence on electrification of rural households. Additionally, findings of this study revealed that most rural electrification projects face difficulties of finding sufficient, appropriate and continuous funding for their continuity. It was further proved that weak capacity of leadership and governance couples with interference of local politicians and civic leaders and interference and lack of support from rural communities were also major hindrances electrification of rural households.

5.3 Discussion of Findings

This section of the report discusses the findings and compares them with literature reviewed in chapter two.

5.3.1 REA'S Involvement and Electrification of Rural Households

From the research results, it was found that REA's involvement has a significant influence on the electrification of rural households. Among the factors that were under study, the amount of funding had the most significant influence on the change from the use of traditional sources of energy to electricity. This can be attributed to the fact that although the rural electrification market is a complex market that integrates the economic, technical, financial, institutional, social, environmental and political aspects of a society, without enough funds the implementation of any rural electrification project will be in jeopardy. For a rural venture to be a success the available funds must be able to cover all the operational costs such as the cost of the required materials and manpower. As a result, there is need for the government to ensure that enough funds are provided to REA as this is the only way of ensuring that its electrification ventures are a success.

Additionally, the findings revealed that monitoring of rural electrification projects has also a significant influence on the electrification of rural households. From this, it is clear that sound electrification monitoring programs and policies can greatly contribute to the success of an electrification venture. This is the scenario because good monitoring policies will help to

discover gaps in the electrification process hence offer corrective measure before a project stalls. Additionally, monitoring can help discover areas that need improvement. As a result of this, even if enough funds are provided, most projects are likely to stall or the funds will be misused; hence, the need for sound policies.

Findings of this research were in agreement with Zhang & Kumar (2011) research findings, whereby it was established that financial viability of the financing organization is a must for a rural electrification venture to succeed. This is the case because some rural areas have a very low number of people, which makes connecting such areas not viable as the operating expenses are higher than income that may be expected from such connection. Additionally, findings of this research are in agreement with Kemausuor et al., (2012) findings in Ghana where it was established that long term planning and proper monitoring are some of the primary factors that have helped Ghana to achieve great strides in this sector.

5.3.2 Alternative Sources of Energy and Electrification of Rural Households

The research findings revealed that the availability, affordability and the availability of different types of alternative sources of energy had a significant influence on the electrification of rural households. Among the factors that were under study, the availability and affordability of alternative sources of energy have the most significant influence on the electrification of rural households. From findings it is clear that when an alternative source of energy is cheap and affordable, more people are likely to adopt it; hence, its use will be more. This is the primary reason why most people in rural households use wood and kerosene as these two forms of energy are very cheap and affordable.

It is worth noting that Kenya has a diverse sources of energy; both renewable and non-renewable. Some of the most common sources of energy include biomass (wood fuel and charcoal), wind, solar, geothermal, biogas, and coal. Although all these forms of energy exist, most people use wood and charcoal fuels as their primary source of energy due to their availability. It is worth noting that the availability of an alternative source of energy goes hand in hand with the socio-economic status of a household, as most affordable sources of energy are easily available making their access easy. In addition to this, there is quite a number of rural households that use solar energy but this is common in households that are made up of the

middle level earners. Therefore, the more a source of energy is available to a household, the more it will be adopted by a society.

Findings of this research were in agreement with the Ministry of Energy (2013) survey which proved that most people in rural areas opt for sources of energy that are cheap and easily available. For instance the research showed that most rural households afford biomass energy as most homesteads are surrounded by woodlands, farmlands, forests and bush lands; hence, over 45% depend on forests for provision energy. Moreover, this research findings were in agreement with The International Bank for Reconstruction and Development: World Bank (2009) research in Cambodia, which proved that 80% of Cambodia's rural households depended on kerosene as their primary source of lighting fuel and over 90% used biomass energy for sustenance. Another study by Heltberg (2003) in a number of developing countries for instance Ghana and India found out that the use of kerosene in most households came second after biomass fuels as these two were the most available sources of energy.

5.3.3 Proximity to Grid and Electrification of Rural Electrification

From the research findings, it was revealed that distance of household from the distribution grid, by connection cost on electrification and distance of household from a transformer had a significant influence of the electrification of rural households. Among these factors, the connection cost of electrification had the most significant influence. It is worth noting that before electricity is distributed to homesteads it must be transported to the main grid after which it is distributed through transformers to households. As a result, if a household is far from the distribution grid, the probability of such a household getting electricity will be low, because of the costs that are involved in the distribution. Additionally, although some rural households are located near centres of electricity generation, the cost of transporting that electricity back from the distribution grid may not be economically viable; hence, most of such localities may not receive electricity. If this happens, then the length of the grid will be small, consequently making the number of people dependent on electricity to be less.

Further, extending an electrical grid is one of the costly ventures most distributors of electricity have cited. This is because the entire extension process involves the purchase of high-voltage lines, secondary distribution transformers, single and three-phase low-voltage lines, and drop-down lines for last-mile connections, all of which are very expensive and most rural households

cannot afford to pay for this. What even makes it worse is that most rural areas are very remote; hence, additional costs associated with transportation, surveying and design, and temporary shutdowns are very high. As a result of all these, if there are few connections, then the length of the grid will be small, leading to a small number of economic activities depending on electricity and this will further lead to the a reduced number of customer connections. On the other hand, the location of a home from the transformer can significantly influence the connection cost and if the connection cost is high, then the likelihood of such rural households getting electricity is low.

Research findings of this study are in agreement with Wang & Luo (2005) findings which proved that one of the primary factors that determine where a transformer is to be installed is geographical position of an urban area, how a household is far from the transformer and the amount of cost that is likely to be incurred when making new connections. Findings of these research were also in agreement with Andreas (2006) research in India which proved that there were great spatial differences in rural electrification rates as some areas had more connection than others due to their accessibility. Further, results of this research study were in agreement with Kembo (2013) research findings in Machakos County where it was revealed that most of the rural homesteads that were connected to electricity are those that were near transformers.

5.3.4 Economic Status and Electrification of Rural Households

Research findings revealed that among factors that were under study, the willingness of the rural households had the most significant influence on the electrification. Additionally, respondents strongly agreed that the ability to pay and the level of education and social learning had a significant influence on the electrification. Therefore, the economic status of a household significantly influences the electrification of rural households. From this results, it is clear that there is a direct connection between the ability to pay for connection and the number of number of beneficiaries, because when more people are able to pay, the more the number of beneficiaries and vice versa. Further, if the number of beneficiaries is high, then there is a probability of the number of activities depending on electricity increasing and this in turn will encourage the transformation of a society from the usage of traditional forms of energy to electricity.

On the other hand, although most rural households may be willing to pay for electricity connection, some may not able to pay for connection leading to low connection rates. If there are few connections, then the grid coverage will be small resulting in very people depending on electricity for economic sustenance. Further, in cases where individuals have access to the electricity grid, it is not guaranteed that that the surrounding people are willing to get connected as some people are normally misinformed of the benefit and cost that comes with this form of energy. Therefore, a society where people are well informed of the numerous benefits that come with electrical energy, the number of connections is likely to increase.

Findings of this research study are in agreement with IEA (2008) research study in Kisumu which revealed that although most individuals were willing to be connected with electricity, most lack the required amount of funding to cover the capital and operating costs. Additionally, the findings were in agreement with Townsend (2000) research findings that proved that although most rural households are willing to pay for connections, their inability to pay for electrification is one of the primary factors that influence the electrification of rural households. Further, findings of this research were in agreement with Schmidt (2014) research in San Francisco Libre, Nicaragua where it was proved that most Nicaraguans who lived in rural areas associated electricity with societal empowerment hence the high numbers of applications for connections.

5.4 Conclusions

The first objective of this research study was to establish the influence of the Rural Electrification Authority (REA) involvement on electrification of rural households in Meru South Sub-County. It was found that among the factors that were under study under REA's involvement, the amount of finding has the most significant influence (mean of 3.9), followed by monitoring (mean of 3.85) and lastly REA's policies (3.85). It is therefore concluded that REA's involvement has a significant influence on electrification of rural households.

The second objective of the study was to assess the influence of alternative sources of energy on electrification of rural households. It was found that the presence of alternative sources of energy had a significant influence on the electrification of rural households (aggregate mean of 4.04). Respondents strongly agreed that all the factors that were under study namely affordability, availability of alternative sources of energy and types of alternative sources of energy had a

significant influence on the electrification of rural households. It is therefore concluded that, alternative sources of energy has a significant influence on the electrification of rural households.

The third objective of this study was to determine the influence of the proximity to the distribution grid on electrification of rural households. The research findings revealed that the distance of a household from the transformer had the most significant influence (mean of 4.02), followed by the connection cost of electrification (mean of 3.95) and finally the distance of the household from the distribution grid (mean of 3.83). It is therefore concluded that with an aggregate mean of 3.93, respondents agreed that the proximity to the distribution grid significantly influences the electrification of rural households.

The last objective sought to determine the influence of the economic status of a household on electrification of rural households. Although research results revealed that all factors that were under study had a significant influence on the electrification of rural households, the willingness of rural households to pay had the most significant influence on electrification of rural households (mean of 4.14). From this, it can be concluded that the economic status of households has a significance influence on the electrification of rural households.

5.5 Recommendations

Based on the research findings of the study, the following are the recommendations:

1. From the first objective which was establish the influence of Rural Electrification Authority involvement in the electrification of rural households, it is recommended that there is need for the government to allocate enough funds to REA and REA must have proper electrification policies which should not only endeavour to make sure that all rural households are electrified but also the cost of electrification is affordable. Additionally, REA must endeavour to do continuous monitoring of its electrification project and use all the learnt lessons for improvement.

2. The second objective sought to assess the influence of alternative sources of energy on electrification of rural households. It is recommended that there is need for the government and any other concerned non-governmental bodies to sensitize the masses on the significance of using clean sources of energy such as electricity and not those that are

readily available such as charcoal, kerosene and biomass which are not clean and renewable sources of energy.

3. From the third objective that sought to determine the influence of proximity to the distribution grid on the electrification of rural households, it is recommended that REA reduces cost through subsidizing the cost of electrification in order to encourage rural residents to get connected. Additionally, REA must ensure that it increases the number of transformers in rural areas, even in remote ones, because once this is in place electricity will be accessible to most rural areas.

4. The fourth objective sought to establish the influence of the economic status of households on electrification of rural households in Meru South Sub-County. It is recommended that REA, the government and non-government organizations that are involved in the promotion of the use of clean forms of energy try and empower societies by offering incentives and subsidies to rural communities in order to encourage more connections. Additionally, because there is a direct relationship between the level of empowerment and education, and adoption and use of clean sources of energy, there is need for REA to increase training and sensitization programs in rural areas on the need for adoption and use of electricity.

5.6 Suggestions for Further Research

Following this study, the following areas were suggested for further research:

1. The scope of this study was limited to Meru South Sub-County. To get the true picture of the situation in the whole of Kenya, there is need for a similar study be conducted on other sub-counties for comparison purposes.

2. From this research study it was revealed that alternative sources of energy have the most significant influence on the electrification of rural households. To get the true picture on how this factors influences the electrification of rural household, a study should be done to ascertain the influence of alternative sources of energy on electrification of rural households.

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APPENDICES

Appendix 1: Introductory Letter

Kathurima Eric
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To whom it may concern,

Ref: Data Collection

I am a student at the University of Nairobi taking a degree in Master of Arts in Project Planning and Management. As part of the requirements of the course, I am required to carry out an independent research; hence, I am currently undertaking a research study on "Factors influencing electrification of Rural Households in Kenya. The study seeks to examine factors such as REA, alternative energy sources, proximity to the distribution grid and demand of electricity.

To enable me successfully carry out the study, a questionnaire is provided to facilitate data collection, which will be the major basis of findings of this research. Your participation in this exercise will be very helpful to the researcher in carrying out the study to its successful conclusion. The study aims to shed more light on this area of research by contributing to the already existing knowledge on electrification of rural households' projects.

Thank you in advance for your contribution.

Yours faithfully,

Kathurima Eric
Reg. No. L50/83892/2012

Appendix 2: Questionnaire for REA)

This questionnaire is administered for the purpose of collecting data for academic purpose only. Any information given shall be held in confidence and not used for any other objective contrary to the stated purpose.

Put a tick (٧) in the appropriate space or use the provided space.

Please complete the items by ticking (٧) or writing the answers in the provided space.

General Information

1. Please indicate:

a. Your Name (Optional)……

b. Your position In REA……..

c. How long have you been with the organization?

a) Less than 1 year [ ]
b) 1-3 Years [ ]
c) 4-6 years [ ]
d) 6 - 10 years [ ]
e) Over 11 years [ ]

2. **On a scale of 1-5, where 1 represents (Strongly Disagree), 2 (Disagree), 3 (Neutral), 4 (Agree) and 5 (Strongly Agree),** please indicate by ticking appropriately how the following factors influence the electrification of rural households

	Variables	**1 SD**	**2 D**	**3 N**	**4 A**	**5 SA**
2.0	Income received by REA is adequate for to fund its operations					
2.1	Most electrification projects face difficulties of finding sufficient, appropriate and continuous funding for their continuity					
2.2	Monitoring is continuous during the life of REPs					
2.3	Monitoring covers sufficient width, breadth and depth to generate useful information for decision making					
2.4	Findings and lessons from monitoring are used to respond to emerging issues and applied in designing future programmes					
2.5	REA has sound policies that are adequate to support and facilitate its performance on rural electrification.					
2.6	REA has the necessary technical capacity and skills to carry out its mandate					
2.7	Weak capacity of leadership, governance and technical areas of development are some of the areas identified as challenges to project completion					
2.8	REA enjoys the support of Government of Kenya, through the energy ministry, to provide effective services to its customers					
2.9	Interference of local politicians and civic leaders is a major hindrance to rural electrification					
2.10	Interference and lack of support from rural communities is a major hindrance to rural electrification					

Appendix 3: For Local Residents of Meru South Sub County

This questionnaire is divided into two sections. Section A will be used to obtain general information about the respondent. Section B will be used to generate information factors influencing electrification of rural households in Kenya.

NB: The information obtained will be strictly treated in confidence and nothing you say will be used against you. Your assistance in completing this questionnaire will be highly appreciated.

Kindly respond to the following questions by ticking on the appropriate box [√] or filling in the answer in the blank spaces.

SECTION A: RESPONDENT'S PROFILE

Please indicate our name and name of your organization below:

1. Name (Optional)……

[Please tick appropriately]

3. Which Location do you come from? …….

4. Which sub-location do you come from?.....

5. How many people are in your household?

a) Less than 3 year [ ]

b) 3-5 Years [ ]

c) 5-7 years [ ]

e) Over 7 [ ]

6. What is your Primary Source of Energy?

a) Kerosene [ ]

b) Solar [ ]

c) Biomass (Wood) [ ]

d) Electricity [ ]

SECTION B: FACTORS INFLUENCING ELECTRIFICATION OF RURAL HOUSEHOLDS

7. Various factors such as REA, demand for electricity, alternative sources of energy and proximity to the distribution grid.

On a scale of 1-5, where 1 represents (Strongly Disagree), 2 (Disagree), 3 (Neutral), 4 (Agree) and 5 (Strongly Agree), please indicate by ticking appropriately how the following factors influence rural electrification of household projects.

	Variables	**1 SD**	**2 D**	**3 N**	**4 A**	**5 SA**
6.0	**REA**					
6.1	REA's policies on increase in economic activity relying on electrical energy					
6.2	REA's policies on change from the use of traditional sources of energy to electricity					
6.3	REA's policies on number of beneficiaries/ customer connections					
6.4	REA's policies on Length of grid coverage					
6.5	Monitoring on increase in economic activity relying on electrical energy					
6.6	Monitoring on change from the use of traditional sources of energy to electricity					
6.7	Monitoring on number of beneficiaries/ customer connections					
6.8	Monitoring on Length of grid coverage					
6.9	Amount of funding on increase in economic activity relying on electrical energy					
6.10	Amount of funding on change from the use of traditional sources of energy to electricity					
6.11	Amount of funding on number of beneficiaries/ customer connections					
6.12	Amount of funding on Length of grid coverage					
7.0	**Alternative Sources of Energy**	**1 SD**	**2 D**	**3 N**	**4 A**	**5 SA**
7.1	Types of alternative energy sources on increase in economic activity relying on electrical energy					
7.2	Types of alternative energy sources on change from the use of traditional sources of energy to electricity					

7.3	Types of alternative energy sources on number of beneficiaries/ customer connections					
7.4	Types of alternative energy sources on Length of grid coverage					
7.5	Affordability on increase in economic activity relying on electrical energy					
7.6	Affordability on change from the use of traditional sources of energy to electricity					
7.7	Affordability on number of beneficiaries/ customer connections					
7.8	Affordability on Length of grid coverage					
7.9	Availability of alternative energy sources on increase in economic activity relying on electrical energy					
7.10	Availability of alternative energy sources on change from the use of traditional sources of energy to electricity					
7.11	Availability of alternative energy sources on number of beneficiaries/ customer connections					
7.12	Availability of alternative energy sources on Length of grid coverage					
8.0	**Proximity to Distribution Grid**	**1 SD**	**2 D**	**3 N**	**4 A**	**5 SA**
8.1	Distance of household from the distribution grid on increase in economic activity relying on electrical energy					
8.2	Distance of household from the distribution grid on change from the use of traditional sources of energy to electricity					
8.3	Distance of household from the distribution grid on number of beneficiaries/ customer connections					
8.4	Distance of household from the distribution grid on Length of grid coverage					
8.5	Connection cost on electrification on increase in economic activity relying on electrical energy					
8.6	Connection cost on electrification on change from the use of traditional sources of energy to electricity					
8.7	Connection cost on electrification on number of beneficiaries/ customer connections					
8.8	Connection cost on electrification on Length of grid coverage					
8.9	Distance of household from transformer on increase in economic activity relying on electrical energy					

8.10	Distance of household from transformer on change from the use of traditional sources of energy to electricity					
8.11	Distance of household from transformer on number of beneficiaries/ customer connections					
8.12	Distance of household from transformer on Length of grid coverage					
9.0	**Demand of Electricity**	**1 SD**	**2 D**	**3 N**	**4 A**	**5 SA**
9.1	Ability to Pay on increase in economic activity relying on electrical energy					
9.2	Ability to Pay on change from the use of traditional sources of energy to electricity					
9.3	Ability to Pay on number of beneficiaries/ customer connections					
9.4	Ability to Pay on Length of grid coverage					
9.5	Willingness to pay on increase in economic activity relying on electrical energy					
9.6	Willingness to pay on change from the use of traditional sources of energy to electricity					
9.7	Willingness to pay on number of beneficiaries/ customer connections					
9.8	Willingness to pay on Length of grid coverage					
9.9	Level of education and social learning on increase in economic activity relying on electrical energy					
9.10	Level of education and social learning on change from the use of traditional sources of energy to electricity					
9.11	Level of education and social learning on number of beneficiaries/ customer connections					
9.12	Level of education and social learning on Length of grid coverage					
9.13	Household attitude and perception on increase in economic activity relying on electrical energy					
9.14	Household attitude and perception on change from the use of traditional sources of energy to electricity					
9.15	Household attitude and perception on number of beneficiaries/ customer connections					
9.16	Household attitude and perception on Length of grid coverage					

Appendix 4: Letter of Authorization from the University Of Nairobi

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION AND EXTERNAL STUDIES
SCHOOL OF CONTINUING AND DISTANCE EDUCATION
DEPARTMENT OF EXTRA-MURAL STUDIES
NAIROBI EXTRA-MURAL CENTRE

Your Ref:

Our Ref:

Telephone: 318262 Ext. 120

Main Campus
Gandhi Wing, Ground Floor
P.O. Box 30197
NAIROBI

21st October, 2016

REF: UON/CEES/NEMC/24/335

TO WHOM IT MAY CONCERN

RE: ERIC KATHURIMA MARETE - REG NO L50/83892/2012

This is to confirm that the above named is a student at the University of Nairobi, College of Education and External Studies, School of Continuing and Distance Education, Department of Extra- Mural Studies pursuing Master of Arts in Project Planning and Management.

He is proceeding for research entitled **"factors influencing electrification of rural households in kenya."** A Case of Meru South Sub-County.

Any assistance given to him will be appreciated.

CAREN AWILLY
CENTRE ORGANIZER
NAIROBI EXTRA MURAL CENTRE

UNIVERSITY OF NAIROBI C.E.E.S. P O Box 30197 24 OCT 2016 NAIROBI NAIROBI EXTRA MURAL CENTRE

Appendix 5: Research Permit from NACOSTI

THIS IS TO CERTIFY THAT:
MR. ERIC KATHURIMA MARETE
of UNIVERSITY OF NAIROBI, 505-60200
Meru,has been permitted to conduct
research in *Meru County*

on the topic: *FACTORS INFLUENCING ELECTRIFICATION OF RURAL HOUSEHOLDS IN KENYA: A CASE OF MERU SOUTH SUB-COUNTY*

for the period ending:
11th November,2017

.....
Applicant's Signature

Permit No : NACOSTI/P/16/67710/14619
Date Of Issue : 11th November,2016
Fee Recieved :Ksh 1000

.....
Director General
National Commission for Science, Technology & Innovation

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officer will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one (1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEACH CLEARANCE PERMIT

Serial No.A 11744

CONDITIONS: see back page