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RURAL ELECTRIFICATION AND NONFARM JOBS CREATION IN RWANDA.

CASE STUDY: BUGESERA DISTRICT

A thesis submitted in partial fulfillment of the requirements for the degree of Masters of Science in Economics at the University of Rwanda.

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Declaration

I, AHUMUZA Emmanuel Keita, hereby declare that the work presented in this thesis for the partial fulfillment of the requirements for the degree of Masters of Science in Economics at University of Rwanda entitled "RURAL ELECTRIFICATION AND NONFARM JOB CREATION IN RWANDA. CASE STUDY: BUGESERA DISTRICT" is my original work and has never been presented elsewhere for any academic award.

All consulted works have been systematically presented in references

Signature: ……....

Date: ……

Certification

I, Dr. Felicien Usengumukiza hereby certify and recommend for acceptance by the National University of Rwanda a research report entitled: **Rural electrification and nonfarm Jobs creation in Rwanda**, in partial fulfillment of the requirements for the degree of Masters of Sciences of Economics of National University of Rwanda.

Signature: ……....

Date: ……

Dedication

I dedicate this work to the almighty God for the gift of life,

The Lake Victoria Research Initiative (Vicres) research project for the financial support,

My family for the gift of love,

My Lecturers for their hard work and high degree of professionalism,

and

Friends for their overwhelming support.

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Abbreviations

BPC:	Botswana Power Corporation
DDP:	District Development Plan
EARP:	Rwanda Electricity Access Roll out Program
EDPRS:	Economic Development for Poverty Reduction Strategy
EICV:	Integrated Household Living Conditions Survey (Enquête Intégrale sur les Conditions de Vie des ménages)
Eskom:	Electricity Supply Commission
ESMAP:	Energy Sector Management Assistance Program
EWSA:	Energy, Water and Sanitation Authority
GoR:	Government of Rwanda
HH:	Household
IEA:	International Energy Agency
IEG:	Independent Evaluation Group
IMF:	International Monetary Fund
KM:	Kilometer
KPLC:	Kenya Power and Lighting Company
KV:	Kilovolt
LEDs:	Light Emitting Diode
MDGs:	Millennium Development Goals
MSMEs:	Micro and Small-medium Sized Enterprises
MININFRA:	Ministry of Infrastructure
MINITERE:	Ministry of Lands, Environment, Forestry, Water and Mines
NGOs:	Non Governmental Organisations
NISR:	National institute of Statistics of Rwanda
REG:	Rwanda Energy Group
RURA:	Rwanda Utilities Regulatory Authority
SMEs:	Small and Medium Enterprises
SO:	System Operator
SPSS:	Statistical Package for the Social Sciences

TVET:	Technical and Vocational Education and Training
UNDP:	United Nations Development Program
WHO:	World Health Organisation

Abstract

Lack of access to electricity is one of the major impediments to growth and development of the rural economies in developing countries. That is why access to modern energy, in particular to electricity, has been one of the priority themes of the World Bank and other development organizations. The purpose of this study is to reveal relations between access to electricity, job creation and advancement in socio-economic conditions in rural areas of Bugesera District. As a case study, we have analyzed 4 recently electrified rural areas in the District. This study departed from the previous studies looking into several causes of rural underdevelopment but instead endeavored to establish the impact that connection to the national grid had on the nonfarm activities. To achieve the main objective, a survey in the 4 sampled cells of Bugesera was conducted from a population frame of 100 households. The target population was from both farm and nonfarm activities.

The tests of correlations indicated a strong relationship between connection to the national grid and value addition services in the area. The study recommends that the body charged with electricity service provision (REG) should reduce installation costs as well as introduce subsidies to help more nonfarm businesses connect to the national grid. Awareness campaigns were also recommended on the advocacy to help more people connect to the national grid. This enabled a conclusion to be made that connection to the national grid was the motivation for creation, value addition in services as well as expansion of nonfarm business establishments in Bugesera.

CHAPTER ONE: INTRODUCTION

1.1. General Introduction

Electricity is prevalent in all industrialized countries and largely absent in the developing world: Today about 1.6 billion people in developing countries world-wide lack access to electricity, and 2.4 billion still rely on traditional biomass fuels (Saghir, 2005). Even though many would consider electricity to be an indicator for development, and despite several historical episodes of wide-spread electrification in developed countries (for example, the rural electrification of America in the 1930s), we know little about the direct effects that new access to modern energy infrastructure will have on the process of Job creation and finally development. Clean, efficient, affordable and reliable energy services are indispensable for global prosperity (United Nations, 2010). The lack of access to energy by the poorest people is a major barrier to poverty reduction and economic development. Consequently, achieving universal access to electricity is one of the most important goals set for the energy sector by governments in the developing world (Crousillat et al., 2010).

Other than the basic use of electricity in households for lighting, radio and phone charging and other basic home appliances, governments are looking at ensuring productive use of electricity in activities that generate income through Nonfarm productive enterprises and modern agricultural investments as an important engine of growth (Doll and Pachauri, 2010). Rural access to electricity is particularly crucial to human development through the support of bottom-of-the pyramid activities such as lighting, refrigeration, running household enterprises that cannot easily be carried out by other forms of energy. Moreover, sustainable provision of access to electricity in rural areas can free large amounts of time, labor and promote better health and education (Crousillat et al., 2010; Doll and Pachauri, 2010).

1.2. Background to the study

Electrification is widely believed to contribute to the achievement of the Millennium Development Goals (MDGs), based on the assumption that sustainable access to modern energy services fosters economic and social development, and leads to improvements in the quality of life. As published in the statistical yearbook 2014 by the National Institute of

Statistics of Rwanda, 19 percent of Rwandan households have access to electricity. However, the rate decreases to 4.6 percent in rural areas (NISR, 2014). As part of the efforts to achieve the MDGs it is among the national policy priorities of most countries to improve access to electricity – be it via extension of the national grid or decentralized electricity. The national target for Rwanda, for example, is to augment the overall electrification rate to 70 % by 2020 – six times the rate in 2005. The international donor community joins these efforts and has increased its support to the energy sector in general and electrification projects in particular (IEG 2008).

According to the Mininfra report of 12th June 2014 on connecting rural areas to electricity as a way of disconnecting them from poverty, the Government of Rwanda (GoR) launched a 5-year Rwanda Electricity Access Roll out Program (EARP) in 2009 as its flagship program to realize the primary targets of the EDPRS for the electricity sector. The medium term goal of EARP phase I was an increase of the total number of electricity connections from 110,000 in 2009 to 350,000 by the end of 2012 (about 16%), and cumulatively to 1,700,000 households by 2017 equivalent to 70%. The emphasis is connecting social infrastructures such as health facilities, schools, administrative offices and commercials centers. The total cost of required sector investments is realistically being met through affordable customer charges, Government funding and support from development partners. The ongoing success and momentum of EARP phase I prompted the government of Rwanda to raise its connection targets even higher for phase II. During an annual policy review in 2012, the original goal of achieving 50% national electrification by 2017 was raised to 70%. The objective of EARP is to improve access to reliable and cost effective electricity services for households and priority public institutions and the programme was designed along the line of least cost plan to ensure access to electricity by all citizens in the long run.

The report further states that establishing a thick trellis of electricity connections in urban and rural areas is in line with Government program of attaining the ideals of Vision 2020 and Economic Development for Poverty Reduction Strategy (EDPRS). EARP is meant to partly meet some of those ambitious goals. The programme focuses on some components such as Grid Roll-out, Green connections and Technical assistance, capacity strengthening, and implementation support.

The EARP is also in response to the incumbent challenges faced by business enterprises in accessing adequate power resorting to use of expensive diesel generators. Research indicates that access to reliable electricity enables product value addition to Small and Medium Enterprises(SMEs) especially those involved in agribusiness activities(Rwanda SME Policy, 2010). Inadequate supply and expensive electricity leaves small business enterprises such as hair salons, maize mills, wood processing mills and others resort to diesel generators at exorbitant costs. The cost of electricity is a significant contributor to the cost of Doing Business especially by rural based enterprises and enhanced rural electrification would come in as a solution for the rural business investments. After the electricity crisis in 2004, government resorted to renting of diesel generators to meet the supply needs, pushing the cost of a Kilowatt hour very high (US$21 cents) attracting heavy government subsidies (EARP Midterm Review, 2012)

1.3. Problem statement

In spite of the significance and potential of non-farm jobs in the Rwandan economy, there are several factors that hinder their establishment and growth. One of the factors that may contribute to these problems is on grid electricity services. Thus, without available and reliable electricity services, there is no possibility of utilizing modern electrical appliances and machinery which may pave the way for small and cottage industries. There cannot even be convenient lighting in businesses such as bars, clinics and shops which reduces the number of working hours.

Considering that there is very little knowledge on the linkages between uses and impact of electricity services on non-farm jobs establishment and growth; it was important that this study be carried out to evaluate whether new access to household electrification increases job creation opportunities in rural areas and the extent to which rural electrification program impacts on the socioeconomic conditions of rural livelihoods of Rwandans living in rural areas. The results of these analyses will strongly improve our understanding on the impacts of this infrastructure in a poor, rural setting.

1.4. Research questions

In order to investigate this problem, the researcher focuses on the following two main research questions:

- To what extent does the rural electrification program impact on the socioeconomic conditions of rural livelihoods of Rwandans?
- Does rural electrification contribute to nonfarm jobs creation in rural areas?

1.5. Objectives of the study

This research has general and specific objectives.

1.5.1. Main objective

The main objective of the study is to assess the impact of rural access to electricity on non-farm job creation in Bugesera District.

1.5.2. Specific Objectives

In order to realize the general objective, two specific objectives guided this study:

- To analyze the extent to which access to electricity impacts socioeconomic conditions of rural livelihoods of Rwandans living in rural areas.
- To confirm whether rural electrification leads to nonfarm jobs creation in rural areas.

1.6. Research hypotheses

Hypothesis refers to a tentative explanation to a phenomenon, used as a basis for further investigation/research. For this regard, this study shall consist of verifying the following hypotheses:

- Rural electrification can increase the likelihood of nonfarm jobs creation and contribute to the improvement of socio-economic conditions.

1.7. Purpose of the study

The purpose of this study is to determine the extent to which rural electrification impacts on non-farm jobs creation.

1.8. Scope of the study

The study will seek to establish the impact of rural electrification on non-farm jobs in Bugesera District for the last 4 years between (2010-2014)

1.9 Significance and Limitations of the Study

1.9.1 Significance of the study

My findings will be presented at the University of Rwanda as a partial requirement for the award of MSc Economics. The theoretical contribution of this research is in exploring the issues concerning the changes that happened in rural non-farm jobs in Bugesera District because of taking up electricity services. A good explanation was developed, which is appropriate to non-farm jobs in rural areas in Bugesera District and it may be applicable to other areas of the same characteristics within Rwanda or any other developing country.

The research findings and explanations are hoped to provide a better understanding to entrepreneurs, modern energy suppliers, policy makers and other modern energy stakeholders on the linkages and impact of electricity services on non-farm jobs in rural areas. These findings are further expected to facilitate and stimulate the productive uses of grid electricity for increasing income and consequently reduce poverty.

Furthermore, the research is aimed at contributing towards filling the gap identified by examining how electricity services may or may not facilitate the increase in performance and increase in income of non-farm establishments in rural areas and finally contribute to poverty reduction.

It is believed that the availability and reliability of information from the case study could enable decision-makers, government, donor organizations and other energy stakeholders to support efforts to increase accessibility of electricity for informal sector. It could also stimulate the rural poor who depend much on non-farm jobs as a source of their income to improve their business plan and use electricity services productively.

The focus of this research is nonfarm jobs in specific rural areas of Bugesera using grid electricity. The output of this research is a report offering explanations of study findings on linkages between grid electricity services and non-farm jobs development in rural areas of Bugesera. The findings of this research will contribute to a better understanding of the present problems and their causes so that solutions may be proposed between both electricity stakeholders and entrepreneurs on how to overcome the problems. Also the findings are expected to stimulate and facilitate the discussion about the linkages between grid electricity services and home based nonfarm micro-enterprises on how electricity services can be more available and used more productively.

1.9.2. Limitations of the study

Limited budget of the researcher; some people wanted money because they thought I had been hired by a wealthy research firm.

Most people were not sure of their information when it came to backing responses with statistical figures.

CHAPTER TWO: LITERARTURE REVIEW

2.1. Introduction

The recent literature on rural electrification has emphasized the significance of linking its development with productive uses for energy. Therefore, the purpose of this chapter is to review the past and more recent literature on the role and relation of infrastructure, particularly rural infrastructure, to economic growth and development. It will examine some of the economic and social issues underlying the development of rural electrification, drawing on the experience with both grid based expansion and off-grid applications in developing countries. The review will assess the impact that schemes for rural electrification have had on small business development and income generating activities and on access and affordability. Affordability is of course, related to household income and opportunities to earn income, as well as income or concessions provided through various types of policy interventions (e.g. implicit and explicit in the design of tariff and subsidization policies). Affordability is also integrally affected by wider issues, such as participation in community-based initiatives and the availability of localized credit facilities to help develop and finance access and use of energy.

2.1.1. Definitions of common words and phrases

Alexandra niez (2010) defines rural electrification as the process by which access to electricity is provided to households or villages located in the isolated or remote areas of a country. Remote or rural regions lacking electricity supply are often characterised by well identified challenges. They may lie at a reasonable distance from national or regional electricity grids, may be difficult to access (far from urban centres with a difficult terrain such as large rivers or jungles), or may suffer harsh climatic conditions that render electrification through grid extension a perilous task. Rural communities are also often highly dispersed with a low population density and characterised by a low level of education, low load density generally concentrated at evening peak hours, and low revenues. Adding to these challenges, the rural poor without access to electricity either spend relatively large amounts of their scarce financial resources on energy, or a disproportionate amount of time collecting firewood. In light of these challenges, electricity

provision to the world's rural poor calls for a committed and long-term action plan. The benefits that electricity access brings to households and communities are justified not only on social and economic grounds but also on grounds of equity objectives.

Lanjouw (1999) defines the rural non-farm economy as being all those activities associated with waged work or self employment in income generating activities that are not agricultural but are located in rural areas. Thus, non-farm activities might include manufacturing (i.e. agro processing) and be accumulative (e.g. setting-up a small business), adaptive, switching from cash crop cultivation to commodity trading (perhaps in response to drought), coping (e.g. non agricultural wage labour or sale of household assets as an immediate response to a shock), or be a survival strategy as a response to livelihood shock. The rural non-farm economy cannot be considered homogeneous; rather it is characterised by its heterogeneity, incorporating self employment, micro and small-medium sized enterprises (MSMEs) and traders. The sector incorporates jobs, which require significant access to assets, whether education or access to credit, and self-employed activities such as roadside "hawking" of commodities which has low, or no barriers to entry and low asset requirements.

2.2. The Relationship Between electricity Infrastructure and Growth

Intuitively rural electrification is an important part of a country's infrastructure, although it has not always been the case that it has been given priority in a developing country's economic plans for infrastructure. The interest in the importance of infrastructure for growth and development has historically ebbed as has the debate over whether it ought to be provided by the public or private sector. Central to these issues has been the type of case that can be made for developing infrastructure. Should infrastructure be developed primarily because the relationship to economic growth is a supportive one, acting as a prerequisite for growth? Or alternatively, does economic growth increase the demand for more infrastructural services? In contrast, can the development of infrastructure be viewed as a universal right, giving people access to essential services? Clearly, the case for this has been made more strongly in relation to water and health. A definitive answer to these age old questions has been difficult to find. Swings in political ideology at the national and international levels have played their part in explaining the fluctuating interest in issues relating to infrastructure. In recent years, there has been a belief that

the differences in growth between the successful East Asian economies and other parts of the developing world can be explained by failure to invest sufficiently in infrastructure (Estache and Fay 2007).

Moreover, the concern for rural electrification has resurfaced in recent years with the heightened interest in infrastructure in relation to the part it can play in improving welfare and reducing poverty. Poverty is now officially recognized as the core issue of international development; notably, halving absolute poverty by 2015 is at the top of the list of the Millennium Development Goals (MDGs) (UN 2000), and the MDGs are recognized by most aid agencies, as well as by many NGOs, as constituting their leading priority. In part this is a return to a recognition that the relative importance of infrastructure may relate to a country's level or stage of development. In developing countries, even on economic grounds, it is now seen that there is an urgent need to expand infrastructural services as widely as possible to integrate dispersed populations in rural areas into the mainstream economy. The mainstream economy has typically been concentrated in urban areas where economic activities have been most vibrant. A contrast in experience can be witnessed in the industrialized countries, where increased attention on private ownership and the development of infrastructure have changed the pattern and level of service provision in rural areas, although welfare has not necessarily declined as a consequence. For example, the privatisation of railways has often resulted in a deterioration of services in rural areas, as provision has been rationalized on economic efficiency grounds, but alternatives and substitutes in the form of other methods of transport have often been more readily available. The relation between infrastructure and growth has been a debated arena for some time as both the quantity and quality of infrastructure affect growth.

Infrastructure affects growth through a number of channels both direct and indirect. The most evident direct link is through the productivity effect. This is often captured in a production function framework, where an increase in the quantity of infrastructure ought to raise the productivity of other factors. For example, giving enterprises access to electricity will spread to the development of other types of investment. This process can be applied to infrastructural investment in remote areas and result in an increase and diversified range of private investments in productive activities. Direct channels, therefore, concern the effects of infrastructure on productivity in industry, agriculture as well as various types of services. The impact of

investment in infrastructure on growth, output or firm costs will in turn also depend on the indirect channels. For example, on the number of users and, in the case of electricity, on the extent of the network as there will be network effects. Modeling the effect of infrastructure on growth will need to include these nonlinear effects and capture the effects of network externalities which will be reflected in the size of the network, the institutional development associated with network development and the degree of competition or factors that affect the quality of the service provided.

Agenor and Moreno-Dodson (2006) point to improvements in the stock of infrastructure reducing private capital adjustment costs through lowering the logistic cost of such investments and by allowing the substitution of palliative investments in machinery. Here infrastructure services can be made more reliable to reduce a firm's necessity to invest in substitutes to hedge against potential service disruptions, therefore freeing up resources for more productive things. In rural areas this may relate to the effect on labour productivity due to reductions in the time commuting, fetching, carrying and organising work. Developing infrastructure can also contribute to improving health and education which increases labour productivity in both the short and longer terms. An interesting characteristic of infrastructure investment is its spatial dimension. It involves choices concerning the selection of rival locations for equipment and processes and connections for energy, since it is an input for firms and household's consumption and investment decisions. The location of infrastructure will affect patterns of behaviour such as the decision to migrate and locate a business. The contrast between urban and rural areas is often portrayed as one between leading and lagging regions. Rural populations market most of their goods in urban concentrations. In this respect the most promising research from a spatial dimension has been developed from the approaches combining new growth theory with new economic geography (Krugman 1995).

Literature in this arena suggests that infrastructure will interact with physical characteristics to affect the comparative advantage of a region. Investing in electricity to help disadvantaged regions could change characteristics in order that these areas could integrate with more prosperous parts of the economy. Evidence from the transport sector can be used to illustrate the point. Improved infrastructure in a poorer area may remove a natural trade barrier that was

protecting a local industry and lead to a higher concentration of employment in a more successful region. In this way access to electricity in an underdeveloped area could lead to the inward migration of new enterprises moving to lower cost regions. This effect is likely to be reinforced if complementary types of infrastructure and related services are also being developed, which will further contribute to lowering costs. This point is developed in more detail later in the paper in relation to rural electrification. Numerous studies and reviews of the relation between infrastructure and economic growth have been undertaken. Recent examples include Straub and Vellutini (2006) and Straub (2008). Calderon and Serven (2004) point out that increases in the quantity and quality of infrastructure raise growth but the effects can take a long time and can be costly. Whilst these reviews find both positive and negative effects on growth, there appears to be consensus that infrastructure matters more for growth in lower income countries (Romp and deHaan 2005).

Fewer studies explore the relationship between infrastructure and growth in Africa and most are hampered by the low quality of data and the concentration on the role of human capital (Estache and Fay 2007). More recently, Escribano et al. (2010) has extended the analysis by using total factor productivity in African manufacturing to examine the relationship with infrastructure. They find although infrastructure (including electricity) has a low impact on total factor productivity in the higher income countries in the region, the poor quality of electricity provision does have adverse effects in poorer countries. Earlier Esfahani and Ramirez (2003) came to similar conclusions, estimating that poor economic performance in Sub- Saharan Africa was due to under investment in electricity and telecommunications.

Some of the blame for the poor performance of low income economies has been linked to the adverse effects on infrastructure investment resulting from the pursuit of economic liberalisation and forms of structural adjustment policies in the 1980s, which called for smaller government and reduced public expenditure (Cook 1988). Most capital expenditure in low income developing countries was aid financed in the 1980s since indebtedness caused the cessation of external private capital inflows. Some of the external financing supplied by the only lenders at the time, the World Bank and the IMF, was diverted to support recurrent rather than capital costs, as the effects on operating and maintenance of previous capital expenditure was becoming

increasingly recognised (the so-called recurrent cost problem). Inevitably, this limited the growth of infrastructure in a wide range of low income developing countries. Although private investment in infrastructure, principally through privatisation did not significantly develop until the mid-1990s, after the World Bank concluded in its Bureaucrats in Business Report (1995) that utility privatisation had not proceeded as anticipated, the results have nevertheless been disappointing. A recent study by Cook and Uchida (2008) showed that although the performance of privatised utilities may have improved immediately after privatisation in developing countries, this was not the case later. Even 10 years after privatization there have been significant declines in investment and rising indebtedness has been used to cover operation and maintenance costs of privatized electricity utilities in many developing countries.

2.2.1. Electricity and Growth

Electricity infrastructure as consumption and an intermediate good is linked to growth in income and therefore causality between income and infrastructure may be in both directions. Changes in income lead to changes in the demand for electricity and electricity generation. The causality between electricity and economic growth has preoccupied energy economists for a number of years.

Four types of causal relationship between electricity and economic growth have been postulated in the recent literature (Ozturk 2010). These consist of no relationship, which implies that a policy directed at each is irrelevant for the other. If the relationship is one where economic growth leads to the growth in demand for electricity then policies directed towards conserving energy may have little effect on economic growth. If on the other hand electricity consumption leads to economic growth, then conserving energy may adversely affect economic growth.

The most plausible relationship is likely to be in two directions and in this case the relation between policies towards promoting growth, energy use and conservation are likely to be more complex. The differences are, however, increasingly relevant as the ideas for sustainable development continue to penetrate thinking about future growth paths for developing countries. The initial relationship between energy consumption and economic growth was explored by Kraft and Kraft (1978) in the US. Since then, numerous studies in this field have used single

country bi-variate and multi-variate models (which have included variables such as fixed capital formation, labour force etc.) to examine the relationship (see Ozturk 2010 for a recent review). The results from the majority of studies examined on causality are mixed. A recent study by Huang et al. (2008) has grouped countries by income to investigate the relationship between energy consumption and growth. They use panel data for 82 countries between 1972 and 2002. They find a bi-directional (feedback) relationship between energy consumption and economic growth. In lower income countries there did not appear to be a causal relationship between energy consumption and economic growth, with the implication that setting parameters for energy policy would be less clear cut since increases in energy consumption would not lead to growth. In middle income countries (lower and upper) economic growth leads positively to energy consumption and negatively in higher income countries. This implies that high income countries have already undertaken conservation policies to protect the environment. With the relation postulated for middle income developing countries there is the additional question posed in the literature of whether the benefits resulting from economic growth from energy consumption outweigh the cost imposed on the environment through pollution. This appears in the so-called inverted U relation between the level of economic development and pollution (Grossman and Krueger 1995). In low income countries there are not many industrial units to pollute. As an economy grows, pollution increases as it attracts higher polluting industries. Eventually, the pollution problem becomes the main concern and there may be a tendency to produce lower polluting products (although firms can export their pollution by relocating to lower income countries).

The inconclusive nature of the empirical results on the causality between electricity consumption or use and economic growth may be due to statistical inconsistencies, inappropriate methodologies for measuring the relationship and differences in comparative country contexts. A major shortcoming of many of the studies is that they have merely extended the range of years investigated and have not introduced significantly different methods. Most data span 30–40 years and using unit root and Johansen co-integration tests with insufficient data points provides low statistical testing power (Huang et al. 2008). Although inconsistent results on the association and the direction of the link exist, the more important question for development comes down to the importance of electricity (or energy) in relation to other factors of production, such as capital and

labour. Even where this has been examined the results continue to be mixed. Recently, Wolde-Rufael (2009) has shown that in 11 out of 17 countries studied in Africa energy contributes to economic growth but not as much as capital and labour. It ought to be noted that transport costs also generally form a higher proportion of a firm's total costs than energy. Studies at the country level, however, do find more in favour of a relationship running from electricity consumption to economic growth (Ozturk 2010). This implies that a policy to halt or slow down electricity capacity growth will adversely affect economic growth.

It has also been argued that many studies are flawed in terms of causality or attributing impact because electricity is put into areas with the greatest potential for growth. Further, results can be distorted because a developed country puts more effort into creating energy efficiency and introducing protective regulation for the environment and the economy, whilst a developing country is more likely to put more resources into production rather than energy efficiency and environmental protection.

2.3. Rural Electrification Policies in Developing Countries

The policy emphasis towards rural electrification has fluctuated over time and has been influenced by the World Bank. In the 1970s the World Bank thought investment in rural electrification was worthwhile [reflecting the received wisdom over the previous 20 years that rural electrification would act as a catalyst for rural development (Hirschman, 1970)] but would be loss-making (World Bank 1975). It was thought that the high up-front investment costs and perceived low demand in rural compared to urban areas would constrain rapid development in this direction and that developments in health and water were of higher priority. Despite the spurt to rural electrification projects in the 1980s in, for example, Malaysia and Bangladesh, an Independent Evaluation Group (IEG) found disappointing results in terms of low economic returns, low cost recovery (between 10 and 15 %) and little evidence of an impact on industrial development (IEG 1994). This finding was also reflected in wider reappraisals of its effects which began in the 1980s (Barnes 1988; Foley 1992; Pearce and Webb 1987; Kirubi et al. 2008). The World Bank's approach to energy in the 1990 s turned towards the promotion of utilities in the private sector. The implications for the electricity sector were spelt out in World Bank (1993a). This represented a reversal of earlier policy where the World Bank had argued,

particularly for poorer countries, that privatization of utility sectors was too difficult due political reluctance and the lack of willing buyers and investors (Cook 1999). In the early 1990s the World Bank also attempted to balance efficiency with an emphasis on sustainable development with little real success (World Bank 1993b). The subsequent shift by the World Bank and other international development institutions after 1995 towards a strategy based on poverty had a more significant implication for rural electrification programmes and the ways in which they were perceived. The link between energy and poverty was clearly laid out in a number of the World Bank's reports (World Bank 1996). By 2008 the World Bank could claim that the economic case for investment in rural electrification is proven and that the benefits to rural households are above the average long run supply costs, indicating that cost recovery tariff levels are achievable (World Bank 2008). The World Bank's coverage of rural electricity is still low in South Asia and Sub Saharan Africa and it acknowledges that it supports few projects in the countries where access to electricity is poor and rural electrification is limited, although new energy projects have recently commenced in Ethiopia, Uganda and Rwanda. The motives for supporting projects are evenly matched between those that aim to improve welfare (60 % have this component and it includes poverty reduction), those to increase electricity supply (72 % have this component) and those to foster institutional development (75 % have this component). Most poverty reduction objectives are associated with multi-sector projects. Institutional development mainly relates to utilities and private sector development and includes training and operational support as for example provided in Senegal and some grid and off-grid regulation projects in Peru.

Most World Bank support for off-grid projects appear to be linked to renewable energy schemes and is usually a component of a larger project, as is the case in at least 28 out of the 33 off-grid projects that involve the World Bank. Many of these are considered pilot projects which attract co-funding from the Global Environment Facility (See Sovacool 2010 for a recent review of support mechanisms for renewable electricity). The World Bank uses several criteria to support electrification projects. These include cost effectiveness to connect, distance to a grid, affordability and population density. Sometimes a wider more socially-oriented criterion is used in a minority of projects (usually multisectoral projects) and has been used to support projects in deprived regions of North East Brazil and in Chile, Honduras and Vietnam.

According to the World Bank, projects furthest from a grid are likely to involve off-grid solutions, where there are small communities. In this way a kind of pecking order is used which favours grid over off-grid support. Financial considerations are also used to determine the merit order. This is the case because the World Bank's favoured model for delivering even off-grid electricity is through the private sector, as in Nicaragua and Laos. However, as the example of Cuba shows the real value of supplying a locality with off-grid technology lies in its ability to draw on local resources and help develop local potential (Cherni and Hill 2009).

As far as an overall assessment is concerned it is evident that the private sector has not developed electrification in rural areas on the scale envisaged with privatization and the variety of approaches pursued to increase private participation in infrastructure. This is largely the case whether consideration is given to investment in rural electrification through privatised utilities, forms of public–private partnerships, increased use of subsidisation, through for example output-based aid and more overtly through development assistance. The deficit has to a very limited extent been filled by the growth of local micro and small scale private providers and community-based cooperatives, who have become more prominent and have to some extent compensated for the failings of large scale privatisation and publicly-owned monopolies, either through stand-alone or mini-grid systems (Ellegard et al. 2004; Sebitosi et al. 2006; Moner-Girona 2009; Yadoo and Cruickshank 2010). In addition, there is evidence that larger scale private firms resort to generating their own electricity in response to the insecurity in network supply. For example, Steinbuks and Foster (2010) find significant evidence of own generation of electricity in Africa. They examined 25 countries. Self-generation accounts for 6 % of installed capacity in Sub-Saharan Africa, or 12 % in lower income countries in the region. Own generation is high despite power sector reforms. The marginal costs of own generation are high and emergency backup does not appear to fully explain why there are so many own generators, although power failures, when they occur, do put strains on smaller enterprises, for example in Nigeria (Adenikinju 2005) and Uganda (Reinikka and Svensson 2002) and on enterprises in the informal sector. If smaller enterprises generate electricity they tend to install less than 5 MW thermal generators. Again, although maintenance levels are generally low, essential parts are sometimes difficult to acquire. Reinikka and Svensson (2002) also suggest that the costs of own generation outweigh the benefits. The decisions to generate own electricity result from many factors and the benefits are

difficult to measure. They include elements such as lost sales due to power failures and where backup is needed to meet export demand. Since own generation of power is costly there could be opportunities to sell power at full cost. The extent of this is largely unknown and whether or not excess power could be sold to grid to improve national power supply is uncertain. For small firms it is believed that own generation imposes relatively low fixed costs but higher variable costs. For larger firms, the reverse is the case, with firms facing relatively high fixed costs and increasing variable costs, indicating that there could be scope for large firms to sell to small firms.

2.4. Poverty, Rural Development and Income

The more positive view of the role of rural electrification and its relation to poverty reduction has interesting implications for rural development strategies as a whole. Most people living in poverty are in rural areas living below the poverty line (70 % in rural as opposed to 30 % in urban areas). Earlier thinking was that rural poverty could be alleviated by raising agricultural productivity (Johnston and Mellor 1962). Underpinning this notion was agriculture as a labour-based activity suitable for income earning possibilities in a labour abundant and capital scarce developing economy (Hayami and Ruttan 1971).

Following these ideas a technological revolution in the form of the Green Revolution gave impetus to the idea that agricultural growth could be stimulated, particularly through increasing the efficiency of yields and involving smaller farming units. This created a view that income could be increased with rising equity and that economic growth could be linked to agricultural change through backward (supply inputs to farmers) and forward (marketing and processing of agricultural outputs and consumption linkages, that is expenditure by farmers on non-farm consumption goods) linkages (Ellis 2006). With these developments, infrastructure could contribute to improving agricultural productivity and reduce rural poverty (Van de Walle 2002; Renkow et al. 2004). This view was reinforced by the associated rise in non-farm activities in rural areas (Freeman and Norcliffe 1981).

However, there are sceptical views of the agriculturally centred approach which emphasise that growth and poverty reduction may come more from the links with industry and services than from agriculture (Harriss 1987; Hart 1993). Work by Bernstein et al. (1992) and Ellis (2000) have questioned the agriculture-centred approach to rural poverty reduction. They point to the importance of non-farm sources of income for rural households through studying livelihood patterns. The livelihood approach emerged in the 1970s and provides the link between assets and the options that people have to pursue alternative activities that give income. The belief that farming alone can provide a sufficient means of survival in rural areas is replaced by a livelihood approach that emphasises a process by which households construct a diverse portfolio of activities and social support capabilities for survival and to improve standards of living. Moreover, it is evident that incomes of farm households also depend on income from migratory flows of labour to urban areas (income remittances). Interestingly, it has been found that the rural poor are more dependent on agriculture than the better-off rural population, who are less dependent on agriculture (Ellis and Freeman 2004). The better-off farmers are also able to use non-farm income to acquire inputs to raise productivity of farms. Part of the explanation for the emphasis on non-farm income is linked to the deteriorating terms of trade between agricultural and industrial goods prices. In many instances then this has led to less reliance on agriculture in rural areas with increasing rural to urban migrations, particularly of males and women remaining in agriculture.

Livelihood research would therefore suggest that rural poverty reduction depends on the scope for intersectoral mobility and adaptability (Ellis 2006). The barriers to these should be addressed, those are institutional factors such as land tenure systems that hamper exit; land tenure systems make land rental difficult without compromising ownership security. There are also social restrictions on the mobility of women (less the case in the Philippines). In this case poverty reduction could be served by encouraging urban and non-farm growth, although some attention would need to be given to raising farm productivity where this is low. Rural lighting, by improving possibilities for education, would help remove the bottleneck of failure to get an urban job by raising skills and increasing prospects of rural non-farm employment (Gibson and Olivia 2009). In practice, many households straddle rural and urban areas through migration and investment strategies, kinship ties and cultivation and livestock ownership (Satterthwaite and

Tacoli 2002). Rural to rural migration is also important, which is often seasonal, and migrants search for work in road construction for example and contribute to building infrastructure (Rogaly 2006). Water and livelihoods are also intimately connected because water is a constraint on food production. Around 80–90 % of all consumed water goes onto fields and only half of that touches crops through poor irrigation. In the water sector the shift to cost recovery has increased prices for those connected to the piped network, however, many of the poorest and those living in low income settlements have not been connected. Low income households can buy water from private vendors but this soaks up a high proportion of their income and may not be viable. Connection is also not tenable because connection charges are high and there is a need to pay bills on a regular basis. Income for the poorest is often uncertain and seasonal. This is a reminder that poor households may find themselves constrained to make choices when allocating their low incomes between necessary and possibly mutually reinforcing public services such as water and energy; if they pay for one they may not have enough remaining income to pay for the other.

2.5. Impact of Electricity on employment

It is argued that electrification enables livelihoods in several ways. By stimulating employment and income generating activities, where people build assets such as the expansion of dairy milk production and achieve better cash flows. It is also argued that electrification enables people to use surplus resources made possible through their entrepreneurship that contribute to the emergence of credit and savings schemes based on the newly available cash. Extra electric lighting and improved water from better pumping facilities are likely to reduce women's drudgery in fetching water and create opportunities to set up other businesses.

In general, one of the underlying dilemmas of rural enterprise in developing countries is that electric machinery potentially replaces labour that is comparatively cheap and the poorly educated fail to recognise the potential uses and benefits of motive power. In this situation the inclusion of complementary services including training becomes an important element for creating change. This is reaffirmed in the study by Peters et al. (2009) who examine the impact of developing rural electricity with complementary services as opposed to just financing

hardware and civil works. Complementary services in their study refer to advocacy to take-up and use electricity. These services comprise sensitisation campaigns to raise awareness amongst households, enterprises and social institutions of both the advantages and disadvantages of electricity. With respect to commercial electricity users, complementary services can be broadened to cover business development services, consumer and micro-finance services and other infrastructure, telecommunications and transport (Kirubi et al. 2008; Brew-Hammond 2009; Mustonen 2010). Utilities could provide complementary services as is the case in Thailand. Kenya used this approach: the Kenya Power and Lighting Company (KPLC), a national utility, put 500 rural electrification schemes covering health, schools and community water in rural Kenya costing 30 million US$ (KPLC 2007). NGOs also contribute in this area. Bastakoti (2006) in a study of rural electrification in Nepal argues that complementary service systems and policy coordination are necessary preconditions for the effective use of electricity power in rural communities. One of the difficulties in assessing the impact of electrification on opportunities for income generation is to separate the effects of existing connections to electricity and the stimulus provided by new connections. The literature does not always address this issue in a direct way. One study that makes a distinction is by Prasad and Dieden (2007).They indicate that growth in income generating activities primarily resulted from businesses already connected to electricity. Prasad and Dieden used household survey data between 1995 and 2004 to examine the impact of electrification on the development of micro, small and medium sized enterprises and those in self-employment amongst households. They estimated that between 40 and 53 % of the increase in enterprise activity was attributed to the extension of the electricity grid, indicating that enterprise growth was higher amongst those already connected. However, in the more remote rural areas the take up did appear to be stronger. It increased by more than 40 % amongst nonconnected and only 10 % amongst the connected. Enterprises were mainly in the wholesale and retail sectors. The increase in cellular telephone technology was also a contributing factor to uptake.

However, the aim of targeting rural electrification towards income generating activities that will raise the demand for electricity and support cost recovery appears to be compatible with the recent shift in policy emphasis by the major International Development Institutions who favour rural electrification that impacts on poverty alleviation and reduction. The discussion on

livelihoods indicated that there were better prospects for developing Nonfarm activities in rural and remote areas than relying on agriculture, although in terms of asset building the greatest scope for developing enterprises might come from the better off in the farming community who has access to a variety of income sources. It was also apparent that the scope for generating economic activities in sparsely populated rural areas might be greatest when inward investment could migrate easily to low cost regions. Clearly, rural electrification would facilitate a response to the risks associated with this by making it easier to operate and repair various types of machinery. This was reaffirmed by Kirubi et al. (2008) conducting fieldwork in Kenya. They reported that electricity enabled the use of electric power tools and equipment which resulted in an increase in productivity of enterprises studied. These ranged from retail shops, grain mills, petrol garages, welding and carpentry businesses. Enterprises could also support the further mechanisation of agriculture as welding facilities were more readily available. An important element of this study, however, was the link to other types of infrastructural development, including business support services. This finding is in keeping with studies of other infrastructure sectors. For example, Whittington et al. (2008) in the case of the water sector shows how important are post construction support.

It is, however, difficult to draw firm conclusions from the empirical studies and project evaluation reports that have attempted to access the impact that rural electrification has had on income generating activities. There are studies that provide a more negative view of the link with electricity. For example, Wamukonya and Davis's (2001) study in Namibia reported that electrification did not have a significant impact on the growth of income-generating activities in rural areas. They found that the share of households with home-based income generating activities was highest amongst households without electricity. In their study home-based activities included basket weaving, cake making and welding. Few home-based enterprises used electricity except for lighting. All the businesses that used electricity started before electrification. The source of electricity, whether from grid or solar powered energy, did not influence the overall findings. Further, in a more narrowly focused study on the effects of lanterns for lighting, Adkins et al. (2010) examined the relation between electric lighting and income generation in Malawi. They looked at the innovative use of lanterns that use light emitting diodes (LEDs) powered by batteries and charged by grid or small solar panels. These

have emerged as a relatively cost effective alternative to kerosene and other fuel-based lighting technologies since they provide a brighter light for longer duration. They found little evidence of a clear connection with income generating activities. Lanterns were paid for in cash and not installment plans. The introduction of LED lanterns dramatically changed lighting patterns for buying households, decreased their reliance on traditional lighting sources and reduced their fuel outlays. Agoramoorthy and Hsu (2009) came to similar conclusions from their study in India. These studies do indicate that lanterns in comparison with other energy sources may still be unaffordable and possibly out of reach of the very poor. Some householders indicated that lanterns did provide opportunities to expand business opportunities by allowing more time to work at night when compared to fuel-based lighting sources. The extent of this is difficult to measure.

Simply in terms of numbers, however, there are more studies that show rural electrification can contribute to the development of income earning activities. But even in the majority of these studies it is difficult to determine that electrification alone accounted for the positive result. Mapako and Prasad (2008) in their study of Zimbabwe adopted a different approach to examining basic indicators by focusing on end user perspectives. Rural electrification took place mainly as a result of extensions to the grid. Surveying 73 enterprises in Matebeland they concluded electrification increased the number and scope of small enterprises and increased employment. Respondents to their survey did not complain about higher tariffs but were more concerned with the reliability of supply. Hiremath et al. (2009) in a more recent study show the viability in India of small scale renewable energy technologies that can be implemented locally by communities and small producers. These permitted increases in activities such as sewing and handicrafts, where sewing machines were predominantly used by women to generate income. Agricultural work could also be extended to night times.

Other studies have sought to broaden the argument of the benefits of rural electrification beyond income generation. These have included the effects on poverty reduction (Fan and Chan-Kang 2002 in China for example), the quality of education, health, and gender equality. The World Bank's study (ESMAP 2003); in the Philippines found that access to electricity was correlated with educational achievement. Better illumination from solar electricity contributed to improved

conditions for study. Access to electricity for television viewing also improves information and helps spread knowledge on health and family planning. Gustavsson (2007) shows in Zambia the educational benefits resulting from solar technology. The study did not suggest that school children's marks improved (this could not be measured) but more time was spent reading and studying. Health benefits were also likely to occur through less eye strain. Obviously, the benefits for income generation through strengthening education are more likely to be revealed in the longer term. Kanagawa and Nakata (2008), using multiple regression analysis show that literacy rates above 6 years are explained by household electrification. Finally, Howells et al. (2005) examine the effects on the quality of life in rural Africa as a result of energy use. They argue that the benefit of electrification in reducing local pollution (cleaner energy) and allowing for special high value added services helps explain why the South African Government and Eskom (the public electricity utility) have engaged in electrification programmes for poor areas and support a subsidy for an initial volume of electricity for poorer consumers.

2.6. The Impact on Access and Affordability of Electricity

According to the World Development Indicators (2007) access to electricity is lowest in low income countries and, as a percentage of population, is lower than access to other infrastructure services such as telecommunications, water and sanitation. Whilst access to electricity is undoubtedly the major problem facing electricity reform programmes in developing countries, much progress at an individual country level has been achieved. In recent years, for example, electrification levels have more than doubled in South Africa from 34 to 70 % between 1994 and 2001 and from 20 to 42 % in Zimbabwe between 1980 and 2001 (Davidson and Mwakasonda 2004). In these countries off-grid electricity programmes were used to reach the poor, particularly for lighting. Questions have been raised concerning whether or not this use of electricity is the highest priority for the poorest communities (Davidson and Sokona 2002). It has been argued that designing energy reform programmes for the poor ought to address household cooking and water heating needs over lighting. This would reduce the heavy dependence on traditional fuels such as wood, dung, candles and kerosene that are predominantly used by the poor (Louw et al. 2008); although even here the value to lighting cannot be under estimated, in terms of providing opportunities for the poor to raise their capabilities through the extra hours of

studying that can be undertaken and the additional illuminated time it provides to engage in simple income earning activities.

Even where electricity is made available to a poor community the take up has been affected by a wide range of factors. Various models have indicated that the demand for electricity is income inelastic, as households view electricity as a basic good. This assumption is implicit in most individual country's electricity planning, for example in South Africa, and in the energy policies of international development agencies such as the World Bank. It is also apparent that cross price elasticities of substitute energy services are inelastic and that various fuels are substitutes for each other. However, it has not always been the case that the poor have switched to more sophisticated forms of energy when these have become available (Howells et al. 2010). In practice, most households continue to use a combination of fuels at any one time, some of which may be advanced and others more traditional. In any event, household fuel choices are likely to be related to the size and diversity of household incomes, and other factors such as education and distance and availability of natural resources come into play (Heltberg 2004). The cost and availability of electric appliances, such as cooking stoves, has often been a prohibiting factor in the take up of electricity. If appliance costs were to be subsidized then indications are that the demand for electricity take up and use would increase amongst the poor. However, whether or not the cost for this is borne by cross subsidisation by higher income and higher consumption households has to be carefully considered as price sensitivity amongst higher income groups could lead them to switch to other fuels, with a consequent fall in the demand for electricity.

The experience from projects has shown that where electricity becomes available the take up is variable. Sometimes it takes between 1 and 3 years for households to start using electricity, and there are still high percentages that do not connect. So a distinction can be made regarding the type of policy that ought to be used to improve connection where electricity has arrived, and towards expanding electricity to areas where it does not presently exist. The World Bank report that the emphasis is on the latter in Indonesia. This situation exists, despite the fact that once a community is electrified, the marginal cost of electrifying additional households is low. Marginal costs fall as more households become connected. It is therefore argued that if tariff levels are sufficient to cover operating and maintenance costs then little is lost by providing connections.

However, in terms of affordability it may mean looking more critically at discriminatory tariffs to capture the poor that go beyond the cross subsidisation of commercial and noncommercial users (as in Cambodia) and rural and urban users. The World Bank confirms that in their experience connection rates are low for the poor even when electricity becomes available. This has mainly been attributed to the relatively high cost of connection. They cite the example of Laos, where 30 % of the population cannot afford the $100 connection charge. They also reiterate that even though off-grid schemes can be delivered to a community at lower cost than an electric grid can be extended to an area, it is sometimes still the case that the price of off-grid electricity is higher than to those households that are buying electricity from a grid elsewhere. It is obvious that cost continues to be a barrier to accessing off-grid electricity for poorer households. But even for the better off, costs can be formidable in many countries in Africa. For example, for a solar heating scheme in Namibia a household needs $2,500 per year. The World Bank in their projects has also looked at the issue of late connectors, as in Laos, but has largely attempted to deal with the issue through loans rather than subsidies. These are being tried in Ethiopia and Thailand. It is apparent that the use of subsidies are more common in relation to off-grid projects, particularly to meet the upfront equipment installation costs, since operating costs are negligible in the case of solar energy and these systems only require limited maintenance. This circumstance may represent a problem for low skilled poor communities and may correspondingly provide opportunities for unscrupulous businesses to exploit the situation by introducing high dealer and maintenance costs.

In general the World Bank favours the use of partial subsidies schemes that retain an incentive element. They also prefer the use of extended credit and possible micro credit institutions but these do not exist in all areas. Community based schemes assist in getting people together to pay and work (for example in Kenya) but may be more difficult to organise in the more remote areas of a country. It is likely that subsidies have gone to the better off and there is some evidence that the poor pay more per kilowatt hour for electricity than higher level consumers (Angel-Urdinola and Wodon 2007). These circumstances can be attributed to design flaws in tariffs. Tariffs are often skewed against the poor because they represent a higher risk category i.e. they have a greater tendency to default and have to be disconnected at a cost. These categories of the poor

are also more likely to tap into or grab electricity illegally. Part of the problem here is tariffs are not always made clear to the poor, whose education may be low, and they have not previously been used to paying regular bills. It has also been argued that subsidies for electricity, especially where a free element is provided, can have distorting effects through encouraging poor households to cook with electricity rather than using potentially cheaper alternatives such as liquefied petroleum gas (Howells et al. 2006).

A useful study on many of the issues discussed so far is provided by Prasad (2008), who compares the impact of energy reform in Botswana, Ghana, Senegal and Honduras. Prasad gives two examples of successful energy reform to increase access and affordability. In Botswana the electricity that was delivered resulted in a method of payment adjustment to make it affordable to the poor. This led to a fivefold rise in rural connections between 1996 and 2003. In the most recent phase of reform potential customers formed groups of 4 or more to share the cost of extending the grid to their premises. A 5 % payment was required before connection work began. The balance of 95 % was provided by a loan from the Botswana Power Corporation (BPC), paid with interest spread over 18, 60 and 180 months according to customer preferences. Full cost recovery was insisted on to sustain the reform programme. The government paid for the grid extension. It was reckoned that 80 % of the beneficiaries would not be connected without the scheme. Groupings also increased affordability. Low income households could afford loans because BPC did not require income guarantees and security. Sometimes lower interest rates than commercial loans were applied. However, low income households on irregular incomes continued to encounter affordability problems. In Senegal households got subsidies for butane gas for cooking. The scheme also subsidised small stoves and gas cylinders. This led to a reduction in the use of charcoal and wood and helped with deforestation. The exit of the subsidy did depress growth in demand. 85 % of Senegalese households across all income ranges tend to use gas for cooking compared to 23 % of the lowest income group in Botswana. Motives for reform did vary between the two countries and there has been some deforestation in Senegal. In Botswana poverty alleviation and deforestation was secondary. In both countries the poorest of the poor remained excluded despite government intentions. The poorer were also the first to revert to wood when the subsidy was reduced to 20 % in Senegal.

Typically subsidies for rural electrification tariffs are based on estimates of household spending for lighting and light electricity use. This was the case in Argentina (Covarrubias and Reiche 2000). In the absence of willingness to pay analysis, household expenditure on kerosene, bottled gas and dry batteries was used as an indicator of the upper limit of electricity tariffs and affordability. This determined the baseline cost the rural poor could pay. If the actual cost of electricity provision was higher, then the difference ought to be subsidised. But surveys show that willingness to pay, even if estimated in this way, can be lower than a household's capacity to pay. In practice households generally want to pay less than they previously paid for kerosene when switching to electricity or any other new energy source. Obviously, there are advantages which they may not recognize such as convenience of use and less pollution in the household. Problems remain in relation to the knowledge poor communities have over the benefits of electricity and in convincing them that these will eventually contribute to improving welfare. The poor may continue to be reluctant to adopt newer processes when they perceive meeting regular monthly payments will be difficult, since their income flows vary in time and are often seasonal.

2.7. Impact on Income Distribution

According to paul cook (2011), there is a group of studies that analyse the distributional impact of infrastructure reform. Amongst them are Adam and Bevan (2004), Bricefio-Garmendia and Klytchnikova (2006) and Boccanfso et al. (2009). Bricefio-Garmendia and Klytchnikova use household data to show that the access gaps for infrastructure between the poorest and richest 20 % in various countries are systematically strongest in poorer countries. Again according to Bricefio-Garmendia and Klytchnikova (2006), access to electricity is 9.7 % for the poorest 20 % of the population compared to 68.7 % for the richest 20 %. Access for middle income countries was higher in both extremes of the income spectrum, reaching 80 % amongst the poorest 20 % of the population and almost 100 % for the highest income category. It is apparent, however, that access rates for the poor are much higher for water and sanitation than for electricity, although they are low for telephones. Presumably this results from the greater priority given to water and sanitation over energy and telecommunications because they are identified more clearly as universal basic needs and also have significant health and public health implications. Balisacan et al. (2002a, b), using data from the Philippines 1985–1997, argue that the rich benefit more

than poorer segments of the population from access to electricity. Balisacan et al. (2002a, b) in examining Indonesia in 1990 showed that a 10 % improvement in access to electricity raised income to the poor by only 2 %.

Access to electricity will affect market production and the demand and supply for labour and may lead to a change in the nature of enterprises that can operate in these rural areas. According to Dinkelman (2009) there is a net labour supply effect in South Africa as labour is freed up with the arrival of electricity. The effect on women is greatest. The female employment response is driven by the middle poor and second -richest communities that initially rely on wood for cooking and are able to respond more when new electricity services become available. The effects are larger for women in their 30 and 40 s and there is evidence to suggest that this is related to women having fewer child-care responsibilities at these ages. Dinkelman also looks at the potential spillover effects from electrification. If firms create jobs for people living in neighbouring areas, then there are said to be positive spillover effects. If, however, people move out of a non-electrified area towards an electrified area to get a job, then there is a negative spillover. Dinkelman suggests there are no strong spillover effects between communities.

Electrification was driven by household targets and capacity was too small to stimulate even mid-sized enterprises or services. The lack of evidence for spillovers, therefore, supports the claim that electrification increased employment primarily through a labour supply rather than a labour demand channel. Why might middle-quintiles in particular have larger employment effects? It appears these communities contain households that experienced the largest changes in home production technology when electricity arrived. Middle poor areas are initially less likely to be using electricity than richer areas and are anyway more reliant on wood for cooking. Women who have additional home-production responsibilities are less likely to be able to respond to the new access to electricity, even though their productivity at home may be substantially enhanced by the use of electricity i.e. child care.

2.8. Overview of the Electricity sector in Rwanda

The Ministry of Infrastructure (MININFRA) has the primary responsibility for setting the overall policy and strategy of the energy sector, and for coordinating the developments of the electricity sub-sector. The electricity supply industry is currently dominated by the Energy, Water and Sanitation Authority (EWSA) in a vertically integrated structure carrying out generation, transmission, distribution and supply. It is important to note that the System Operator (SO) functions reside also inside the EWSA.

The Government of Rwanda has embarked on an electricity market reform process to allow the private sector to play a much bigger role in the electricity industry. The Law N°21/2011 of 23/06/2011 governing Electricity in Rwanda (Electricity Law) provides an insight into what the future electricity market structure will look like. The following electricity licenses to be issued by the Regulator stem from the Electricity Law and the Electricity Licensing Regulations:

Electricity Production, electricity transmission, electricity distribution, electricity domestic trade and electricity international trade (Import and Export). (http://www.rura.rw/energy-water-sanitation/energy/electricity/)

2.8.1. Electricity transmission network in Rwanda and the role of RURA

Electricity transmission is facilitated through high voltage cables with 110kV and 70 kV. The current transmission network length has a length of 370 km that includes a 253 km (110kV) and a 96 km (70kV) network. The Distribution network is composed of 15 sub-stations (high and medium voltage) that include: In the north: Ntaruka, Mukungwa, Gifurwe, Rulindo. In Kigali we have Jabana, Gikondo, Gasogi, Mont Kigali. In the East there is Musha, Kabarondo, Rwinkwavu and finally there is Kigoma, Kilinda, Karongi, Kibogora, Mururu,1 and Mururu 2 in the south (REG transmission report, 09th October 2014).

The regulation of electricity is performed through three Units within RURA namely Energy Unit, Legal, Licensing and Enforcement Unit and Industry and Consumer Affairs Unit to cater for all technical, economic and legal aspects of regulation. Those aspects include but are not limited to**:** Review and advise the Government on policies relating to the electricity sub-sector, review license application in Generation, Transmission, Distribution and Supply of electricity, set and

enforce regulations and standards, monitor compliance with license terms and conditions by licensees, monitor, evaluate and ensure the quality of the technical services provided by Licensed Operators in Electricity, develop tariff methodologies and structure, and evaluate tariff applications from licensees, review power purchase agreements and network service contracts, collect and publish relevant information relating to the electricity supply industry, issue permits to electrical installations practitioners, handle potential complaints from consumers and licenses. (http://www.rura.rw/index.php?id=93).

2.8.2 Bugesera District overview

Bugesera District is located in the south Eastern plains of Rwanda notably in the south west of the Eastern Province. It borders with the Republic of Burundi (Kirundo Province) in the South, Ngoma district to the East, Kigali city and Rwamagana district to the North. The district is sandwiched between Rivers Nyabarongo and Akanyaru which converge at the southern part to form Akagera River. Bugesera district's area is characterized by numerous lakes, the biggest of which are Rweru and Cyohoha. These two plus the other small lakes in the region comprise an estimated surface area of 10,635 hectares (MINITERE/CERECE 2003). The region is predominantly vegetated by dry savannas which are characterized by short grasses, shrubs and short trees – a characteristic of arid and semi-arid areas (MINITERE/CERECE 2003).

The district covers a total surface area of 1337 Km² of which arable land is estimated at 91,930.34 ha. The average size of land cultivated per HH is 0,59ha. The district is composed of 15 Sectors, 72 Cells and 581 Villages with a total Population of 363,339 people in the following proportion: 177,404 males and 185,935 females (General population census 2012).

Its population Average Annual Growth Rate is 3.1%, with a population density of 282 people per km2. The population of Bugesera district is estimated at 13.9% of the whole Eastern Province population, and at 3.4% of the total population of Rwanda (General population census 2012) and 48.4% are below poverty line where 28.3% are poor and 20.1% are extremely poor (EICV3 report).NISR 2012.

The topography of Bugesera is characterized with a mixture of plateaus with an altitude varying between 1,100m and 1,780m and undulating hills dominated by varying heights. Most prominent of these hills are; Kabuye (1,772m the highest), Juru (1,667m), Maranyundo (1,614m), and

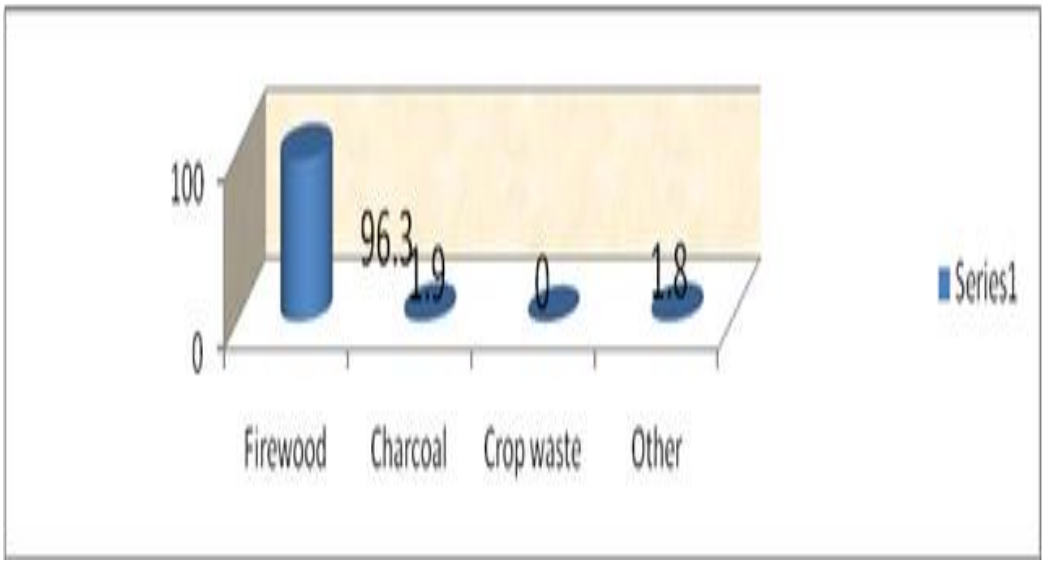
Mwendo(1,575m). The relief is also constituted by a succession of low-plateaus with hills and dry valleys. The district is equally rich in marshlands alongside rivers; they cover an estimated area of 6,100 ha and are exploited at an average of 46.3% (Community Development Plan of Bugesera district, 2006).

2.8.3 Energy sector in Bugesera

The energy sector registered great achievement in the last 5 years. However there is still a long way to go. According to the EICV3 report, 4.3% of people in the district use electricity. Thanks to rural electrification program, access to electric power has increased to 12.8% so far (EWSA report, February 2013). The rest use other alternative sources for lighting like fire wood, lantern, battery among others (EICV3).

As for cooking, 96.3% of people in Bugesera use bio mass, 1.9% use charcoal and 1.8% use other sources including biogas and solar energy among others.

Figure 1 showing the different forms of energy used for cooking



Source: DDP 2013-14

2.9. Level of Non-farm activities in Bugesera District

In recent past, there has been provision of theoretical education that does not match with the demands of the labour market. As a result, there is a shortage of skilled personnel on one hand, and wide spread unemployment of the educated on the other hand. This means there is a mismatch between the nature of the education provided and the skills demanded on the labour market.

Bugesera District has a challenge of a big number of youths who are unemployed due to lack of practical skills, despite different opportunities arising to cater for their needs. This makes them dependent on their families and the Government for their survival yet they are energetic and expected to be more productive and innovative (Bugesera DDP 2013-14).

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

According to Saunders, Thornhill and Lewis (2007), research is the process of studying in order to discover something. The research process must include the relevant facts, go beyond superficial impressions and endure long enough to get a reasonably complete picture of a given situation. Leedy (1993) says that research methodology is the approach by which the meaning of data is extracted and is a continuous process. Research methodology gives the direction to follow to get answers to issues that are of concern.

In order to conduct a research the starting point is first to decide on a suitable perspective and then select appropriate methods of collecting relevant theoretical and empirical information on the concerned issue (Leedy, 1993).

This chapter describes the methods that were used in the study. It explains the research design, the study population, sampling method and procedures, data collection procedures and instruments, data analysis, reporting and ethical issues.

3.2. Site Description

Bugesera district covers a total surface area of 1337 Km^2 of which arable land is estimated at 91,930.34 ha. The average size of land cultivated per HH is 0,59ha. The district is composed of 15 Sectors, 72 Cells and 581 Villages with a total Population of 363,339 people in the following proportion: 177,404 males and 185,935 females (General population census 2012).

The settlement pattern in the district is determined mainly by the agricultural potential and closeness to the lake. The district is sandwiched between Rivers Nyabarongo and Akanyaru which converge at the southern part to form Akagera River. Bugesera district's area is characterized by numerous lakes, the biggest of which are Rweru and Cyohoha. These two plus the other small lakes in the region comprise an estimated surface area of 10,635 hectares (MINITERE/CERECE 2003). The region is predominantly vegetated by dry savannas which are characterized by short grasses, shrubs and short trees – a characteristic of arid and semi-arid areas (MINITERE/CERECE 2003

The study focused on 4 trading centres of Bugesera District namely; Nyabagendwa, Kabukuba, Kanzenze and Rurenge. Nyamata town is the designated headquarter of the district and by default the major commercial hub of the district. Nyamata point town has various entrepreneurial opportunities in the service industry such as banking, health facilities, government services and institutions, small scale trade and other social amenities.

Bugesera District has seen significant infrastructural growth in the last few years. Central to this has been the improvement of the road networks and access to electrification. The town and its environs is currently connected to the national grid and this has led to the development of small-scale industries and establishment of welding units, mechanical works, information technology and other business ventures

During the study, we sampled 100 small and medium enterprises that are located within the 4 cells or trading centres selected in Bugesera District.

3.3. Research Design

This study followed a quantitative approach design with some small elements of qualitative approach. Kumar 2009, noted that the quantitative design methods renamed structured approach is more appropriate to determine the extent of a problem, issue or phenomenon; and quantitative methods allow measurement of relationship between variables under study.

Study design

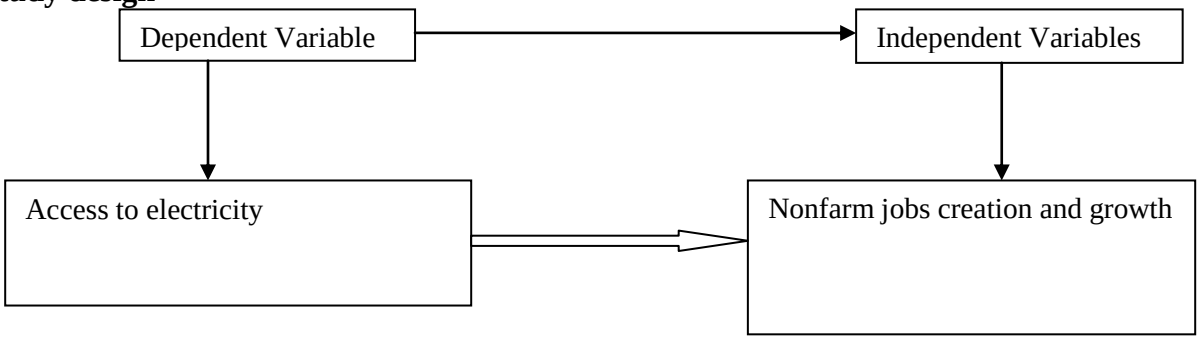


Diagram 1 showing the study design

The dependent variable is access to electricity while the independent variable is non-farm jobs creation which further contributes to the development of individuals and further increased level of income.

According to Cooper and Schindler (2003) a descriptive study is concerned with finding out the what, where and how of a phenomenon. This study therefore enabled the generalizing of the findings from electrification program on non-farm jobs and the effect it had on their growth. The main focus of this study was quantitative in nature. However some qualitative approach was used in order to gain a better understanding and possibly enable a better and more insightful interpretation of the results from the quantitative study.

3.3.1. Type of Data

This study sought for information relating to the present and historical performance status of the non-farm jobs in Bugesera. Specifically, the research aimed to establish the employment history, the history of product value addition by non-farm job establishments, history of efficiency of service delivery, profit history, product upgrading history, forward and backward linkages by non-farm businesses, growth in cottage industry, and market reach by the non-farm activities.

3.3.2. Data Collection Instruments

According to Yin (2003), depending on the nature of the information to be gathered, different tools are used to conduct the assessment. The various data collection tools include questionnaires, interview schedules and data collection forms. Yin (2003) continues by stating that all the tools have their advantages and disadvantages, there is no single tool considered more superior than the others. A good case study should use as many tools as possible.

A questionnaire is a written list of questions given to respondents, who fill it in themselves. Interview schedule refers to a series of questions that are personally addressed to individual informants. Data collection forms are used to collect data that is either being observed or summarized from secondary sources of data.

In this study, both Primary and Secondary data was collected. The data collection instrument used was a questionnaire. The items in the questionnaire were structured (closed ended) and unstructured (open ended) developed by the researcher. The structured questions measured the subjective responses to clarify the objective responses and at the same time, enhanced formulation of recommendations of the study. Multiple-choice closed ended questions were

suitable for this study because of their efficiency. In addition they were easier to measure, record, code and analyze and they were economical to use in terms of time and money.

3.3.3. Data Collection Methods

The data was collected through administration of questionnaires to the respondents by researcher and the research assistants. The research assistants had prior training on the data collection exercise by the researcher. Alongside the questionnaire, direct observation was employed during data collection in this study.

3.4. Sampling

Sampling is defined as a systematic process of selecting a number of individuals for a study to represent the larger group from which they are selected (Gay, 1987). Chandran (2004) pursues this and says that, a sample method is a way of selecting a portion of population such that the selected portion represents the population adequately. Wimmer and Dominic (1997) state that, the sample size depends on the project type, project purpose, project complexity, amount of error willing to be tolerated, time constraints, financial constraints and previous research in the area.

A sample is part of population under study. It is scientifically known that, a well-designed sample provides equal result as if the whole population has been involved. To be more specific, it is worth noting that the target population of this study is the household located in rural areas of Bugesra that have newly accessed electricity in their homes and/or in the trading center in a period of less than five years back. The current data provided by the Institutes in charge of electricity indicate that only 16% of households have access to electricity including households in urban areas. Separating rural and urban areas, we can say that the average of households accessing electricity drastically reduces.

Due to budget constraints, I **sampled 100** households in Bugesera. This number was a random figure which I expected to be statistically large to help me reach the research questions, solve research questions, verify hypothesis on nonfarm jobs and draw a conclusion to all population. The selection of households to be included in sample of in this study, there was of two stage processes:

First stage: A selection of the sites which accessed the electricity in recent years, Electricity, Water and Sanitation Authority (EWSA/EARP) provided a list of areas that accessed the electricity in four years back and from that List; I applied a random sample to choose sites to be visited. By the rule of thumb a sample of 4 sites were chosen in the whole District.

Second Stage: Consisted of selecting the respondents in a site; here the process pursued simple random route techniques in the area where electricity has been availed in recent years.

In this study, the population entailed a survey of all non-farm business establishments operated within the 4 trading centers of Bugesera District. The researcher sought to do a survey of 100 households. This sample is statistically large to offer valid and reliable information.

3.5. Units of Analysis and Observation

According to Mugenda and Mugenda (2003) units of analysis are units that are designed for purposes of aggregating their characteristics in order to describe some larger group or abstract phenomenon. Nachmias and Nachmias (1996) describe the units of analysis as the most elementary part of the phenomenon to be studied. To Singleton et.al (1988) they are "what or whom to be analyzed". In this study, the unit of analysis was the farm and non-farm business enterprises while the unit of observation was owner of business within the selected trading centers.

3.6. Data Analysis and Presentation

Data are the build-brocks to be critically taken into consideration for the realization of the research, and I went to the field to collect the data using the structured designed questionnaires see annexed) and mapping the characteristics of visited areas. After the collection of the data, there was a period for data cleaning, data entry into the software and analysis. Data were analyzed using the Statistical Package for Social Sciences (SPSS) software.

Descriptive statistics

To properly understand the patterns of the data, we have performed descriptive analysis of different variables and socio-demographic status of the respondents. Similarly, we performed

cross tabulation analysis by looking at the dependence of households' characteristics to access to electricity.

Regression analysis

To critically analyze the contribution of access to electricity explaining, we also performed linear regression analysis. The dependent variable was number of nonfarm jobs created while the dependent variables were age of head of households, number of Years residing in the area, the size of households, cost of electricity, and households income, and Marital status.

In summary, the regression model is presented as follow

General model: $\mathbf{Y_h = b_0 + {}_{b1}AGE_h + {}_{b2}NYEARS_h + {}_{b3}SIZE_h + {}_{b4}HHINCOME + {}_{b5}GENDER_h + {}_{b6}EDC_h + {}_{b7}MSTATUS + b8\ CELECTRI\varepsilon}$

Whereby Y_h: Number of nonfarm jobs created by a household, AGE: Age of the respondent SIZE: size of a household (number of people living in a household); NYEARS: Number of years a respondent lived in his/her place, HHINCOME: Households' income; GENDER: Sex of the respondent; EDC: Education level of the respondent; MSTATUS: Marital status, CELECTRI: Cost of electricity per a household; **b(i)**: coefficient of regression; ε: indicates the disturbances.

In data display the data was displayed in an organized form and the data had to be put into an order to easily draw the conclusion. Tables and graphs were used to indicate distinct frequencies of various factors.

3.7. Validity and Reliability

According to Yin (2003), it is possible for researchers to judge the quality of any given design by certain logical test. There are two common tests that have been used very commonly to examine the quality of any social research which are construct validity, and reliability (Yin 2003). Saunders and Lewis (2007) state that validity concern with whether the findings are really about what they appear to be about. The researcher decides to use more than one source to obtain data such as interviews, documentations, and websites. Concerning the main data collection method which was questionnaires, the researcher came up with a few measures to increase the validity of the study. First of all, the selection of informants was handled very carefully. Mostly, people

who had been actively involved in the operational activities were questioned.

Reliability deals with if a later investigation follows the same procedures of earlier studies, the later study should reach the same findings and conclusion (Yin, 2003). The researcher increased reliability of this study by letting the respondents to choose the most suitable time for them to be questioned. Open-ended questions were used in order to let the respondent express themselves in their own words.

3.8. Ethical Issues

Ethical consideration

The study was conducted following the ethical principles of research. Name and identity of individuals were concealed or changed where necessary to conceal their identity and to ensure confidentiality of responses, the participants were guaranteed that the identifying information would not be made available to anyone who was not involved in the study and it would remain confidential for the purposes it was intended for.

Permission: The researcher sought permission to carry out the research from the respective Cells where the research was carried out.

Informed consent: The prospective research participants were fully informed about the procedures involved in the research and were kindly asked to give their consent to participate.

Anonymity: Some participants remained anonymous throughout the study and even to the researchers themselves to guarantee privacy.

CHAPTER FOUR: FINDINGS AND DISCUSSION

4.1. Introduction

The main objective of the study was to assess the impact of rural access to electricity on non-farm job creation in Bugesera District. This chapter presents the results and discussions of the findings collected in the four study areas of the District. The chapter starts with the overview of the study area, demographic characteristics, individual variables and finally the interpretations of the findings.

4.2. Socio-Economic characteristics of households

This research was conducted in one of the districts of Rwanda "Bugesera" located in the eastern province. It has 15 sectors and 72 cells, but we randomly selected 4 cells: Kabukuba, Nyabagendwa, Kanzenze and Rurenge. In each cell 25 households were systematically selected. We found that among the households that report to have farm jobs, 36%, 27%, 18% & 18% respectively were in kabukuba, Rurenge, Kanzenze & Nyabagendwa respectively. This would predict that Kabukuba cell has a higher number of households involved in farm jobs. Nonetheless, we found that among households reported to have nonfarm jobs, 25%, 26%, 25%, & 24% of those were respectively in Nyabagendwa, Kanzenze, Rurenge & Kabukuba Cell.

The majority of respondents were males with 60% of our sample. Among households reported to have farm jobs, majority of those are headed by females 64%, whereas among households that reported nonfarm jobs, majority are headed by males 63%. This shows that in most instances the majority of our respondents 48% were married and 40% were still single, these results predict that married people are more likely to get involved in productive activities than singles.

Majority of the respondents (86%) have been to school, 33%, 28%, 16%, and 9%, have respectively an education level of primary, secondary, TVET, & university. This implies that the responses can be given a good degree of credibility due to the fact that most people who have gone to school keep their business records in writing.

4.3. Access to electricity and rural livelihoods

4.3.1. Access to electricity in rural electrified areas/zone

Among households that reported to have electricity, majority of them were connected in 2013 (53%). Electrified households depending mainly on farm jobs were connected in 2013 (50%), the same applies to households depending on nonfarm jobs (53%). Majority of the respondents 89% said that all rooms of their houses are installed with electricity, this means that their children can easily do evening revision without any disturbances, hence rising grades in school. Some responded that light availability helps them to easily organise and sort out products to take to the markets the next day without any vision hindrances. Majority of the households 86% reported to have security lights outside their houses. This clearly shows how much electricity instills a sense of security in any kind of community or socio setting.

4.2.2. Use of electricity in rural electrified areas/zone

Table 1: Use of electricity in rural areas

Indicator		Farm Jobs	Non-Farm Jobs	Total
Electricity as the primary source of energy for household lightening	Yes	36.4%	100.0%	93.0%
	No	63.6%		7.0%
	Total	100.0%	100.0%	100.0%
Is electricity the primary source of energy for cooking in your households?	Yes		13.5%	12.0%
	No	100.0%	86.5%	88.0%
	Total	100.0%	100.0%	100.0%

Source: Survey data analysed by researcher

The majority reported electricity as the primary source of lighting in their households (93%). However, the majority of households whose main activity is farm jobs reported that electricity is not the main source of lighting (64%), whereas all households whose main activity is nonfarm jobs reported that their source of lighting is electricity (100%). All households whose main activity is farm jobs reported that electricity is not their primary source of cooking, whereas only 14% of households depending mainly on nonfarm jobs use electricity as their main source for

cooking. This clearly shows that however much electricity has become an important component in the lives of all households, using it for cooking is still costly.

4.2.3. Electricity and Job Creation

Table 2: Electrification impact on job creation

Indicator		Farm Jobs	Non-Farm Jobs	Total
If a household established any income generating activities after getting access to electricity.	Established	36.4%	50.6%	49.0%
	Not established	63.6%		7.0%
	I had a business before		49.4%	44.0%
	Total	100.0%	100.0%	100.0%
Major types of the business created	Self owned enterprise	100.0%	95.5%	95.7%
	Cooperative enterprise		4.5%	4.3%
	Total	100.0%	100.0%	100.0%
Main sources of funding	Personal accumulated savings		68.5%	65.6%
	Bank/microfinance/SACCO loans	100.0%	16.9%	20.4%
	Borrowing from friend		5.6%	5.4%
	Sales of agriculture production		4.5%	4.3%
	Sales of some livestock		4.5%	4.3%
	Total	100.0%	100.0%	100.0%

Source: survey data analysed

The majority of respondents claim to have setup an income generating activity as a result of access to electricity (49%). 36% of households mainly depending on farm jobs claim to have set up income generating activities due to access to electricity. This however would predict that even though these households are mainly depending on farm jobs, access to electricity has led them to new jobs creation that are likely to be nonfarm jobs because they are already mainly depending on nonfarm jobs. On the other side, the majority of household mainly depending on nonfarm jobs claimed to have set up income generating activities as a result of access to electricity (51%). This tells us that, households depending on nonfarm jobs were able to expand their activities due to access to electricity. On both sides "households depending on farm jobs & those on nonfarm jobs" we found that access to electricity has helped to set up income generating activities. All in

all, the results show that access to electricity could be the main tool towards job creation in rural areas.

Among the respondents that claim to have created jobs after accessing electricity, 96% claim to be running self owned enterprises and most of them (65%) say that their main source of funding was personal accumulated savings. This implies that at the moment, strong credit and loan schemes are needed to compliment the impact of the electrification program among the rural households of Bugesera.

4.2.4. Impact of electricity on non-farm jobs

Table 3: Impact of access to electricity on non-farm jobs

indicator		Farm Jobs	Non-Farm Jobs	Total
Business performance after access to electricity	Yes	0%	93.3%	83.0%
	No	100.0%	6.7%	17.0%
	Total	100.0%	100.0%	100.0%
Increase in business productivity after access to electricity	Yes	36.4%	96.6%	90.0%
	No	63.6%	3.4%	3.0%
	Total	100.0%	100.0%	100.0%
Business expansion after access to electricity	Yes	100.0%	56.2%	58.1%
	No		43.8%	41.9%
	Total	100.0%	100.0%	100.0%
Level of importance of electricity in business's productivity	Not important	63.6%	4.5%	11.0%
	Important		36.0%	32.0%
	Very important	36.4%	59.6%	57.0%
	Total	100.0%	100.0%	100.0%
Increase in number of employees after access to electricity.	Yes	36.4%	36.0%	36.0%
	No	63.6%	64.0%	64.0%
	Total	100.0%	100.0%	100.0%

Source: Survey data analysed

The majority of households claim that access to electricity has led to increment in working hours (83%). 90% claim that access to electricity has led to increment in productivity in their businesses, 58% reported that access to electricity resulted to expansion of the businesses, 57%

and 32% reported that access to electricity is very important and important respectively to positively improve a business's productivity. On both sides, whether households depending on farm jobs and those depending on nonfarm jobs that are connected to electricity, 36% reported to have increased the number of employees in their business establishments.

This section "access to electricity and rural livelihoods" shows that access to electricity provides the main source of lighting in households, it provides opportunities to set up new income generating opportunities, increases working hours, increases the number of employees that leads to business productivity hence leading to business expansion. Therefore, households rate access to electricity as highly important to increase business productivity. This section also shows that access to electricity has a positive impact on socioeconomic conditions and leads to better sustainable rural livelihoods. Thus our first question and first hypothesis was verified.

4.3. The determinants of nonfarm jobs creation in rural areas

4.3.1. Descriptive analysis

The table below provides descriptive statistics for all variables we used in our regression model to investigate factors contributing to rural nonfarm jobs creation. In this table, the households depending mainly on nonfarm jobs represent the majority of our sample (89%). The mean age of the head of household is 28 years, the residence in the area shows that the mean years of households residing in the selected cell is about 8 years, the household size shows an average of 4 people per household, the asset purchase level is low among sampled households (0.23), the improvement due to electricity is higher among selected households (0.72).

Table 4: Descriptive analysis of key variables

Variables	Mean	Median	Variance	Minimum	Maximum
Sex	1.3684	1	0.235	1	2
Age	28.2737	27	48.541	19	43
Marital Status	1.7053	2	0.636	1	4
Number of person living in a household	3.7789	3	8.919	0	12
When Established Residence	2007.916	2009	20.631	1995	2014
Education	2.2947	2	1.678	1	5
Amount paid monthly on electricity	7648.352	4000	1.0E+08	0	45000

Monthly income from different sources before electrification	35549.35	99	2.82E+09	0	200000
Number of employees	1.6	1	2.86	0	5

Source: Survey data analyzed

4.3.2. Correlation

The correlation matrix below shows how the dependent variable in our model is correlated with all independent variables we set to explain changes in nonfarm job creation. The table also shows how all variables induced in our model are correlated to each other. Therefore we found that variables: age of the head of household, number of years in the area, the size of household, number of years with electricity, electricity cuts per month, asset purchase level, use of electricity per day & expenditure before electrification are positively correlated with nonfarm job creation. Whereas, cost of electricity per month, electricity to be back & improvement due to electricity are negatively correlated with nonfarm job creation. The table also shows that only two variables: the size of household & expenditures before electricity access have a weak correlation with nonfarm job creation whereas other variables have very weak correlation with nonfarm job creation.

Table 5: Correlation and covariance

Model			Electricity cost	Age	duration	Education	income	Sex	Marital Status	HH Size
1	Correlations	Electricity cost	1.000	-.128	-.015	.184	.133	-.010	-.327	.118
		Age	-.128	1.000	.157	-.019	-.143	.349	.371	-.521
		Duration	-.015	.157	1.000	.011	.204	.291	-.126	-.318
		Education	.184	-.019	.011	1.000	.198	-.308	-.256	.155
		income	.133	-.143	.204	.198	1.000	-.227	-.323	-.125
		Sex	-.010	.349	.291	-.308	-.227	1.000	.243	-.481
		Marital Status	-.327	.371	-.126	-.256	-.323	.243	1.000	.006
		hhsize	.118	-.521	-.318	.155	-.125	-.481	.006	1.000
	Covariances	Electricity cost	2.681E-010	-6.042E-001	-8.898E-000	3.837E-016	6.960E-008	-6.902E-004	-1.291E-003	1.385E-001
		Age	-6.042E-008	.000	.001	4.906E-007	-1.318E-008	.004	-.001	-.001
		Duration	-8.898E-009	.000	.001	4.906E-007	2.389E-008	.004	-.001	-.001
		Education	3.837E-007	-7.078E-008	4.906E-007	.016	8.082E-008	-.016	-.008	.001
		income	6.960E-012	-1.318E-008	2.389E-008	8.082E-008	1.025E-011	-2.970E-007	-2.495E-007	-2.870E-008
		Sex	-6.902E-008	.004	.004	-.016	-2.970E-007	.167	.024	-.014
		Marital Status	-1.291E-006	.003	-.001	-.008	-2.495E-007	.024	.058	.000
		HH Size	1.385E-007	-.001	-.001	.001	-.014	.000	.005	

Model	Electricity cost	Age	duration	Education	income	Sex	Marital Status	HH Size
					2.870E-008			

a. Dependent Variable: Number of employees

4.3.3. Regression Result

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.614[a]	.377	.316	1.42562

a. Predictors: (Constant), Amount paid monthly on electricity, Age, When Established Residence, Education, Monthly income from different sources before electrification, Sex, Marital Status, Number of person living in a household.

Table 7: Regression results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	12.720	73.59		.173	.863			
	Sex	.958	.409	.272	2.343	.022*	-.039	.250	.204
	Age	.042	.029	.174	1.47	.145	-.121	.160	.128
	Duration of residence	-.007	.037	-.018	-.187	.853	-.066	-.021	-.016
	Marital Status	.604	.241	.280	2.50	.014*	.347	.266	.218
	HH size	-.234	.072	-.410	-3.25	.002*	-.308	-.339	-.284
	Education	-.272	.128	-.207	-2.12	.036*	-.118	-.229	-.18
	Monthly income	2.736E	.000	.086	.854	.395	.089	.094	.074
	Electricity cost	5.756E	.000	.337	3.51	.001*	.447	.362	.307

a. Dependent Variable: Number of off farm jobs created

Note: * Values are significant at 5%

Source: Survey data analysed

The table below shows variables that can significantly affect negatively the creation of nonfarm jobs: those are (i) size of households age of household with -0.410 this indicates that an increase by one member in a households reduces the probability of creating nonfarm jobs after access to electricity by 41%; ii) education level: surprisingly, we were expecting to identify positive effects of education on nonfarm job creation but, the results were reverse. This may lead to the conclusion that the highly educated people opt for employment in other sectors for salaried jobs which further reduce the likelihood for them to create nonfarm jobs. However, our hypothesis

needs further investigations which are beyond the scope of this study. On the other hand, sex (being male,) and marital status, cost of electricity per households are significantly correlated with nonfarm job creation. a) the households headed by male have more probability (95%) larger to their fellow female heading households in creating more nonfarm jobs, b) the individuals who are married showed also positive significant probability of creating nonfarm jobs in comparison to those who have another form of marital status. Importantly, households who pay more on electricity have more chance in creating more jobs. Even if the latter is not a causal indicator, it means that the more electricity is used in a household, the better that household is positioned to creating quite more number of jobs compared to households paying less electricity bill. Furthermore, we were expecting to find a significant relationship between age and nonfarm job creation but the data indicated no evidence.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

Access to electricity remains critical for the sustainable development of the Rwandan economy. The Percentage of households having access to electricity is still small and yet few of the connected households aim to make nonfarm based enterprises utilizing electricity. In this study we explored different literature talking about the relevance of electricity in household development, and the analysis at household level we conducted indicated major contribution to nonfarm job creation. In this section we provide a summary of findings, draw our conclusion and propose key policy recommendations as well further research areas that need in depth investigations.

5.2. Summary of Findings

The main objective of the study was to assess the impact of rural access to electricity on nonfarm jobs creation in Bugesera District and identifying additional drivers. The initial analysis showed that there is a wide consensus by the people of Bugesera on their acceptance and willingness to use grid power as opposed to the alternative power sources. Local entrepreneurs in the rural area were indeed clear in their decision to use national grid power and that even though the cost of maintenance was said to be high, the benefits were much greater than the costs.

The analysis shows that even though rural electrification has been a shining light in Bugesera District as a whole, men have benefited more, a fact that is proved by the statistical figures above showing that men take a lion's share of (63%) of the nonfarm jobs under my research sample.

It was also established that both farm and nonfarm jobs increased as a result of connection to the national grid thus leading to improved living standards. Since the driver of that turnaround was the efficient power source, business people felt that more efforts should be made to help people connect to the national grid line.

Another great finding was that efforts by the government to support the rural electrification programme were bearing fruit. Most non-farm jobs have since introduced new services as a

result of the value addition that was enabled by the electrification. For example local bars have bought Televisions and by doing so, this keeps some customers for longer hours hence more beer consumption leading to more profit.

From the growth rate of activities, it was also found that many youths had got engaged in economic activities that encouraged them to be self-reliant. This is simply because young people tend to be better informed about emerging opportunities within the rural economy. They were also found to be in better possession of skills and education required for modern types of nonfarm jobs. The good news is that women are also able to fully participate in economic development of their families.

Lastly, nonfarm business establishments have become more efficient and thus people do not have to access neighboring towns for services. Many cottage industries including tailoring and welding as well as saloons and workshops have sprung up due to rural access to electricity. To this end, even the services that had initially been monoplised by the major towns like Nyamata and Kigali can now be found within some trading centres of Bugesera thereby speeding up the turn-around for most activities.

5.3. Conclusions

The study came to the first conclusion that non-farm jobs had benefited from the connection of national grid and thus the non-farm job numbers had increased immensely and in addition they came up with new services in comparison to pre-rural electrification period.

Another conclusion was that non-farm business owners and operators agreed that the grid connected businesses were more efficient in their operations than the non connected non-farm businesses. They had improved quality of products, operated for longer hours and had faster processes. The reason cited that blocked others from the electrification program was the high cost of connections. The rural people have demonstrated the desire to have power sources which are reliable and easy to access. Indeed there is great potential to still connect more people to the

national grid if the government plans and in particular those of the Vision 2020 are put to effective implementation.

5.4. Recommendations

A major recommendation of the study was that the government should aggressively maintain their link with donors like World Bank who have already acknowledged through their own studies the need for massive injection of funds to support the rural electrification program. In other words, the government needs to be able to give incentives of any kind that will encourage the people to get connected.

Academic researches contain evidence-based information supported by the theoretical arguments that can inform decision making at various levels. However, the ownership of research findings by users especially decision makers sometimes seems to be a problem as the concerned institutions are not engaged during the research process. It is in this regards that I recommend higher learning institutions to promote the use of academic research findings in policy making at different levels.

Another recommendation is that Rwanda Energy Group (REG) Company should increase their maintenance services that are very necessary especially given that grid power cannot be handled by any other technical person apart from the qualified staff. Similarly, there should be more grace period for the rural people in terms of repayment period since they are not used to the urban living style where deadlines on payment attract severe action like total disconnection.

5.5. Areas of Further Research

The government needs to conduct a bigger study on the development of nonfarm jobs in all rural areas of the country as a result of electrification and compare which districts in the region are best utilizing the chance of being connected to the national grid.

There is also need to carry out a research on the role that education plays in the creation of small and medium enterprises in Rwanda.

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APPENDIX

1. Socio-Economic characteristics of households

		Farm Jobs	Non-Farm Jobs	Total
Cell	Kabukuba	36.4%	23.6%	25.0%
	Nyabagendwa	18.2%	25.8%	25.0%
	Kanzenze	18.2%	25.8%	25.0%
	Rurenge	27.3%	24.7%	25.0%
	Total	100.0%	100.0%	100.0%
Sex of head of household respondent	Male	36.4%	62.9%	60.0%
	Female	63.6%	37.1%	40.0%
	Total	100.0%	100.0%	100.0%
Marital status	Married	54.5%	47.2%	48.0%
	Single	45.5%	39.3%	40.0%
	Widow		9.0%	8.0%
	Divorced/separated		4.5%	4.0%
	Total	100.0%	100.0%	100.0%
Education level of the respondents	Primary	36.4%	32.6%	33.0%
	Secondary		31.5%	28.0%
	TVET		18.0%	16.0%
	University		10.1%	9.0%
	None	63.6%	7.9%	14.0%
	Total	100.0%	100.0%	100.0%
Primary employment-Job occupation	Cultivating in other's farm for paid work	63.6%		7.0%
	Working in paid non-farm sector		16.9%	15.0%
	Run self-owned nonfarm business		83.1%	74.0%
	Other	36.4%		4.0%
	Total	100.0%	100.0%	100.0%
Housing Tenure of the respondent	Owned	45.5%	57.3%	56.0%
	Rented	54.5%	38.2%	40.0%
	Employer provided (Free)		4.5%	4.0%
	Total	100.0%	100.0%	100.0%

2. Access to electricity in rural electrified areas/zone

		Farm Jobs	Non-Farm Jobs	Total
When did you get connected to electricity from EWSA?	2012	25.0%	24.7%	24.7%
	2013	50.0%	52.8%	52.7%
	2014	25.0%	22.5%	22.6%
	Total	100.0%	100.0%	100.0%
Are all rooms of your houses installed with electricity?	No	63.6%	4.5%	11.0%
	Yes	36.4%	95.5%	89.0%
	Total	100.0%	100.0%	100.0%
Are there security lights outside your house?	No	63.6%	7.9%	14.0%
	Yes	36.4%	92.1%	86.0%
	Total	100.0%	100.0%	100.0%
How frequent do you experience electricity cut?	Once every day		16.9%	16.1%
	Once a week		46.1%	44.1%
	Twice per week	100.0%	32.6%	35.5%
	Unpredictable		4.5%	4.3%
	Total	100.0%	100.0%	100.0%
How Long does it take electricity to be back?	Less than five minutes		5.6%	5.4%
	21 to 30 minutes		20.2%	19.4%
	31 to 60 minutes	100.0%	62.9%	64.5%
	More than an hour		11.2%	10.8%
	Total	100.0%	100.0%	100.0%

Questionnaire for field research

FIELD(Data collection)		
Interviewer's name……. Completed Date [____/____ /_____]	General Supervisor's name…….. Checked Date: [____/____ /_____]	Data…… …… Entry Date: [____/____ /_____]

INFORMED ASSENT
Hello, My name is _____. I am representing **Mr. AHUMUZA Emmanuel Keita**, a student in final year MSc Economics Program from the University of Rwanda, faculty of Economics and Management, at the College of Business and Economics (CBE). Mr.Keita is doing a research on (Rural electrification and Nonfarm Job Creation in Rwanda) as a partial requirement for the award of the Master's Degree. Please help me and answer all the questions provided as honestly as possible, to the best of your knowledge. This research is purely academic and its purpose is only to collect views concerning the above topic. All the answers that you provide will be kept confidential, only members of the survey team will have access to this information and it will only be used for this research. You can stop the interview at any time, ask me to clarify any question, or ask me to repeat something you don't understand well. Thanks in advance for your co-operation.

Section on A: IDENTIFICATION OF RESPONDENT		
1.	Province	.....
2.	District	.....
3.	Sector	.....

4.	Cell	.....
5.	Sex of respondent.	1. Male 2. female
6.	Age group of respondent (Indicate a number) ***Hint:*** *For data collector Help a respondent to compute his/her ages if she/he faces some challenges*	
7.	When did you establish residence in this area Hint: for data entry, mention only the year	
8.	Marital status	1. Married (Legally or not) 2. Single 3. Widow 4. Divorced/separated
9.	Number of persons including children living in a household	
10.	If an established household, number of children in a household	
11.	Education level	1. Primary level 2. Secondary level 3. TVET 4. University level 5. None
12.	Primary employment-Job occupation	1. Farmer in own farm 2. Cultivating in other's farm for paid work 3. Working in paid non-farm sector 4. Run self owned nonfarm business 5. Paid regular monthly salary 6. Other(Specify) …… ……..
13.	Housing Tenure of the respondent	1. Owned 2. Rented 3. Employer Provided (Subsidized) 4. Employer Provided (free) 5. Other (specify). .....

Objective one and Two: Magnitude at which rural electrification contributes to improved rural livelihood (Health, education quality improvement, households lightening), and Examine the contribution of Rural Access to electricity in inducing rural based business productivity in Rwanda.

1. **Access and use of electricity in rural electrified areas/zone:**

14.	When did you get connected to electricity from EWSA? (Indicate year of connection)	
15.	How much money did you spend/pay to get fully connected (*Indicate amount in Rwf)*?	
16.	Are all rooms of your houses installed with electricity?	1. Yes 2. No
17.	Are there security lights outside your house?	1. Yes 2. No
18.	On average how much money do you spend on electricity per month (*For researcher check some of recent invoice of electricity*)?	
19.	How frequent do you experience electricity cut?	1. Once every day 2. Once a week 3. Twice per week 4. Once per month 5. Unpredictable
20.	How Long does it take electricity to be back?	1. Less than five minutes 2. 5 minutes to 10 minutes 3. 11 minutes to 20 minutes 4. 21 to 30Minutes 5. 31 to an Hour 6. More than an hour
21.	Since the time you accessed electricity, have you purchased the following electrical materials. (*More than one response is possible*)?	1. TV SET 2. Radio 3. Computer/Lap top 4. Mobile phone 5. Iron 6. Fridge

		7. Kettle 8. Cooking machine 9. Washing machine 10. Other materials (please mention them)
22.	Is electricity the primary source of energy for lightening in your households?	1. Yes 2. No 3. NA
23.	Is electricity the primary source of energy for cooking in your households?	1. Yes 2. No 3. NA
24.	All in all from 1 to 10 scales, how much did access to electricity contribute to improvement of living conditions in this area of residence: **1 is less important** and **10 is highly important?**	
25.	Since the time you got electricity, have you been able to set up an income generating activity? Specify the activity created.	1. Yes 2. No go to **Q41** 3. I had a business before go to **Q42**
26.	If yes, what is that business?	.....
27.	Is the business registered with RDB?	1. Yes 2. No
28.	Do the business activities fall under the following category? (for researchers More than one option is possible)	1. Agro-processing (Milling machine, Juice making machine, food processing, banana processing) 2. A business shop operated at home or near the households 3. Retailing business operated in a modern market where electricity is installed 4. Welding 5. Tailoring 6. Beauty saloon 7. Cinema show 8. Charging mobile phones 9. A pub 10. Butchery 11. Agriculture mechanisation 12. Others (what).....
29.	What is the types of the business created	1. Self owned enterprise 2. Cooperative enterprises
30.	How much was the start up capital?	

31.	What was the main source of funding	1. Personal accumulated savings 2. Bank/microfinance/SACCO loans 3. Tontine 4. Borrowing from friend 5. Sales of agriculture production 6. Sales of some of livestock's 7. Sales of milk 8. Support from VUP
32.	Do you regularly borrow from financial institutions business loan?	1. Once I acquired business loan 2. Twice I acquired business loan 3. Never acquired business loan 4. Tried to acquire business loan but denied access to the loan
33.	If 1 or 2 responses options: how much did you received. (Researcher writes the figures in RWF)?	
34.	Do you currently have an outstanding business loan?	1. Yes 2. No
35.	How many male people employed in your businesses?	
36.	How many female people are employed in your business?	
37.	All in all, can you confirm that access to electricity inspired you to start business in this location?	1. Not likely 2. Somehow Likely 3. Likely 4. Very likely
38.	Does your business employ unpaid household members?	1. Yes regularly 2. Some time in peak period 3. Never use unpaid HH member
39.	If no business was started, what reasons hindered you to do so?	1. Lack of information on types of business to operate 2. Lack of business funding 3. Fear of loss 4. I started the process and I am waiting for approval of business loan 5. I am not interested in business
40.	If owned any business before access to electricity; Did you increase the working hours from your	1. Yes 2. No

	businesses?		
41.	Did business productivity increase when you accessed electricity?	1. Yes 2. No	
42.	Did you expand your business after Access to electricity?	1. Yes 2. No 3. N/A	
43.	If Yes, did you add the following items in your business as a modernization mechanism?	1. Fridge 2. TV Set to attract customers 3. Oven/Food dryer machine 4. Radio to attract customers 5. ICT products: Computers, internet, Signs 6. Others (Specify)…….	
44.	How can you rate the importance of electricity in your business's productivity?	1. Not important 2. Less important 3. Important 4. Very important	
45.	After accessing electricity, did you increase the number of employees in your business?	1. Yes 2. No	
46.	If yes how many were/ are employed in your business?	Before access	In access
47.	Over the last 5 years, have you opened bank accounts?	1. Yes 2. No	
48.	Over the last 5 years, have you made regular savings?	1. Yes 2. No	
49.	On Average, how much profit do you realise in a month period (***Researcher:*** *Ask in Rwandan francs, and help the respondent to define profit as an added value to the business after deducting all due expenses: taxes and other administrative costs*)		
50.	How many Hours do you spend in your primary business (***Hint****: Researcher, define primary business as the*		

	one generating more money to monthly income)	
51.	(How many Hours do you spend in your secondary business "***Hint****: Researcher, define primary business as the one generating little money to monthly income.)*	
52.	What should be done by the government in order to encourage people to start businesses linked with electricity Hint Researcher: One possible option is allowed)	1. Encourage young people to stop searching for Jobs 2. Teach young people in TVET 3. Promote entrepreneurship skills 4. Reward new innovations 5. Facilitate access to finance 6. Increase the quantity of electricity

2. Changes after access electricity

		Before electrification	**After Electrification**
53.	What was/is your monthly income from different sources? (Indicate amount in Rwandan francs)		
54.	Assessing spending: how much in average do you spend on the items below:		
	1. Water		
	2. Purchasing primary food "Ibiribwa by'ibanze"		
	3. Ceremony "Ubukwe, intwererano, amaturo"		
	4. Clothes for children and other people in households		
	5. Rent		
	6. Communication (airtime)		
	7. Transport		
	8. Education		
	9. Personal savings		
	10. Health "Kwivuza"		
	11. Others		
55.	Do you or any household member have a mobile telephone?	1. Yes 2. No	1. Yes 2. No
56.	Have you renovated your house?	1. Yes 2. No	1. Yes 2. No
57.	Do you have or had Willingness to relocate (Kwimuka)?	1. Unlikely 2. Likely	1. Unlikely 2. Likely

		3. Very likely 4. Didn't think about it	3. Very likely 4. Didn't think about it
58.	Have you Identified diversified business opportunities?	1. Not Available 2. Somehow Available 3. Available	1. Not Available 2. Somehow Available 3. Available
59.	Are you likely to encourage your friends to come stay in the region?	1. Unlikely 2. Likely 3. Very likely 4. Didn't think about it	1. Unlikely 2. Likely 3. Very likely 4. Didn't think about it
60.	Would you advise/had advised young people to leave this place in order to go in cities where life is easy	1. Unlikely 2. Likely 3. Very likely 4. Didn't think about it	1. Unlikely 2. Likely 3. Very likely 4. Didn't think about it