



College of Business and Economics

Stakeholders' Perception of Socio-Economic Benefits of Rural Electrification Programme in Rwanda

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BY

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Rwanda, June 30th 2017

DECLARATION

I, RUMONGE Bill Reagan, declare that this thesis is my original work and has not been presented and will not be presented to any other university for a similar or any other degree award. Where it is indebted to the work of others, due acknowledgement has been made.

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CERTIFICATION

I, the undersigned, certify that the work entitled the “**Stakeholders’ Perception of Socio-Economic Benefits of Rural Electrification Programme in Rwanda**” reported in this thesis was carried out by the candidate and has been approved for submission and recommended for the acceptance by the University of Rwanda College of Business and Economics (UR-CBE) as university supervisor.

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DEDICATION

To my dear sister Riziki Feza and my dear brother Byamungu Bertherz I miss you dearly.

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ACRONYMS

AERP	: Access to Electricity Roll Programme
CBE	: College of Business and Economics
EDCL	: Energy Development Corporation Limited
EDPRS	: Economic Development and Poverty Reduction
ESMAP	: Energy Sector Management Assistance Programme
EUCL	: Energy Utility Corporation Limited
EWSA	: Energy, Water and Sanitation Authority
GDP	: Gross Domestic Product
IEA	: International Energy Agency
KWH	: Kilowatt Hours.
KWH	: Kilowatt-hour
MDGs	: Millennium Development Goals
MINECOFIN	: Ministry of Finance Economic and Planning
MININFRA	: Ministry of Infrastructures
MW	: Megawatts
NCC	: National Control Center
NGO's	: None Government Organizations
NRACA	: National Rural Electric Co-operative Association
OECD	: Organization for Economic Co-operation and Development Organization
RE	: Rural Electrification
REG	: Rwanda Energy Group
ROR	: Republic of Rwanda
SPSS	: Statistical Package for Social Sciences
UERP	: Urgent Electricity Rehabilitation Project
UNDP	: United Nations Development Programme
UNSD	: United Nations Department of Economic and Social
UNEP	: United Environment Programme
UNESCO	: United Nations of Education, Scientific and Cultural
UNICEF	: United Nations International Children's Fund
UR	: University of Rwanda
USAID	: United State Agency for International Development
WEO	: World Energy Outlook

ABSTRACT

This topic entitled the **“Stakeholders’ Perception of Socio-Economic Benefits of Rural Electrification Programme in Rwanda”** was carrying out to: Assess the impact of rural electrification in the socio-Economic development; To raise the standards of living of rural people through the delivery of enhanced social services in health, education and income generation projects; to assess the progress of rural electrification in Rwanda; The role of the government of Rwanda in promoting rural electrification; To suggest measures for further improvement in rural electrification programme in Rwanda which will help reverse rural to urban migration. The researcher covered different areas of the country.

The data was collected through a primary and secondary research. For the primary research, the questionnaire was used to collect the data for mostly literate respondents; Secondary research, the data was collected from library and other internal sources and documents from REG. Interview was conducted with REG officials and other agencies and the illiterate respondents. To evaluate the study data was analyzed with the aid of the Statistical Package for Social Sciences (SPSS 15.0 for windows Evaluation Version). We used the sampling of 388 questionnaires have been distributed to the respondents as representative sample.

The results have shown that that, there is a relationship between rural electrification and economic benefits 87,6% of the respondents agree that more small businesses are operating because of rural electrification, 96.6 % of the respondents agree that electricity has improved communication and access to information (Telephone, TV, Radio...), 86.3 % of respondents agree that rural electrification increased service delivery, 80.2 % of the respondents agree that small and medium industries have increased, 73.8 % of the respondents agree that the family revenue has increased because of electrification, 88.6 % of the respondents agree that the value of land and buildings (business and homes) increased.

The respondents’ findings agreed that rural electrification provides social benefits (with a mean 3.67) and economic benefits (with a mean of 3.83). Based on all findings, the perception from the electrified householders revealed that a social and economic benefit exists among different groups with slight different.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study Problem

According to the International Energy Agency's (IEA) World Energy Outlook (2013), more than 1.2 billion people worldwide did not have access to electricity in 2015. Almost all of them live in developing countries (1,257,000 out of 1,258,000). The region most affected by the lack of electrification is Africa, specifically Sub-Saharan Africa. While the electrification rate in North Africa reached 99% in 2011, it was not higher than 32% in sub-Saharan countries. These figures are even more alarming when we consider the electrification rates in rural areas. The IEA reports that only 65.1 percent of rural areas in developing countries had access to electricity in 2011, while rural electrification rates of transition economies and OECD countries was 99.7 percent.

Electricity alone may not be able to create all the conditions for economic growth, but it is obviously essential for basic human needs and economic activity (IEA, 2013). In theory, access to electricity can improve socio-economic conditions in developing countries through its influence on key components of poverty, namely health, education, income and environment (Kanagawa and Nakata, 2008). Concerning rural areas, Khandker, Barnes, and Samad (2009) claim that lack of access to energy and more precisely to electricity is one of the major impediments to economic development. Chaurey, Ranganathan and Mohanty (2004) argue that a strong correlation exists between rural poverty and access to electricity because electricity is a pre-requisite for productive activities. In addition to improving productivity by giving access to more efficient means of production, access to an electrical grid and better electricity services could also lead to household time savings and allow them to work more hours by increasing their access to markets (Bernard and Torero, 2011). Rural electrification programs seem to be crucial to improve living conditions and promote development; however, there is also a need for evaluation of such programs' impacts to determine whether or not interventions are relevant and cost effective.

According to Davis, only weak evidence indeed suggests that electrification accelerated the energy transition. The more recent paper of Madubansi and Shackleton (2006) gives a detailed analysis of changes in energy consumption patterns. Using data related to five rural villages in 1991 and 2002, the authors find that “electricity is simply viewed as an additional energy, rather than an alternative.” If electricity use increased for lighting and powering entertainment appliances, fuel remained the main energy source for thermal needs, with an increase in the number of fuel types used per household. Dinkelman (2011) uses panel data and two identification strategies, namely the instrumental variables strategy and fixed effects approach. Her main findings include a positive effect of electrification on female employment. She details that new infrastructure seems to increase hours of work for both men and women. If women are released from home production, their wages tend to decrease while men appear to earn more money. Again concerning South Africa, Spalding-Fecher and Matibe (2003) aim to estimate the externalities of electrification. They study air pollution impacts on human health, damages from greenhouse gas emissions, and the avoided health costs from electrification. The total external cost of electricity generation amounts to 40 percent of industrial tariffs and 20 percent of residential tariffs. These estimates lead to qualified results of electrification in South Africa. While it seems that electricity access significantly improved rural households’ conditions and promoted economic activities, cleaner electricity production in the country appears to be needed.

Other countries are also studied within the literature. For instance, Khandker, Barnes and Samad (2009) and Khandker et al. (2009) analyze the welfare impacts of rural electrification and provide evidence from Bangladesh and Vietnam. Concerning Bangladesh, the authors mention the 1975 “Total Electrification Programme,” a first initiative to ensure access to electricity in rural areas of the country. In 1977, the government established the Rural Electrification Board (REB), which aimed to support rural electrification. Khandker, Barnes and Samad (2009) use a survey that was conducted in 2004 by REB and various econometric models to estimate a valid counterfactual. They explain the difficulty to find a “counterfactual”; it may be hard to estimate “what would have happened to the households with electricity if they did not have electricity” (Khandker, Barnes and Samad, 2009).

Noting that randomization can be difficult to implement, they use two different methods to assess the impacts of rural electrification. The first technique is the

propensity score matching (PSM). The authors find that rural electrification has a significant impact on income, expenditures, and education. The second technique is the use of instrumental variables (IV) to correct for biases due to unobservable and endogeneity, which PSM does not correct for; examples include the degree of people's motivation and dynamism. Most of the findings remain unchanged but the magnitude of the impact differs.

The economic development and Poverty Reduction Strategy (EDPRS Sept 2007) defines Government policy targets for the electricity sector. This poverty reduction strategy is aimed at boosting economic development and reducing poverty in the country as opposed to the first strategy (2002-2005) which emphasized the development of social institutions as a method of poverty reduction. One of the main objectives of EDPRS is to provide a reliable and affordable source of electricity supply in the country as a means to boost economic development. The following table shows electricity access by region in 2015.

Table1.1 Electricity access in 2015-Regional aggregates

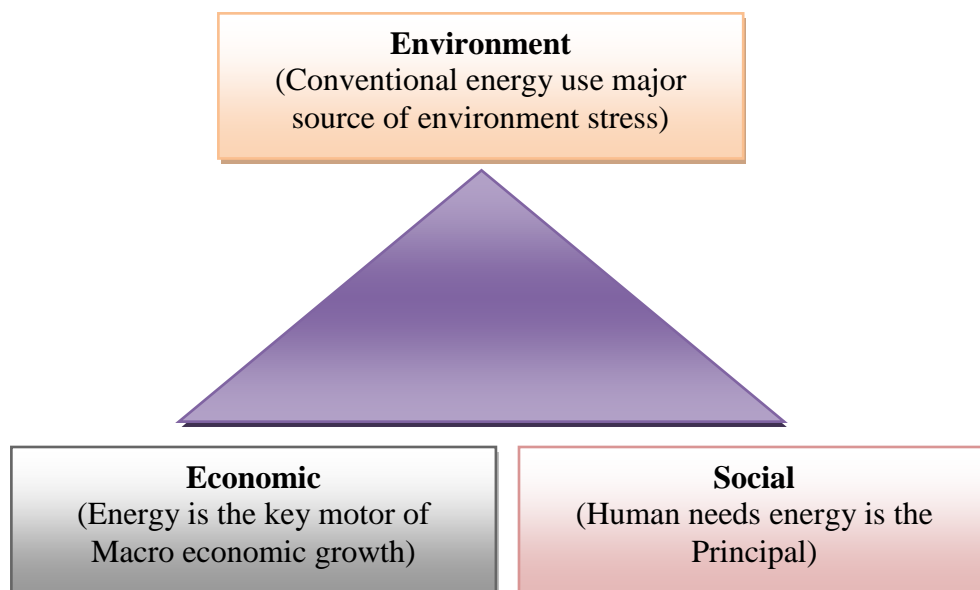
Region	Population without Electr	Electrification rate %	Urban electr rate %	Rural Electr rate %
Africa	587	41.9	68.9	25
North Africa	2	99	99.6	98.4
Sub-Sahara Africa	585	30.5	59.9	14.3
Developing Asia	799	78.1	93.9	68.8
China East Asia	186	90.8	96.4	86.5
South Asia	612	62.2	89.1	51.2
Latin America	31	93.4	98.8	74
Middle East	22	89.5	98.6	72.2
Trans. Econ. & OECD	3	99.8	100	99.5
Developing Countries	1,438	73	90.7	60.2
World	1,441	78.9	93.6	65.1

Source: Weo 2015

Victor and Heller (2006) state that electricity in rural areas, particularly in developing economies, is quite challenging because of three primary reasons: First, rural populations are usually dispersed and have low consumption, resulting in high capital costs spread over low returns. Second, the ability to pay for most of the rural populations is low, making centralized grid expansion unable to recover costs. Third, generation shortages, long rural feeder lines and poor maintenance often result in low quality power being delivered to rural consumers.

According to Bench and Peter (2010) the Government of Rwanda has charted out an ambitious development agenda aimed at transforming the country into a middle-income and knowledge-based economy by 2020. Thus increased access to energy is one of the key to set the Rwanda economic machinery in motion with a major roll out program being implemented in 2009, to expand the customer base of REG to 350,000 by end 2017 off the current base of approximately 210,000 customers (REG report, 2011). MINECOFIN (2014) confirm that the government of Rwanda is trying to increase the socio-economic status of its rural population. Against this background of increasing interest in rural electrification, it is crucial to obtain a more solid basis of empirical knowledge about its relevance to different dimension of poverty, ESMAP (2003); and Khandler (2009a), Khandler et al (2009b), provide some evidence on poverty reduction by the rural electrification programs in Asian countries, and Bangladesh. In this, the development of sustainability energy has a close link to the environment, economic and social conditions of the region (Najam, 2003).

Figure 1: Link to the environment, economic and social



Source *Electrification benefits on different indicators*

Electricity is a commodity that supports all the three pillars of sustainable economic growth, social development and environment. Electricity enhances economic development by enabling the growth of commerce and industry; stimulates social progress by improving social communication, healthcare and education; and promotes environmental improvement by replacing the less efficient means of energy convention. Nevertheless, electricity faces challenges of becoming accessible, reliable, and affordable for the people living in poverty (E72003).

Table 1.2 Electrification rates and population without access to electricity

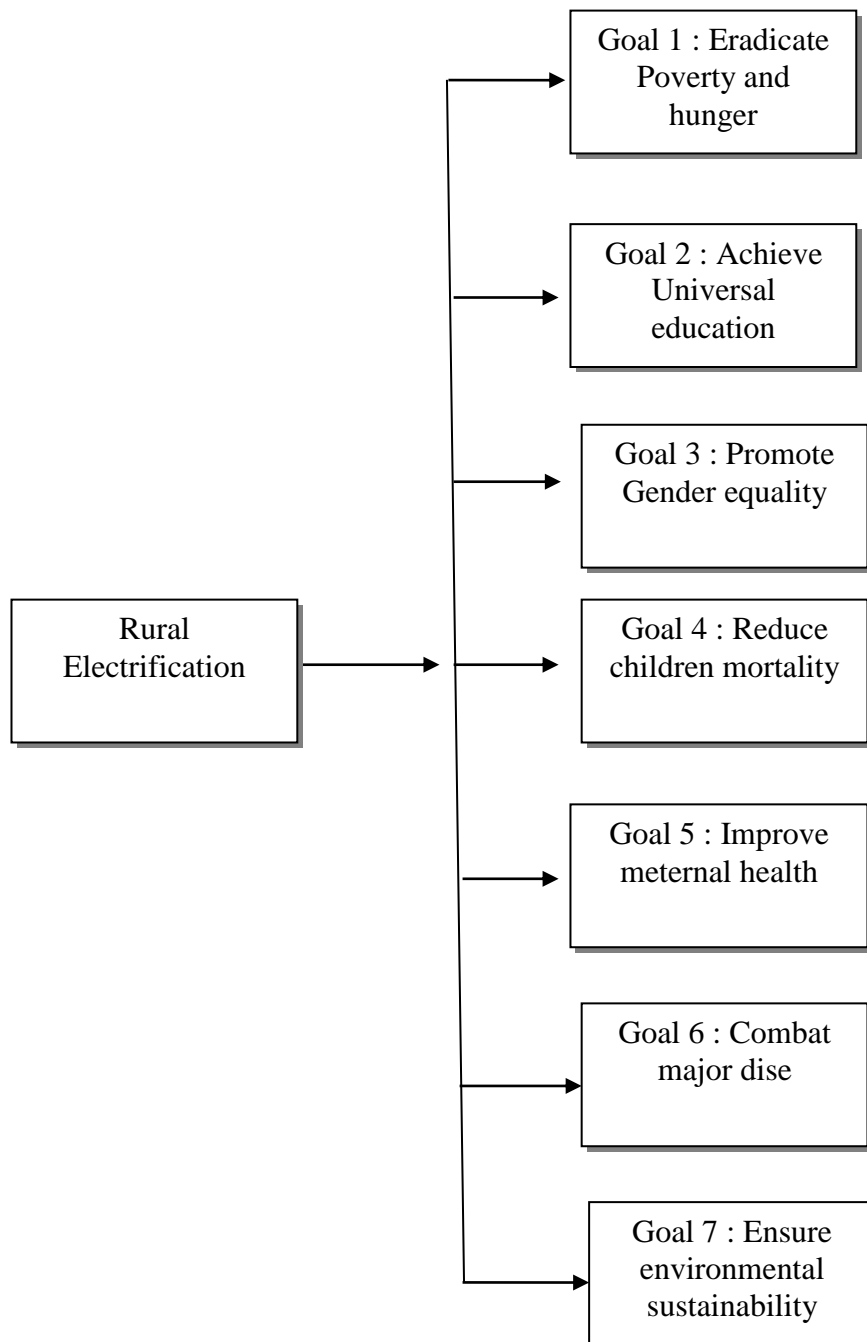
Region	1970	1990	2000	2015	2030
Africa	14	25	34	43	56
North Africa	34	61	90	98	99
Sub-Saharan Africa		16	23	33	44
China East Asia	30	56	87	94	96
South Asia	17	32	41	53	66
Latin America	45	70	87	94	96
Middle East	36	64	91	97	99
Developing Countries	25	46	64	72	78
World	49	60	73	78	83

Source: Electrification rates and population without access to electricity (WEO 2016)

1.2 Millennium Development Goals (MDGs) and the Role of Energy

Rural electrification is believed to contribute to the achievement of the MDGs. MDGs are formed to provide better living conditions to world poor. Energy does not show direct linkages but support in achieving them. Electricity, in general, is positively associated with development goals.

The figure 2 below shows how rural electrification is important in achieving the MDGs



Source: Rural electrification and MDGs

Goal 1: Eradicate extreme poverty and hunger; At the minimum level, eradicate poverty and hunger determines resolves around food, water security, values additional to local resources and small income opportunities. Energy is essential for cooking, irrigating, and processing agro-products (IISD 2004).

Goal 2: Universal Primary School: Household's electrification improve the quantity and quality of lighting, the provision of which is very important for raising the primary education standards (IEA 2002).

Goal 3: Promote gender equality: Energy accessibility and quality affects directly women who comprise the 70% of the world poor. Along with the children, women are primary gathered and users of traditional fuels who are most severely fuel shortage and environmental degradation. Thus, they will be primary beneficiaries in case of both accessibility and improved quality of fuels for households energy services (IEA, 2002).

Goal 4: Reduce Children mortality: Long term exposure harmful gases increase the risks for children developing an acute respiratory infection; about two or four to five billion childhood deaths annually. Improved energy services, particularly improved quality fuel and efficient technologies have direct impact on health.

Goal 5: Improve maternal healthcare: A fraction of women labor is devoted to energy end-use. Energy service can create a rural livelihood opportunity that also helps delays marriage age (which are often in early stage), and reduce child labor requirement for water and wood collection, thereby decreasing the rational for the large family (IISD, 2004):

Goal 6: Combat major diseases: Malnutrition, poor water and sanitation, and indoor air pollution are the main factors generating major diseases spread in rural areas. Provision of electricity reduces of these risks through improved food security by intensifying agriculture productivity, increasing water accessibility and security and reducing the exposure to indoor air pollutants. Furthermore, rural electrification is also essential for prevention diseases and treatment including refrigerated vaccines, intensive care and communication

Goal 7: Ensure environment sustainability: Improve and efficient energy services are essential for environment protection. Energy efficient and plays a major role in promoting rural livelihood (World Bank, 2002).

From the above mentioned background, this study will investigate the perceptions on socio-economic benefits of rural electrification in Rwanda

1.3 Statement of the Problem

Socio-economic development in Rwanda continues to lag behind despite the area's high agricultural and industrial development potential. Among many other bio-physical factors, low development in the region has been attributed to insufficient use of modern energy sources occasioning continued underproduction and decline in economic production. Electricity in particular, has been identified as a prime determinant of household socio-economic development. However, electricity's low accessibility coupled with low adoption present a major setback in propelling and empowering rural household development in Rwanda.

Inception and subsequent implementation of EARP in 2009 has foreseen substantial increase in electricity connectivity and accessibility. However, electricity adoption among households is quite low and below the targeted adoption level for the first phase of rural electrification. This has been a major drawback since the anticipated and projected goals of increasing electricity accessibility in the area have not been realized. Additionally, there is limited focus and lack of detailed information on adoption dynamics of rural electrification via national grid extension among households in Rwanda.

Based on this background, this study sought to examine determinants of electricity, examine spatial dynamics of electricity access points, adopters/non-adopters, as well as the effects of electricity on households and public facilities in the study area.

1.4 Research Objectives

The broad objective of this study was to assess rural electrification dynamics in the study area.

To achieve this objective the study addressed the following specific objectives:

- i. To determine the influence of socio-economic benefits characteristics on rural electrification.
- ii. To assess the socio-economic benefits and challenges of rural electrification among different activities
- iii. To assess the effect of rural electrification on development of remote areas facilities.
- iv. To examine the perception on socio-economic benefits of rural electrification

v. To find out the relationship which exists between the respondents' perception of social and economic and rural electrification?

1.5 Research Questions

This study sought to specifically answer the following research questions:

1. What is the profile of the respondents in relation with rural electrification?
2. What are the socio-economic benefits and challenges of rural electrification adoption among households in the study area?
3. To what extent is the effect of rural electrification on development of remote areas facilities in the study area?
4. Is there a significant difference on the perception on economic benefits of rural electrification of the respondents?
5. Is there a significant relationship between the respondents' perceptions of social and economic benefits of rural electrification?

1.6 Research Hypotheses

Considering the above questions formulated in the statement of the problem, the research tested the following null hypotheses:

H₀₁: There is no significant difference between socio-economic benefits of rural electrification characteristics and electricity adoption in the study area.

H₀₂: there is no significant relationship between the respondents' perception of social and economic benefit of rural electrification in the study area.

1.7 Significance of the Study

The study will generate knowledge to policy makers, administrators, householders, to the society, and to the ministry about many benefits of rural electrification. The study is further expected to show the perception of respondent on socio-economic benefits of electrifying rural area, and then suggest solutions to this persistent problem of rural electrification.

The research findings will provide REG officials and its agencies with the necessary knowledge, abilities and skills to understand well the problems rural electrification concerning education, communication, business, public health etc...

The study is expected to increase on the existing literature on the perceptions of respondents on socio-economic benefits of rural electrification in Rwanda, hence creating more knowledge and information to future researchers and academicians.

The research work can become a role model in conducting similar researches in other communities of Rwanda and other countries. That is why this research will be an excellent tool through which the research will appreciate its efforts put in place in order to implement the rural electrification

This research will also encourage unelectrified household to be connected to the electric network

1.8 Scope and limitation of the Study

The researcher conducted the study at the national level and limited to its scope to the rural households which have been electrified by the rural electrification programme (AERP) in Rwanda. For adequate representation of electrified household 388 households were used to represent a large population. The population in this research includes the number of households electrified in rural areas since 2010 up to 2016. All corners of the country have been covered. Also sectors of the districts were considered as remote ones and are recently electrified by Roll out Programme). The selection criteria were based on the data provided by REG. The districts with 1,000 and above electrified households were prioritized by the researcher.

1.9 Organization of the study

This report is organized in five chapters. Chapter one introduced the study by giving the background to the study, statement of the problem, objectives of the study, research questions and significance of the study. Scope of the study and the limitation has been also included in this chapter.

The remaining chapters of this study have been structured as follows: chapter two discusses the literature review, while the methodology adopted and applied in the study is provided in chapter three. The findings on objectives of this study have been given in chapter four, while the conclusion, recommendations arising from the findings and areas for further research are in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The first part of this chapter provides definitions of key concepts, while the second section of the chapter explains the preconditions of rural electrification. The third part will concern Perception on benefits of rural Electrification in Developing countries while the fourth section explains Perception on social benefits of rural electrification The fifth part provides the Economic benefits of rural electrification sixth section will explain the perceptions on Electrification Benefit, while the seventh section is about main challenges and issues in rural electrification eighth will treat the empirical literature review and the low cost of connection and the last part will provides the conceptual framework.

2.1 Definitions of Key Concepts

2.1.1 Economic benefits: An economic benefit is a profit that can be expressed numerically as an amount of money that will be saved or generated as a result of an action.

2.1.2 Rural electrification: Basically this concept of rural electrification refers to the electricity supply to areas outside cities. It refers to provision and distribution of electricity in rural areas via the national grid extension.

2.1.3 Perceptions: According to Babitski, perception is the process of attaining the awareness or understanding of sensory information.

2.1.4 Household: Refers to a group of persons who reside in the same homestead/compound but not necessarily in the same dwelling unit and are managed by the same household head.

2.1.5 Rural Development: Sustainable socio-economic improvement of the rural population at household and community level due to among others the productive use of electricity.

2.1.6 Electricity Access: This means that following aspects are in place: distribution network within vicinity, connection to the location of household and supply is operational.

2.1.7 Social benefits: The total benefits of an economic activity to both individual and the spillover effects to third parties' social benefits are the sum of private benefits and any external benefits. The social benefits can also be defined as the increase of the welfare of the society that is derived from particular course of action.

2.1.8 Socio-economic benefits: These are the sum total of both private and external as well as economic benefits to individuals as a result of perceived economic activity

2.2 Preconditions for Rural Electrification

The following is a summation of what the International Agency of Energy IAE calls the baseline preconditions which should essentially serve as a precursor to effective rural electrification so that whatever socio-economic benefits can be fully realized. In its Comparative Study On Rural Electrification In Emerging Economies (Barkat, A, 2012) gives a practical example of such institutional structures when it gives the example of Brazil whose 1988 Constitution recognizes the distribution of electricity as an essential public service, for which the federal government is to assume full responsibility, either directly or through designated concessions or permits. However unlike in Brazil where the baseline law, the Constitution recognizes the distribution of electricity as an essential public service, in China where the national electrification rate has reached 99% of rural areas (Barkat, A, ccessed,2012) The Department for New and Renewable Energy of the National Energy Administration deals with the bulk of planning related to rural electrification following which the plans are sent to the National Development and Reform Commission NDRC for approval. On the other hand, India, which has a 44% rural electrification rate [8] like Brazil does have baseline legislation in the form of The Electricity Act of 2003, which is the major piece of legislation covering generation, transmission and distribution of electricity in India and which compels utilities to supply electricity to all, including in rural areas. Sound statistical data on populations' geographical distribution and a clear description of the electrification situation are essential if governments are to avoid the risk of overlooking remote population groups and to facilitate the choice of end-use.

2.3 Perceptions on benefits of Rural Electrification in Developing Countries

Most people in rural areas in developing countries do not have access to electricity, and even metropolitan area is incomplete or unreliable. It has been widely reported that about two billion people in developing countries do not have access to electricity. Most electrification programs and projects are planned and evaluated on the basis of economic and socio-economic performance (Trevor, 2007). The issue that implies the rural electrification is that different countries define rural electrification only in respect of access for purpose of economic development (e.g. agriculture and small business, which should be done by the people from the rural areas). According to a list by NRECA (ESMAP, 2002), numerous opportunities exist in rural areas to improve productivity by means of electricity and to achieve social benefits.

Cecelski (2006) analyzed some USAID and World Bank funded electrification projects in 19 developing countries. These projects were selected according to criteria set by government including political reasons, maintaining or achieving regional balances, and improving the stability of an area. The villages and towns in the region were chosen according to various sets of selection criteria both economic and social. In this context, Mason correctly states that “the problem with using a set of weighted socio-economic factors as a proxy for a socio economic rate of return is that the weights applied are usually quite subjective since they are not based on any quantitative ex post evaluation of electrification experience.” She also argues that the results of most impact monitoring studies are such that it is difficult to come to firm conclusions regarding the economic benefits. Nevertheless, she reached a number of tentative conclusions. Rural electrification appeared to have had some impact on agriculture development in a few countries where irrigation is a widespread activity, but very little in others and then only under certain conditions. The impact on industrial and commercial development, in the sense of the growth of the number of new businesses, was in general modest.

Schramm (2005) concluded that there is sufficient evidence to argue that electrification by itself has never been a catalyst for economic development. He also concluded that the impact of electrification on agriculture growth is often

overestimated, and that there is little evidence that electricity by itself results in new agro-industries and commercial or small-scale industrial activities.

Foley (March 2010) concurs that rural electrification, on its own, does not necessarily cause development of rural areas. It also can provide a stimulus to economic activity; especially in the service sector and where the necessary conditions are present – it can have a major impact on form that development takes.

Schramm (2005) found that the tendency to overestimate productivity gains in the industrial and commercial sectors during the economic appraisal of electrification schemes has been systematic. The writer is of the opinion that rural electrification appears to stimulate agro-industrial and commercial activity, although the direction of causality is not completely clear. He also reports that the electrification of rural areas in developing countries promoted agricultural development best when certain complementary inputs, such as electric pumps and financial services were included. It is best to select rural areas that are, more or less, ready for sustained growth for early electrification since these will generally exhibit rapid demand growth. This was more or less confirmed by IEA (March, 2010). They argue “the more developed an area, the greater the impact of electricity on economic growth,” and they conclude that rural electrification is a “selective catalyst” in the sense that the region already well equipped with infrastructure other than energy (transportation, water systems), in fact, reap the stimulating effects, while those areas that are less developed cannot benefit from them. All these evaluations refer to rural electrification projects implemented in the seventies and eighties. Without suggesting, in general, that the situation has dramatically improved since then; a few optimistic notes can be struck. For example, the socio-economic impact evaluation of the rural electric programming Bangladesh (Barnes, 2007) noted positive results.

Evan and Hund (2000) examined the impact the electrification of a small rural community, six years after electrification. Prior to the electrification of the village a baseline study was undertaken; and thus, their results are based on comparative analysis. The area featured a large number of government offices, well developed commercial sector, some scale small businesses, and reasonably dense residential area. Even if all the potential domestic consumers would have been connected, their

consumptive use of electricity would still have been less than 50% of the total. A range of interactive interviews and participatory approach was adopted. Although loan schemes (for up to 60% of the connection charge) existed to facilitate domestic access to electricity, households were still required to make large upfront payment. As a result, only around 4% of the privately owned domestic houses in the area were electrified and only 9% of the small and informal businesses. The majority of the larger businesses and government departments have been connected to the distribution grid. The “willingness to pay” was determined on the basis of the avoided cost for alternative energy resources. For domestic and small commercial consumers, the willingness to pay appeared to be 30% above the actual electricity tariff. For large commercial consumers the willingness to pay was calculated at 10%: unfortunately, Davis et al. did not give information about the reliability of the service, which is an important factor in the willingness to pay.

Davis et al. concluded that electrification had stimulated local economic development including the establishment of new businesses. The number of additional jobs was assessed, and 10% of the relevant annual salaries were estimated to be a benefit of electrification. A major conclusion of the impact assessment was that special financing arrangements are necessary to allow income households to become connected. Another conclusion was that the project was only marginally economically viable, even with the low social discount rates. Given the fairly favorable conditions of the site investigated, Davis et al. purports that more appropriate economic benefit assessment method need to be addressed at that particular attention must be paid to the identification of the most promising rural areas in terms of electrification.

Foley (1997) reports that in Costa Rica after the electrification of rural areas particulars dairy and poultry farms used electricity widely. These farms usually switched from their own diesel generation to grid electricity. The smaller farm did not use electricity for their farm task, only for domestic purposes. Thus the idea that rural electrification in general enhances productive farming activities was not confirmed.

Dwived (2006) confirms that “both at the macro-economic and the business level, many rural electrification activities appear rather unattractive in the frame of classic evaluation methods for profit oriented projects such as power plant or a factory which are based on the internal rate of return. Thus, economic and financial analyses should

give priority to at least cost approach rather than to an economic an economic cost-benefit analysis which in areas often can rely on doubtful data”. He continues by saying “in first instance, rural electrification should be regarded as an infrastructural prerequisite, based on an already achieved economic level, for the further promotion of rural development. It does not belong to the category of profit-oriented project but rather, like public transport sector activities, to the category of public infrastructure. The justification of rural electrification projects, programs and plans should therefore not depend on their individual profitability but on their contribution to achieving positive development impacts and to satisfy basic social needs in a wider frame”:

Vogel is right in saying that rural electrification should not be in isolation from the overall development level. He is of the opinion that a rural electrification program should not be derived from the natural, but subjective, wishes of rural people to benefit from the comfort of services requiring electricity supply. It should rather be justified in connection with factors such as:

1. An identified potential of economic activities which could not, or not adequately, be realized without the availability of electricity.
2. The ability and willingness of the society and their political representative to redistribute surplus and funds in favor of the development of rural areas
3. The ability of the institutions/ establishment implementing the program and benefiting from it to cope with the organization and financial requirements

Considering these aspects, Vogel argues that rural electrification is unlikely to be just a heavy burden on fragile economic without giving significant regional and national development impulses. Rather, it could become an instrument to diversify the economic, to create employment, to improve general living conditions and to reduce rural-urban disparities. Combined with other factors, it can contribution to prevent over-centralization, congestion and growing shanty townships and informal settlements in urban areas. Barnes (2004) also concluded that rural electrification can significantly contribute to social and economic development, but that opportunities depend on complementary programs or conditions.

A certain degree of economic development seems to be necessary in creating the conditions for successful rural electrification. This implies that electrification should

follow, and not attempt to lead, regional economic development. In any case, where rural electrification is considered and planned in combination with other rural development activities, the social and political circumstances need to be conducive. If these other activities are not successful, the positive socio-economic effects of rural electrification will be partly or fully limited.

An often used example of how rural electrification should be organized is the simultaneous introduction and agricultural mechanization to the rural areas of the United States of America. Mason (1990) found, in her study of the impact of rural electrification projects, that electricity did replace more costly energy sources in some cases. In most of these cases however electricity was heavily subsidized and the alternatives generally were not.

Investigations have shown that electrifying areas in general gives rise to increased energy use because people begin to use all kind of appliances. Barnes and Foley (2004) therefore, argues that providing electricity to a region may actually increase overall energy use, thus posing a challenge to the assertions on energy cost savings. He adds that with the electrification of rural areas, the population makes a major step forward which would otherwise have resulted in an increased energy use at some time in the future.

A World Bank study of the economic and social benefits of rural electrification in Philippines (ESMAP, 2002) seeks to capture a variety of indirect and direct benefits of rural electrification.

Table 2.1 benefits of rural electrification in Bangladesh

Benefits Category	Values	Unit (Per month)
Less expensive and expanded lighting	36.75	Household
Less expensive and use of Radio and Tv	19.60	Household
Improve returns of Education and wage Income	37.70	Wage Earner
Time Saving for Household chores	24.50	Household

Source: (ESMAP, 2015, A broadly) methodologically similar draft by Barnes.

They find that lighting has 36.75%, radio and TV 19.60 % improvement of Education and wage income 37.70 and household chores 24.50%. All of this show the benefits rural electrification is bringing to the rural population

2.4 Perception on Social Benefits of Rural Electrification

The household users had quickly taken advantage of grid connection. Each had on average two lights per room. Refrigerator, TV, and radio ownership rates varied between 1 for every 2 households and 1 per household, and some households owned satellite dishes (nationally, 72% of Tunisian households owned refrigerators as of 1994, and 92% had television, of which 70 were color). The beneficiaries were well aware of the benefits that rural electrification could bring (Energia News, Vol 4, 2001). The rural electrification is now stabilized with the rate of urban growth decreasing from 4.3 % in 1975 to 1.2 % in 1999; despite a doubling in the total population. At present 35 % of Tunisians live in rural areas. The rate of population growth has also fallen, from 2.3 % in 1.2 % in 1999 (Energia News, Vol 4, 2001).

The same book Energia News, Vol 4, 2001, describes the following user perception of benefits of Rural Electrification:

1. Education is usually the number one priority for families in all walks of life in Tunisia, so it is not surprising that the first benefit of rural electrification cited by households with school-age children is improving homework and school performance, while at the same time avoiding eye problem from using candles and kerosene lamps. school assert that the rate of enrolment by girls has caught up with that of boys, after the electrification not only of households, but also of schools and public streets. Additionally, public lighting has reduced the risks of travelling to school-an important concern for families with girls. The construction of tarred roads, in a coordinated rural development effort, has also contributed to reducing the rate of absenteeism, within schools, electric lighting has improved conditions, especially during the dark hours of winter, when previously each student had to bring their own candle. Alla this is believed to have contributed to the increased rate of graduation (60-70%) in these rural areas (ADB, 2014).

2. Basic health and families planning has the second most important social priority of the Tunisian state, after education, and this is also reflected in the benefits perceived

from rural electrification. Rural electrification was provided at the same time as clean water and well-equipped and staffed health clinics. For example, a nurse is always available even in these remote clinics, a general practitioner visits once a week, and a specialist health team regularly visits. Health clinics lights, a refrigerator, negatoscope, sterilizer, fan, oil heaters, radio, TV, and sometimes a video. The majority of drinking water points are equipped with pumping devices, with mains electricity much in demand to replace diesel. Beneficiaries and health staff attributed at least part of the reduction in the birth rate in their areas to rural electrification, which increased the effectiveness of family planning and other health programs. Clinic report being able to expand the range of their equipment and services; for example, television and videos are used to present programs on public health and disease prevention in some waiting rooms; instruments can be sterilized; and vaccines for babies and anti-tetanus shots for pregnant women are more widely available (Leffler,& Dagbjartsson, 2014).

3. Women's reproductive health in particular is seen as having benefited from electrification: women with electricity organize their daily task so that they have time to watch TV, which passes on many health messages, for example on reproductive health and contraceptive methods, vaccination, the prevention of sexually transmitted diseases, and health checks for breast cancer, colon cancer etc. the family planning units in the village now use audio-visual aids, making awareness-raising campaigns more effective. Better information for girls from family planning services, but above all from TV, is credited with the rapid decrease in teenage pregnancies. Even tube tying and implants (sterilization), which require hospitalization, have been facilitated by household electricity: with refrigerator, women are less reluctant to absent themselves from their household tasks, since they can prepare and store meals for their families in advance. Women and health staff also perceive other changes in women's quality of life due to rural electrification. Both husbands and wives are reported to spend more time at home watching TV. Installation of TV (and sometimes satellite dishes) in their homes means that women have become much more aware of political events and know much more about what is going on in the world than their husbands, thus giving them the confidence to speak up and defend themselves and take on more leadership roles. Rural women and children-especially girls are

becoming more demanding about personal hygiene and more fashion conscious, following the latest TV advertisements and fashion (Gerald Foley, 2010).

4. Increased economic opportunities for women in the home and the village are perceived as one outcome of electrification. Electric lighting makes evening activities possible, and many girls say they prefer to stay in the village and earn a living using a sewing machine, weaving or knitting, rather than going to the city to work as maids. Sewing workshops and hairdressers (presumably a result of the increased fashion consciousness) figure prominently among the new economic activities linked to electrification equipment is often donated to households through various state development programs. Refrigerator is also valued for providing the ability to conserve food and medicines, and save money by rationalizing shopping (Energia News, 2015).

5. Other benefits of rural electrification can be summarized as; full enrolment of children in primary schools, the increase of life expectancy from 50 to 70 years, improvement in status of women and in health services programs including family planning and basic education.

Generally, most decision about electrification is based on models that assume electrification contribution to economic and socio-economic development. A model of socio-electrification leads instead to decision different from those taken in conventional electrification programs. Identifying the difference between economic and social objectives and their effect on electrification, environment, electricity tariffs and subsidies, electricity distribution industry operations, and regulation, can contribute to better decision-making and greater effectiveness (Trevor, 2007).

2.5 Perception on Economic Benefits of Rural Electrification in Bangladesh

Dhaka, (2015) says that electricity at the household level impacts upon almost all economic variables, improves living standard and quality of life, and reduces poverty. He particularly makes the following observations.

1. Both absolute poverty and hard –core poverty are significantly less pronounced in the electrified than those in the non-electrified households,

2. Electricity contributes to income –poverty reduction. The average annual income of the electrified households is much higher (65%) than that in the households of non-electrified was around 50% higher than that income in the non-electrified households,

3. Electricity has income-enhancing effect. 16.4% of the income of electrified households can be attributed to electricity. The corresponding figures for the non-electrified villages only 3.6%. Other things being the same, 100% electrification of rural households (currently 17.88% of rural households are electrified) might increase the annual rural income by Tk. 671 billion (which is equivalent to the 26% of the GDP), and as high as 43% of this incremental income can be attributed to electricity,

4. The electrified households are much better-off than the non-electrified ones in terms of all human development indicators, namely human longevity (measured using infant mortality rate as proxy), human knowledge, and per capita real income. Bangladesh is a low HDI country (ranks 145 out of 173 countries) but the HDI value for electrified village-segment corresponds to the medium HDI countries such as Egypt, Indonesia, Honduras, and Bolivia. Economic and social impact Evaluation Study of Rural Electrification Program in Bangladesh ensuring household access to electricity alone can be seen as necessary precondition to significantly improve human development scenario of Bangladesh,

5. Electricity contributes significantly in asset-building of the poor. The cultivable land ownership distribution is less skewed in the electrified than in the non-electrified – the bottom 40% of the electrified households own 3.7% of total cultivable land, whereas the bottom 40% of the households in non-electrified villages own only 1.6% of the total land. During the last five years, changes in the land ownership of the bottom 40% were more progressive in the electrified households than in the households of the non-electrified villages. The concentration ratio of cultivable land ownership was 0.61 for electrified and 0,67 for non-electrified segments. Similar changes(during the last five years) in favor of the poor in the electrified households as compared to the poor in the households of non-electrified villages were evident in the ownership of other capital assets –dwelling/non-dwelling rooms, livestock and poultry, agricultural equipment and household durable.

6. Electricity he had significant impact is strengthening the socio-economic foundation and in improving the quality and living standards of the people in the electrified households. This has been amply reflected in the dynamics of self-assessed poverty status by the respondents.

7. Electricity has major demographic impacts. The population growth rate in the electrified household segment is less than that in the non-electrified. This is evident from the relatively low total fertility rate (TFR) as compared to the non-electrified segment. Young age structure and dependency ratios were relatively less pronounced in the electrified than those in the non-electrified household. Electricity in the household contributed 16% of the reduction in TFR. The TFR of the poor in the electrified household is 26% less than that of the poor in the non-electrified villages. As compared to the non-electrified villages, in-migration was much more pronounced in electrified. Population survival rate is higher in the electrified than in the non-electrified villages. Among others this is evident from the relative how infant mortality rates in the electrified, 42.7/1000 live births against 57.8/1000 live births in the non-electrified villages.

8i. Electricity has played an immense role in improving people's overall health status, especially for those in the electrified households, and more so for the poor, women and children. The electrified households are much better endowed than the non-electrified households in the electrified households in terms of the following health indicators: Awareness of crucial public health issue, seeking treatment by medically competent person while sick, use of medically trained persons in child delivery, accessing ANC and PNC check-ups. Use of TT immunization, seeking treatment of medically competent persons in maternal morbidity, rate of full immunization of children (vaccines against 6 diseases), a version of infant deaths, intake of Vit-A capsule to prevent night blindness among children, use of family planning methods, use of hygienic latrines, use of hand washing materials after defecation. In all these indicators, not only that the rich-poor divide was less pronounced in the electrified compared to the non-electrified households, but also the poor (landless) in the electrified have shown much better health outcomes than their counterparts in the non-electrified households, especially than those in the non-electrified villages.

9. Electricity has significant influence in education, especially on quality of education. The influence is much more pronounced among the poor and girls in the electrified households than the poor and girls in the non-electrified households. Compared to the non-electrified, the electrified households fare much better in terms of overall literacy rate; adult literacy rate; enrollment ratio; expenditure on education; performances in terms of examination results, attendance rate, dropout, and average time spent on study (after sunset, 6PM).

The overall literacy rate in the electrified (70.8%) is 26% higher than in the non-electrified and around 49% in the female is 31% higher: the rates being 65% in the electrified and around 49% in the non-electrified. The rich-poor gap in literacy is 20% in the electrified households, but it is as high as 60% in the households of non-electrified villages. The literacy rate among the poor in the electrified (66%) is about 41% higher than that of the poor in the non-electrified villages. The similar pattern holds true for adult literacy. In addition, the average annual household expenditure on education was 87% higher in the electrified compared to that in the non-electrified villages.

According to assessment of benefits of rural electrification made by USAID () , the benefits are ranked as following:

- i. 93.7 % at the electrified households reported decrease in fuel cost.
- ii. 78.2 % Households reported an increase on working house.
- iii. 62.2% reported an increase in household's income.
- iv. 81% reported an increase in reading habits.
- v. 93.7% reported an increase in children's study time.
- vi. 92.0% reported an increase in amusement as well as standard of living.
- vii. 94.7 reported an improvement in security(source: [http: www.bangladeshgov.org](http://www.bangladeshgov.org))

2.6 Perceptions on Electrification Benefit

Rural electrification is potentially a desirable investment in many countries (Schramm, 2005) but there has been, and still is, considerable discussion about the socio-economic benefits and the costs of the electrification of these areas in developing countries. For many rural people in the World however, electrification of

their areas means modernity, progress and, above all, light in the darkness (Foley, 2004).

During a recent socio-economic impact evaluation in Bangladesh, a villager even appreciated electricity as “freedom” (Barnes, 2007). In the early 1940s a farmer, who had just been connected to the electric grid, gave witness in a rural church in the United State of America: “Brothers and sisters, I want to tell you this. The greatest thing on earth is to have the love of God in your heart, and the next greatest thing is to have electricity in your house “(NRECA, 1985). Rev. Fr. J.M. Hayes, a priest in the parish of Bansa in rural Ireland, said in a speech on the occasion of the completion of the electrification of the area in the fifties: “it is more than an amenity, it is a revolution which will sweep away inferiority complexes “ (Manning, 1978).

The impact on people’s lives of a rural society without electricity is difficult to imagine. Life without electricity is possible, as has been demonstrated above, and it is still demonstrated every day by many people all over the world. Because electricity is seen as a “light in the darkness” and a symbol of progress, the electrification of rural area can be socially and politically very important.

According to Charlotte and Wandera (2009), electricity by itself is nothing more than a dangerous wire. “The service being purchased is not really electricity at all, but such benefits as cooling, lighting, communications, cooling, heating, and socializing. Electricity is a means to an end and not the end itself. It also should be noted that electricity can be provided through a grid as is the case in most of the developed world, or through decentralized generation that often is based on renewable energy (Barnes, 2007).

Electrification provides local companies with a reliable source of power and lead to the creation of new jobs, while at the same time making people’s everyday live easier and significantly enhancing their quality of life (IEA report, 2010). According the Vietnam paper (2005), households who adopt electricity experience improvements in the school attendance of their children. Electricity is used immediately for television viewing and of course for electric lighting, making it easier to read, socializes, and

enjoys the evening hours. In some case this can lead to improved incomes as lighting makes possible running small business in the home.

The following are the results from the survey made on the benefits of rural electrification.

Table 2.2 characterizing the most important benefit of rural electrification

Importance	Percent
Lighting	42%
Productive uses	28%
Cooling or Heating	0%
Health clinic and other Public uses	7%
Television or radio	14%
Others	9%

Source: <http://www.twiigs.com>

Cost Rica, the Philippines Tunisia and Bangladesh adopted the well proven low cost single-phase distribution system that has been used in the US rural electrification program since the 1930s. There are some locations that can benefit from single wire earth return systems which can be even less expensive (Barnes, 2007). The rural electrification figures in developing countries are pretty well known by now. There are now an estimated 1.5 billion people without electricity in developing countries, and 85 percent of them live in rural areas (Barnes, 2007).

2.7 Rural Electrification: Main Challenges and Issues

Munashinghe (2004) notes that rural electrification schemes are often defined in terms of local administrative units, mainly for convenience in implementation. He also observes that most often the term ‘rural electrification’ refers to connections to a central grid. He continues by saying that this is not necessarily the most economical method of electrifying every region in every country.

Vogel (2003) observes that, ‘according to the international discussion and the understanding of agencies such as the World Bank, the concept of rural electrification does not only refer to strict rural areas as defined in the country statistics but may also include small to medium-sized towns which are service centers for the surrounding rural areas within a given region. Barnes (2004) defines rural electrification as the “availability of electricity for use in rural communities, regardless of the form of generation”. Yaron et al (1994) simply states that “rural electrification is the process of bringing electricity to rural communities, Maillard et al (1985) argues that an exact definition of rural electrification will raise the issues of delimiting urban and rural areas. They argue that a differentiation on the basis of statistical data carries with it the danger of inaccuracy because of the differences between countries, and because of the fact that data are often unreliable. It should also be noted that the classification of urban and rural areas based on statistical data, disregards specific features and opportunities of both areas. Maillard et al, (2015) proposed the following definition: “rural electrification comprises all activities aimed at enabling users situated outside major cities to have access to electricity. The electrification process can be differentiated from the conventional scheme of extension of a national grid, as it covers everything up to independent configurations supplying power for a specific, determined need, and the solving of specific technical and economic problem”.

In regard to all the aforementioned definitions, it can be concluded that rural electrification encompasses the activities designed to provide people with access to electricity in those areas which show specific features do not only include low loads and the need for specific approaches as suggested by Mason, but also area specific opportunities.

Roughly 22% of the world’s population still does not have access to electricity. In 2008, this represented 1.5 billion people, most of who lived in remote areas often difficult to access and therefore, difficult to connect to national or regional grids. The International agency estimates that roughly 85% of the people without electricity live in rural areas in developing countries, mostly in peri-urban or remote rural areas (IEA, 2009b). Today, most of these people are found in Sub-Sahara Africa and South Asia. The IEA predict in 2030, if no new policy to alleviate energy poverty is introduced,

1.3 billion of people (16% of the total world population) will still be denied electricity most of who resides in South Africa (IEA, 2009b).

It is worth noting that not all electrification policies target poor rural households. Some target a mix of farms, big villages, and small towns all of which call for different technologies. In fact, rural electrification policies are shaped according to the various energy needs, resources, and target groups (Barners, 2007). The Rwanda Rural Electrification program aims at addressing this problem in two phases though against a background of great challenges. The first phase aims to generate high level ideas for cost-efficient, reliable, standalone (off-grid) solutions which explore the use of multiple renewable energy sources. The second phase aims at developing a detailed project to provide electricity to the school, refectory, and health centers within the villages.

2.8 Empirical review of Rural Electrification and Low Connection Cost

The International Energy Agencies report an (2015) and Douglas Barnes (2016) confirm that many developing countries still have very high connection costs. This helps with the utility to recover costs of providing serve, but it also means that many people even in areas with electricity available may not able to afford a connection to the electricity grid. Research from around the world indicates that those countries with low new service connection costs or which provide financial assistance for such costs have much higher rates of connection by poor households. Given that the benefits of rural electrification are quite high, should countries or utilities with high connection costs consider changing their policies?

2.8.1 Eight Steps to success a rural electrification Programs

The pace of rural electrification over much of the developing world has been painfully slow, especially in South Asia and Africa. Rural electrification programs can undoubtedly face major obstacles. The low population densities in rural areas result in high capital and operating costs for electricity companies. Consumers are often poor and their electricity consumption low. This post is on grid rural electrification and there will be a similar future pot on off grid rural electrification. Douglas Barnes

(2007) determines eight steps to successful rural electrification program which may be a source of high income for electricity beneficiaries. These steps are as follows:

Set up effective institutions to deal with problems: Most successful programs have a specialized institution that deals with and promotes rural electrification. The exact nature of institutional structure does not appear to be critical, as a variety of approaches have been successfully. They include a separate rural electrification authority (Bangladesh); setting up rural electric cooperatives (Cost Rica); allocating rural electrification to a new department in the national distribution company (Thailand); or delegating it to a specialized office within the utility (Tunisia). However, there must be a high degree of operating autonomy so the implementing agency can pursue rural electrification as its primary objective without significant political constraints (Barnes, 2007).

Government commitment and dealing with the political dimension: All rural electrification programs have subsidies for the capital costs of expansion. This use of public funds for rural electrification often leads to political interaction at national and local levels. The politicians regard public funding as giving them rights to interfere, but experience shows that this can be quite damaging. Once technical and financial decision-making is undermined in the implementing agency because of political string pulling, organizational goals are undermined (IEA report 2010). However, sometimes political pressure can be turned into a positive force as in Thailand where local politicians were encouraged to raise and contribute funds, so that their constituents could receive electricity before the planned time (Barnes 2007).

Establishment of clear planning criteria for rural electrification: Grid rural electrification is often a step by step process which starts with the most promising high population growth areas and then moves on to more and more remote populations. Successful rural electrification programs have all developed their own system for ranking or prioritizing areas for rolling out the electricity supply. Capital investment costs, level of local contributions, and density of consumer, are among the factors normally taken into account (IEA, report 2010). In Costa Rica, the ranking of communities was based on their population density, level of commercial development, and potential electricity consumption (Barnes 2007).

Subsidies for grid expansion capital costs: In most successful programs, a substantial proportion of the capital has been obtained at discounted interest rates or from outright grants. The program in Costa Rica started with low interest rate loans. In Tunisia, all capital expansion costs were covered by government grants. Having access to such low cost financing and subsidies need have no ill-effects on the implementing agency or the rural electrification program. But such loans and grants should never be provided to companies that are not covering their operating and maintenance costs through revenue collection. This will only worsen their financial position that ultimately results in poor customer service (Barnes 2007).

Charging right price for electricity: All the successful programs reviewed in the case studies had a strong emphasis on covering their operating costs through revenue collection. Cost recovery is essential for the long-term effectiveness of rural electrification programs. When cost recovery is pursued, many of the other program elements can fall into place. Rural electrification prices set at realistic levels sometimes even leads to energy costs savings for new customers as they reduce their Kerosene lighting costs. Charging the right price allows the electricity company to provide an electricity supply in a effective, reliable, and sustainable manner to an increasing number of satisfied consumers (Barnes 2010).

Reducing barriers to obtaining a supply: Generally, it is considered that the initial connection charges demanded by the power distribution companies for new customers are often significant barriers to the adoption of electricity by rural families. They often are even more important than the monthly electricity bill. Reducing this connection charges, or spreading them over several years, even if it means charging more per kilowatt hour of electricity, allows larger numbers of low income rural families to obtain a supply (Barnes 2010). In Bolivia, for example, a small local grid, in spite charging 25 to 30 cents per Kilowatt hour, immediately doubled its number of consumers when it offered them the option of paying for the connection cost over 5 years. In Tunisia the connection charge is over 100US Dollars, but households can spread the payment over 2 years, which amounts to less than 5 US Dollars per month (IEA report 2010).

Benefits of community involvement: Traditional thinking in many utilities is often oblivious to the importance of local community involvement. Rural electrification is seen simply as a technical matter of stringing lines to grateful consumers. The case study show clearly that rural electrification programs can benefit grateful from the involvement of local communities – or suffer because of its absence.

There are many innovative ways to do this (IEA report 2007). In Bangladesh consumer meetings w held before the arrival of the electricity supply, helping to avoid costly and time-consuming disputes over rights of way and construction damage. In Thailand community contributions in cash or kind were often the decisive factor in bringing areas within the scope of the rural electrification program (Barnes 2007).

Reducing construction and operating costs: There are major opportunities for the reduction of construction and operating costs of rural electrification in most countries. Where the main use of electricity is expected to be for lights and small appliances, there is no reason to apply the design standards used for much more electricity intensive urban systems. In many case, careful attention to system design enables construction costs to be reduced by up to 30 percent, contributing significantly to the growth of rural electrification coverage. Each country will have its own cost-saving opportunities for rural electrification planners (IEA report, 2007). Cost Rica, the Philippines Tunisia and Bangladesh adopted the well proven low cost single-phase distribution system that has been used in the US rural electrification program since the 1930s. There are some locations that can benefit from single wire earth return systems which can be even less expensive (Barnes, 2007). The rural electrification figures in developing countries are pretty well known by now. There are now an estimated 1.5 billion people without electricity in developing countries, and 85 percent of them live in rural areas (Barnes, 2007).

2.9 Theoretical Framework/Conceptual Framework

Access to electricity is considered as a basis indicator for rural Development, potentially contributing to income generation, improve educational and health outcomes, increasing gender equality, and a host of other social welfare improvements (International Agency 2004; Cabraal, 2005).

The role that energy plays in development, either directly or indirectly, in creating the enabling conditions for other development interventions to succeed is still arguably underappreciated. For instance, when the millennium development Goals were created as a way to highlight key development needs, energy indicators were not included explicitly. However, electrification will always be necessary to meet many of the goals laid out in the MDGs, whether through refrigeration of vaccine (MDG4: Reduce Child Mortality) or lighting to improve evening study conditions (MDG2: Achieve Universal Primary Education). This led to a follow-up effort to delineate how energy contributes to the MDGs, but this was an ex-post effort rather than being integrated into the MDG development process (Modi et al.2005)

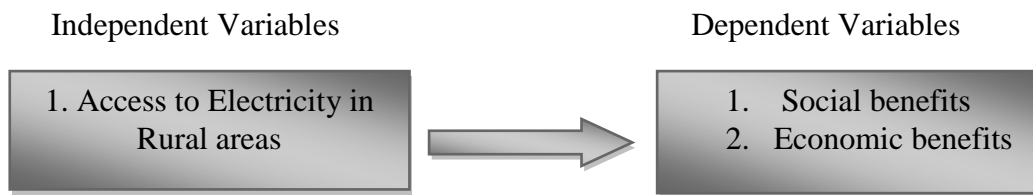
The perception from electrified household on socio-economic benefits of rural electrification refer to a stimulus to economic activity; especially in the service sector like agriculture and to improve the welfare of the society where the necessary conditions are present (Foley, 2010). Women from Bangladesh perceive rural electrification as the solution to their social and economic challenges.

The perception of people from Tunisia, Costa Rica, and Bangladesh perceive the socio-economic benefits of rural electrification as a ‘light in darkness’ and a symbol of progress. The electrification of rural areas can be socially and politically very essential. In Rwanda, habitants of different newly electrified rural areas (Kirehe, Nkombo, Gisagara , etc.) have the same perception like those of the people cited early. It has been observed that spouses in electrified households take more time together at home watching television and this impact family planning. It is the same that rural electrification makes possible to organize for evening activities. Most of them perceive the social-economic benefits such as cooling; lighting, Communication, heating, and socializing (Charlotte and Wandera, 2009).

The conceptual framework for the study was derived from the theoretical framework and linked with the current study.

The following figure shows how is the relationship between the variables have been operationalized

Figure 3: relationship between the variables

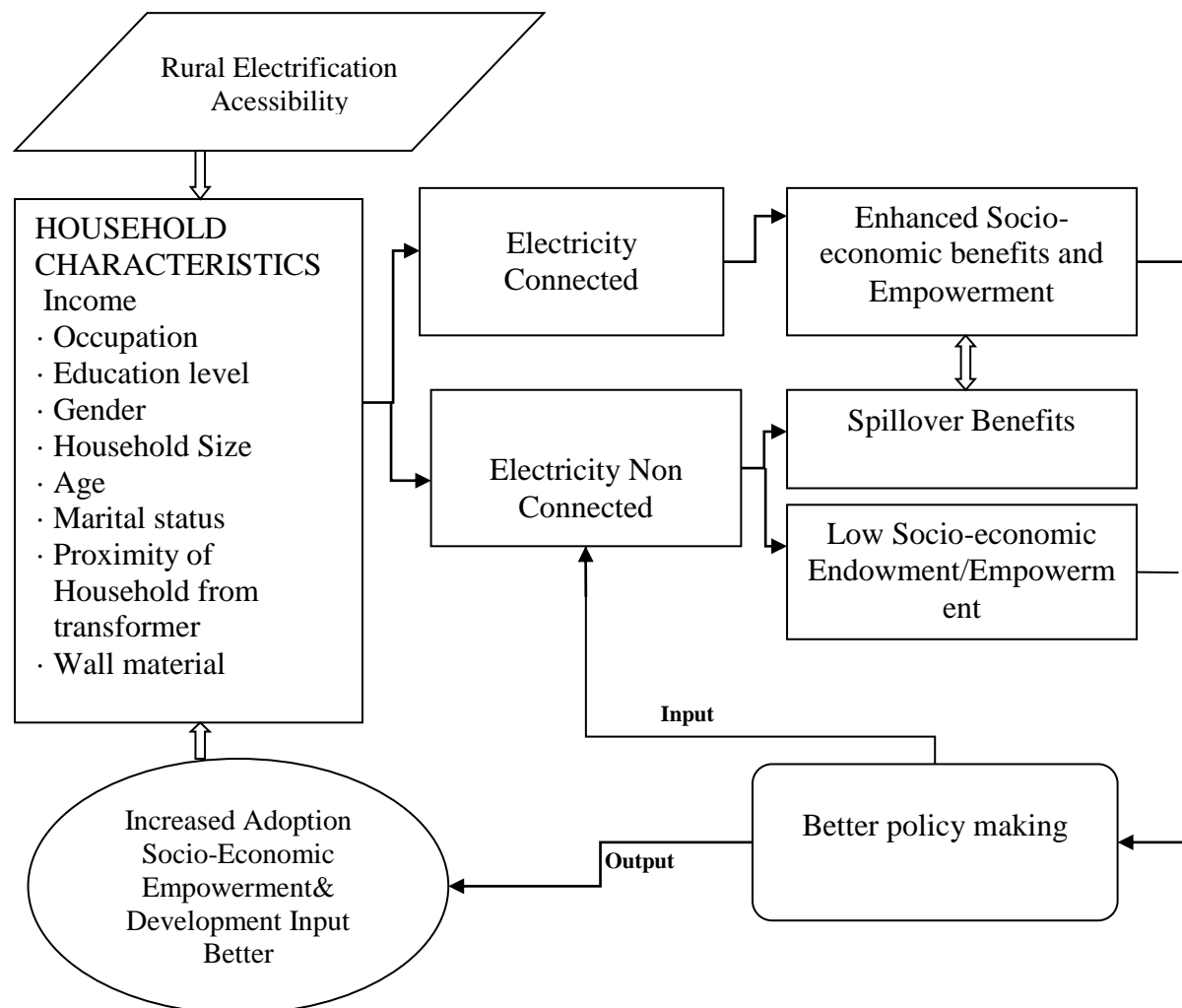


Source: Author's Own Construct, 2017

Other benefits of rural electrification can be summarized as; full enrolment of children in primary schools, the increase of life expectancy from 50 to 70 years, improvement in status of women and in health services programs including family planning and basic education.

These links are illustrated in the above conceptual framework by examining households' characteristics influencing electricity adoption, and socio-economic benefits of rural electrification.

Figure 4: Conceptual Framework



Source: Author's Own Construct, 2017

The implementations of specific policies contribute to rural development and social economic empowerment among rural households.

The following table 2.3 indicates some of the activities needed to supplement the effects often stated as expected from electrification

Intent	Nature of Objective	Supplementary actions needed
Create employment	Economic	Support growth so that increased productivity from electrification does not reduce employment
Stimulate rural Industrialization	Economic	Provide other factors of production and access to markets, particularly roads.
Raise household income	Socio-economic	Support productive use in households in addition to consumption.
Improve health Service delivery	Socio-economic	Provide and manage clinic services
Promote home study	Socio-economic	Improve schooling and adult literacy. Programs. Provide resources from which to study at home
Reduce migration from rural to urban areas	Socio-economic or social	Counter perception of better life (Opportunities and services) in urban areas.
Poverty alleviation	Poverty alleviation	Supply basic quantity of energy at subsidized tariffs with conditions that target the poor

Source: Report on socio-Economic, & environment dimensions of access to electricity 2017

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter is divided into eleven parts, which are: the first part of the chapter explains the research design used while the second part provides the area of the study. Section three of the chapter discusses the study population and the fourth part gives the sample size and the sampling techniques used. Research variables and units of measurement are explained in part five, part six of the chapter covers research instruments, while part seven presents the validity of the instruments. Part eight is concerned with sources of data. Data collection methods are presented in part nine, part ten discusses how the collected data were processed and analyzed and the last part presents the limitations to the study.

3.2 Research Design

The research design was a case study. The case study enabled the researcher to cope with time and financial constraints allocated for the purpose. However, this design enabled the researcher to use effectively and efficiently the scarce financial and time resources endowed for the study. A case study research design creates an enabling environment for combining a variety of tools such as interviews, documentations and observations to conduct a thorough inquiry in the phenomenon this has been associated with the Correlation Research Design in which the researcher has identified the independent and dependent variables. It tried to find out if there is or not a relationship between the variables. Correlation research is the form of analysis in which you correlate one variable with another to determine if there is a relationship between them. It is of great interest to note that the descriptive and correlation research methods are two of the five basic designs of quantitative methods of research (Zeulueta and Costales, 2003).

3.3 Study Area

The study was conducted in Rwanda. The researcher selected nine Districts among them the researcher picked up 12 sectors because of the size population which is above 1000 habitants. The District is among the Government Authorities in Rwanda that is challenged with the inexistence of electricity in rural areas.

3.4 Study Population

Population refers to larger group from which the sample is taken (Kombo and Tromp, 2006) In this study the researcher targeted officials of REG and its agencies, the Districts responsible for welfare of population, crop and animal traders, business men in agricultural produce, Artisans, farmers, public servants, the number of households electrified in rural areas since 2010 up to 2016 and others. The population comprised of both male and female.

3.5 Sample Size and Sampling Techniques

The sample of 388 was considered appropriate for the study; respondents from different population categories as indicated in Table 3.1 below were selected and interviewed.

The population in this research includes the number of customer divided into residential, industrial, commercial, institutional sector of REG in different areas in Rwanda since December 2011. The research covered all the regions in Rwanda with targeted population of all those who are connected but are mostly disturbed by the electricity and the ones who are waiting to be connected to the grid.

Due to the lack of time and resources, the sampling covered those regions that are assumed to use more electricity on a month basis. Thus, it covered only those regions with more than 1,000 customers as indicated in table 3.2 below. Given that the target population was greater than 5,000, the sample was derived using the formula suggested by Zuelueta and Clostales (2003).

$$n = \frac{N}{1 + Ne^2} \quad \text{Where: } n = \text{Sample Size}$$

N=Population

e= Marginal errors ($e \leq 0.05$)

With a population of 14, 315 elements, the sample considered to be representative was 388 respondents. Using the sampling technique, a percentage was derived of resultant number and applied to the table as shown below.

$$Std = \frac{n}{N} \times 100 \text{ i.e } Std = \frac{389}{14,315} \times 100 = 2.7\%$$

This percentage has been applied in each number of populations in each district.

Table 3.1 Sample

Region	Population category Sample	Sample size	Percentage of the Sample
Muhanga	1,728	47	12,11
Musanze	3,258	88	22,68
Rusizi	1,311	35	9,02
Huye	1,371	37	9,54
Rwamagana	1,359	37	9,54
Nyamagabe	1,158	31	7,99
Kabaya	1,124	30	7,73
Nyagatare	1,040	28	7,21
Nyamata	2,026	55	14,18
S/Total	14,375	388	100

Source: Research primary data, 2017

The sample included forty seven (47) respondents from Muhanga which represents twelve point eleven percent (12.11%) of the total sample. Twenty two point sixty eight (22.68%) From Musanze, 9.02% from Rusizi, 9.54% from Huye and Rwamagana, 7.99% from nyamagabe, 7.73% from Kabaya, 7.21% from Nyagatare, 14.18 From Nyamata of the total sample.

In this study, the researcher used Purposive and simple random sampling techniques. Purposive sample design involved selecting units (people) whose views are thought to be relevant, important and particularly worth obtaining for the research, Kothari (2010). Thus the researcher deliberately selected units to be included in the sample; the sampling method was called for, due to the nature of the study which demanded for the collection of Data from units with involvement, specialist, and experience in matters or field related to rural electrification where most people are reluctant to share information.

However, for the traders, simple random sampling technique was used as this offered the researcher with the opportunity to select respondents who fully represent the entire population.

3.6 Research Variables

The principle independent variable was Access to Electricity in rural areas and the dependent variable was Socio-economic benefit.

3.6.1 Independent Variable

Accessing to Electricity in rural areas was measured using satisfaction of being connected and use of some sets, the service delivery, and behavioural attitude.

3.6.2 Dependent Variable

Socio-economic benefits as dependent variable were measured by the increase of the welfare of the society that is derived from particular course of action or result of perceived economic activity

3.6.3 Validity, Reliability And Pilot Study of the Questionnaire

The validity of the questionnaire items was done, and the reliability of the instrument was tested. Validity implies good conceptualization and good operationalization. Reliability is a statistical measure on how reproducible the survey instruments' data are. The questionnaire was used to measure the variables. Validity and reliability assessment is merely the first step toward understanding the complex issues of measurement in theoretical and applied research settings (Edward & Zeller, 1976). The reliability of the research instrument was determined by the use of Cronbach's Coefficient Alpha that is used to test internal consistency. The Cronbach Coefficient alpha for reliability of this research was used at 0.627. This indicates that the research is quite reliable. The alpha provides a coefficient to estimate consistency of scores on an instrument if the items are scored as continuous variable (Disagree to Agree).

3.7 Sources of Data

The researcher used both primary and secondary data. Primary data were obtained from responses administered through questionnaires. The participants responded to the questions from all section. The researcher travelled in all the districts where the respondents are located and ensured that they provide answers as expected. The

questionnaire was used to get the perceptions on socio-economic benefits of rural electrification in Rwanda.

Secondary data were obtained from library and other documents such as Reg reports, audited and unaudited reports, minutes of the planning etc.

The researcher interviewed the above population in order to get more clarification about the perception of

3.8 Data Collection Instruments

Questionnaires were used to collect data from respondents; some questionnaires were left to those with busy schedules and were picked later after being filled. Where the respondent could neither read nor write especially in English, the researcher read the questions to the respondent with a number of probe. Before interviewing, the researcher introduced himself, the title of the study, and clarified on the overall objective, time to be taken and confidentiality assurance by the use of interview guide. The interview guide used is attached as Appendix 2.

3.8.1 Questionnaires

Questionnaires were issued to respondents, having both closed-ended and open ended questions. The closed-ended questions enabled the researcher have responses in his own words, while the open-ended questions provided chances to interviewees to include more issues that were outside the knowledge and experience of the researcher. The questionnaire used is attached as Appendix 1.

3.9 Data processing and Analysis

Data collected were carefully compiled, sorted, edited, classified, coded and checked for accuracy and relevancy.

3.9.1 Data processing

Data from various documents including questionnaires were read carefully, edited for completeness and accuracy. Data pertaining to REG collected over 5 years was aggregated with the help of Excel spread sheet and SPSS programme.

3.9.2 Data analysis

Tables, graphs, figures and percentages were used to analyze and present the findings of the study.

3.10 Limitations to the study

Like any other research, a number of problems were encountered during the study.

- i. Lack of co-operation from respondents, as some of them thought they were suspects of tax evasion and avoidance. Here the researcher was forced to give more clarification and submit an introduction letter from the University that tried to convince respondents to understand that, the study was for academic purpose and their responses would be kept confidential in order to give them confidence and thereafter, they were able to respond positively.
- ii. Communication was a problem as most of the respondents were not able to read and write in English, in this case, questionnaires had to be translated during the interview and others were allowed to write their responses in Kinyarwanda language.
- iii. The study was affected by non-response from some expected respondents.
- iv. Financial constraints did not permit for in-depth investigation, as some respondents required money before they could respond.

3.11 Data Analysis Methods

The obtained Data was analyzed with the aid of the Statistical Package for Social Sciences (SPSS). Descriptive method such as frequencies, percentages, means and correlation coefficient were used to analyse data. According to Neil (2009), the correlation coefficient reflects the degree of relationship between variables. The correlation was used to investigate the relationship between dependent variable (access to electricity) and independent variable (social benefits, economic benefits).

The data collection process proceeded for a period of one week. The use of the official records of documents such as REG's reports was also consulted as a secondary source of data.

CHAPTER FOUR

PRESENTATION OF DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

This chapter contains the results, discussions and the interpretation of the responses from the study. For clear comprehension and better understanding of this study, this chapter is divided in two sections which are:

Section 1 will treat the rural electrification in Rwanda and section 2 will concern the data analysis relating to the data collecting from people and secondary data. The chapter starts by the section one which presents the real situation of rural electrification in Rwanda since the period of independence, the power stations in Rwanda and Rwanda Energy Sector Overview.

The section 2 deals with the findings and presentation included: First, the characteristics of respondents, characteristics of respondents by age and sex, level of education etc

Section 1:

4.1 Rural Electrification In Rwanda

In 1962 when Rwanda was acceded to independence, there was an only 1 small hydropower station in rural Rwanda, with a total installed capacity of 11.5 MW, and total electricity consumption in rural areas was 20 kWh. Since 1995, rural electrification has made considerable progress and contributed a lot to the sustained and steady development of the agricultural sector, the rural economy and the quality of life of rural households. As a developing country, Rwanda has introduced electricity access to over 9million rural residents in over 22 years

and has achieved an electricity access rate which is not as high as 7.7 percent now. Considering the high cost of electricity delivery and the low income of rural residents, Rwanda has not yet been highly successful in electrifying rural areas in the past half century.

Access to electricity is the key to overall development of the rural region. The historical process of rural electrification in Rwanda has seen major institutional changes at the central government level over the last 23 years. In 1962, when the Rwandan People were independents, it was short of capital, technology and management professionals to promote rural electrification.

From 1995 to 2014, there coexisted two separate electricity systems in Rwanda: rural electricity with AERP and EUCL state electricity. From 1999 to 2005, Rwanda established a comprehensive vertical system of rural electricity administration under strict central planning.

From 2012 to 20014, Rwanda implemented a policy of reforming rural electricity management, renovating rural power grid, and unifying rural and urban electricity tariffs, and the central government separated local electricity supply from local government to facilitate the commercial operation of the utility market

In year 2016, the government of Rwanda in its strategic plan aimed at increasing electricity access rate by 16 per cent (MININFRA, 2016). In order to achieve these objectives and to increase the electricity network, the government's vision 2020 electricity target is to have at least 70 per cent of the population connected to electricity up from the 16% in 2010.

The EARP is a fairly new organization that was established in terms of the Rural Electrification Act in developing rural electrification. In February 2009 the idea of a countrywide rural electrification programme was mooted. This study led to the current Rural Electrification Programme, which was endorsed as a cabinet approved master plan in 2017/2018.

4.1.1. Power Stations in Rwanda

The following page lists all power stations in Rwanda. The country is in the midst of a rapid expansion of its electrical grid and many new plants are proposed or under construction. See in appendix

Rwanda is planning to expand from 45 MW of grid power in 2006 to 563 MW in 2018 and may import up to an additional 450 MW from neighboring countries. As of February 2017, national generation capacity totalled 209 Megawatts.

Rural electrification is a common challenge facing developing countries due to the high cost of electricity delivery and the low income of rural residents, and because private investors have little incentive to invest.

Why then has Rwanda made a progress in rural electrification what is the relationship between rural electrification and its institutional reform? The World Bank (2014) proposes that the success of rural electrification in Rwanda is a result of the Government's emphasis on providing electricity and the central government's favorable policy that encouraged the development of rural electrification, but they did not provide an empirical demonstration of their argument.

In terms of fund sources, investment is made not only by central and local governments, but also by rural residents. Therefore, the effect of institutional structure and its reform on different investors would have been overlooked if the rapid progress of rural electrification had been attributed only to governmental investment and its favorable policy.

The main challenge is that electricity market is not yet liberalized in order to take advantages of the diversify sources of investment and consolidates the achievements of rural electrification. The main targets of rural electrification are to facilitate rural social, economic and cultural development, not just to offer electricity access to rural areas, but to maximize the function of electricity.

Therefore, in the course of rural electrification, the government should synthetically consider policies and strategies for boosting local electricity market, agricultural production, industry, and education development, instead of making electricity access its ultimate target.

4.1.2 Rwanda Energy Sector Overview

The Government of Rwanda, under its latest Economic Development and Poverty Reduction Strategy, envisions transitioning from a developing country to a middle-

income country by 2020. But Rwanda's ability to achieve this ambitious goal is constrained by challenges in the power sector. As a result, Rwanda's government is working to target 100% access to electricity by 2020.

Although Rwanda is endowed with a number of natural resources, including hydro, solar, and methane gas to power, and has plans to generate 563 megawatts (MW) of electric power from these sources, it currently only has about 209 MW of installed generation capacity to serve a population of more than 11.5 million people.

The majority of its existing capacity comes from hydropower (approximately 59%) and thermal generation (approximately 40%). Most of the generation projects in Rwanda are the result of public-private partnerships between the government and independent power producers.

A law repealing the previous utility, the Energy, Water and Sanitation Authority, paved the way for the creation of a corporate entity which was incorporated in July 2014 with 100% government shareholding. The Rwanda Energy Group Limited (REG Limited) and its two subsidiaries; The Energy Utility Corporation Limited (EUCL) and The Energy Development Corporation Limited (EDCL) entrusted with energy development and utility service delivery while the Water and Sanitation Corporation (WASAC) has the mandate to develop and operate water and sanitation infrastructure has the mandate to develop and operate water and sanitation infrastructure and deliver related services in the country.

Since 2008, power supply has grown by 360% from 45 MW to 209 MW while peak demand has grown only 133% from approximately 119 MW in 2017. Rwanda is also part of the Eastern Africa Power Pool, and has plans to import up to 30 MW from Kenya in 2017.

Based on current data, Rwanda's national electrification rate has reached 25% (3% off-grid, 28% on-grid). Over seven million people still lack access to electricity.

Despite high resource potential and opportunities for cross-border export, Rwanda's power sector faces significant challenges, including a constrained transmission system. The annual consumption of electricity per capita is among the lowest in

Africa, with approximately half of consumers using an average of less than 20 kWh per month.

The Ministry of Infrastructure (MININFRA) leads the country's national energy policy. In an effort to reach the 100% access target, MININFRA developed a Rural Electrification Strategy, which was approved by Cabinet on April 27, 2016. This strategy revised the target of providing 70% access to electricity by June 2018 with on-grid connections, to a target of 22% of households gaining access to a Tier 1 energy service (as defined in the SE4ALL Multi-Tier Framework) and 48% of households gaining access to on-grid or at least Tier 2 energy service.

On January 1, 2017 Rwanda introduced cost cutting measures for poor households by cutting the tariff for the first 15kWh consumed per month by 50%. It also reduced industrial tariffs to bring make them competitive with regional rates and brought in a time-of-use tariff for industrial customers in order to shift load to off-peak periods.

Power Africa is supporting Rwanda's energy development strategy through a wide range of technical assistance, in cooperation with the World Bank Group, the African Development Bank, the Government of Sweden, the Government of Norway, the Government of Canada, the UK Department for International Development, and other development partners:

1. Assist with the development of new policies and procedures that will facilitate private-sector led IPP investments in solar, hydro, and other projects
2. Provide transaction assistance to projects attempting to reach financial close
3. Assist with the planning, operation, and maintenance of generation, transmission, and distribution systems
4. Support access to off-grid electricity

4.1.3 Health Butaro Hospital at Burera, Northern Province

The quality of healthcare in Rwanda has historically been very low, both before and immediately after the 1994 genocide. In 1998, more than one in five children died before their fifth birthday, often from malaria.

Rwanda government has made healthcare one of the priorities for the Vision 2020 development programme, boosting spending on health care to 6.5% of the country's gross domestic product in 2013, compared with 1.9% in 1996. The government has devolved the financing and management of healthcare to local communities, through a system of health insurance providers called *mutuelles de santé*. The *mutuelles* were piloted in 1999, and were made available nationwide by the mid-2000s, with the assistance of international development partners. Premiums under the scheme were initially US\$2 per annum; since 2011 the rate has varied on a sliding scale, with the poorest paying nothing, and maximum premiums rising to US\$8 per adult. As of 2014, more than 90% of the population was covered by the scheme.

The government has also set up training institutes including the Kigali Health Institute (KHI), which was established in 1997 and is now part of the University of Rwanda. In 2005, Rwanda government also launched a program known as The Malaria Initiative. This initiative aimed to help get the most necessary materials for prevention of malaria to the most rural areas of Rwanda, such as mosquito nets and medication.

In recent years Rwanda has seen improvement on a number of key health indicators:

1. Between 2005 and 2013, life expectancy increased from 55.2 to 64.0,
2. under-5 mortality decreased from 106.4 to 52.0 per 1,000 live births,
3. Incidence of tuberculosis has dropped from 101 to 69 per 100,000 people.

The country's progress in healthcare has been cited by the international media and charities. The Atlantic devoted an article to "Rwanda's Historic Health Recovery". Partners In Health described the health gains "among the most dramatic the world has seen in the last 50 years".

Despite these improvements, however, the country's health profile remains dominated by communicable diseases, and the United States Agency for International Development has described "significant health challenges", including the rate of maternal mortality, which it describes as "unacceptably high", as well as the ongoing HIV/AIDS epidemic. According to the American Centers for Disease Control and Prevention, travellers to Rwanda are highly recommended to take preventive malaria medication as well as make sure they are up to date with vaccines such as yellow fever.

Rwanda also has a shortage of medical professionals, with only 0.84 physicians, nurses, and midwives per 1,000 residents. The United Nations Development Programme (UNDP) is monitoring the country's health progress towards Millennium Development Goals 4–6, which relate to healthcare. A mid-2015 UNDP report noted that the country was not on target to meet goal 4 on infant mortality, despite it having "fallen dramatically" the country is "making good progress" towards goal 5, which is to reduce by three quarters the maternal mortality ratio while goal 6 is not yet met as HIV prevalence has not started falling.

4.1.4 Telecommunications in Rwanda

The largest radio and television stations are state-run, and the majority of newspapers are owned by the government. Most Rwandans have access to radio; during the 1994 genocide, the radio station Radio Télévision Libre des Mille Collines broadcast across the country, and helped to fuel the killings through anti-Tutsi propaganda.

As of 2015, the state-run Radio Rwanda is the largest station and the main source of news throughout the country. Television access is limited, with most homes not having their own set. The government rolled out digital television in 2014, and a year later there were seven national stations operating, up from just one in the pre-2014 analogue era. The press is tightly restricted, and newspapers routinely self-censor to avoid government reprisals. Nonetheless, publications in Kinyarwanda, English, and French critical of the government are widely available in Kigali. Restrictions were increased in the run-up to the Rwandan presidential election of 2010, with two independent newspapers, Umuseso and Umuvugizi, being suspended for six months by the High Media Council.

The country's oldest telecommunications group, Rwandatel, went into liquidation in 2011; having been 80% owned by Libyan company LAP Green. The company was acquired in 2013 by Liquid Telecom, a company providing telecommunications and fibre optic networks across eastern and southern Africa. As of 2015, Liquid Telecom provides landline service to 30,968 subscribers, with mobile operator MTN Rwanda serving an additional 15,497 fixed line subscribers. Landlines are mostly used by government institutions, banks, NGOs and embassies, with private subscription levels

low. As of 2015, mobile phone penetration in the country is 72.6%, up from 41.6% in 2011.

MTN Rwanda is the leading provider, with 3,957,986 subscribers, followed by Tigo with 2,887,328, and Bharti Airtel with 1,336,679. Rwandatel has also previously operated a mobile phone network, but the industry regulator revoked its licence in April 2011, following the company's failure to meet agreed investment commitments. Internet penetration is low but rising rapidly; in 2015 there were 12.8 internet users per 100 people, up from 2.1 in 2007. In 2011, a 2,300 kilometres (1,400 mi) fibre-optic telecommunications network was completed, intended to provide broadband services and facilitate electronic commerce. This network is connected to SEACOM, a submarine fibre-optic cable connecting communication carriers in southern and eastern Africa. Within Rwanda the cables run along major roads, linking towns around the country. Mobile provider MTN also runs a wireless internet service accessible in most areas of Kigali via pre-paid subscription

4.1.5 Infrastructure

Transport in Rwanda, Electricity in Rwanda, and Water supply and sanitation in Rwanda

The Rwandan government prioritised funding of water supply development during the 2000s, significantly increasing its share of the national budget. This funding, along with donor support, caused a rapid increase in access to safe water; in 2015, 74% of the population had access to safe water, up from about 55% in 2010; the government has committed to increasing this to 100% by 2017 because of availability of electricity in rural area..

The country's water infrastructure consists of urban and rural systems that deliver water to the public, mainly through standpipes in rural areas and private connections in urban areas. In areas not served by these systems, hand pumps and managed springs are used. Despite rainfall exceeding 750 millimetres (30 in) annually in most of the country, little use is made of rainwater harvesting, and residents are forced to use water very sparingly, relative to usage in other African countries.

Access to sanitation remains low; the United Nations estimates that in 2012, 34% of urban and 20% of rural dwellers had access to improved sanitation. Government

policy measures to improve sanitation are limited, focusing only on urban areas.[194] The majority of the population, both urban and rural, use public shared pit latrines.

Rwanda's electricity supply was, until the early 2000s, generated almost entirely from hydroelectric sources; power stations on Lakes Burera and Ruhondo provided 90% of the country's electricity. A combination of below average rainfall and human activity, including the draining of the Rugezi wetlands for cultivation and grazing, caused the two lakes' water levels to fall from 1990 onwards; by 2004 levels were reduced by 50%, leading to a sharp drop in output from the power stations. This, coupled with increased demand as the economy grew, precipitated a shortfall in 2004 and widespread load shedding.

As an emergency measure, the government installed diesel generators north of Kigali; by 2006 these were providing 56% of the country's electricity, but were very costly. The government enacted a number of measures to alleviate this problem, including rehabilitating the Rugezi wetlands, which supply water to Burera and Ruhondo and investing in a scheme to extract methane gas from Lake Kivu, expected in its first phase to increase the country's power generation by 40%. Only 18% of the population had access to electricity in 2012, though this had risen from 10.8% in 2010.

4.1.6 Rwanda's service sector

Rural electrification is playing a great role in Rwanda's service sector suffered during the late-2000s recession as bank lending; foreign aid projects and investment were reduced. The sector rebounded in 2010, becoming the country's largest sector by economic output and contributing 43.6% of the country's GDP. Key tertiary contributors include banking and finance, wholesale and retail trade, hotels and restaurants, transport, storage, communication, insurance, real estate, business services and public administration including education and health in rural areas.

When Rural areas are electrified, the tourism is one of the fastest-growing economic resources and became the country's leading foreign exchange earner in 2014. In spite of the genocide's legacy, the country is increasingly perceived internationally as a safe destination. The number of tourist arrivals in 2013 was 864,000 people, up from 504,000 in 2010. Revenue from tourism was US\$303 million in 2014, up from just

US\$62 million in 2000. The largest contributor to this revenue was mountain gorilla tracking, in the Volcanoes National Park; Rwanda is one of only two countries in which mountain gorillas can be visited safely; the gorillas attract thousands of visitors per year, who are prepared to pay high prices for permits.

Other attractions include Nyungwe Forest, home to chimpanzees, Ruwenzori colobus and other primates, the resorts of Lake Kivu, and Akagera, a small savanna reserve in the east of the country.

In 2016, Rwanda was ranked 42nd and second best country in Africa to do business in the Mara Foundation

4.2 Section 2

This section covers the relevant information on the respondent's background in term of location (Province, District and Sector), gender, marital status, family size, occupation and academic qualification. The questionnaires were distributed to four provinces of the country: North, South, East, and West. Generally, the survey was conducted in remote sectors where rural electrification is implemented and secondary data

Table 4.1 Distribution of respondents by provinces

Provinces	Frequency	Percent
North	115	29.7
South	115	29.7
East	92	23.8
West	65	16.8
Total	388	100.0

Source: Research primary data, 2017

The above table 4.1 shows the distribution of the respondent by provinces. The Northern and Southern provinces have the same percentage of respondents at 29.7, both being the highest due to the fact that rural electrification has been fast tracked in these two provinces as compared to others. We also observed that the respondents are

distributed equally in the north and South provinces with 29.7%. The East province has 23.7%. while the West province represents the portion at 16.8%.

Table 4.2 Distribution of respondents according to the Districts

District	Frequency	Percent
Muhanga	48	12.4
Musanze	87	22.4
Rusizi	35	9.0
Huye	37	9.5
Rwamagana	37	9.5
Nyamagabe	31	8.0
Kabaya	30	7.7
Nyagatare	28	7.2
Nyamata	55	14.3
Total	388	100

Source: Research primary data, 2017

The table 4.2 presents the distribution of respondent per district with Musanze located in the north province having the highest distribution at 22.4% and Nyagatare in the East province having the lowest distribution at 7.2 %. Generally, due to the concept of Umudugudu (regrouped habitat), rural electrification has been fast tracked in the regions of Musanze and nyamata, which are the second ranked distribution at 14.3%.

This table4.3 below indicates the distribution of respondents by sectors, covering twelve rural sectors selected from the twelve districts representing the four provinces. Musanze which is located in Musanze district has 16.8% and Tumba sector with 0.5% respectively the high and low percentage of respondents at it representing its respective districts. This indicates that, the study collected reliable information about the perception on socio-economic benefits

Table 4.3 Distribution of respondents by Sectors

Sectors	Frequency	Percent
Rwigombogo	35	9.0
Kabaya	30	7.7
Runda	48	12.4
Mbazi	20	5.2
Tumba	2	0.5
Ngoma	15	3.9
Gisaka	31	8.0
Mwurire	37	9.5
Nyagatare	28	7.2
Mayange	55	14.2
Kamonyi	22	5.7
Musanze	65	16.8
Total	388	100.0

Source: Research primary data, 2017

The table 4.4 Distribution of respondents by gender

Gender	Frequency	Percent
Male	223	58.5
Female	158	41.5
Total	381	
Missing system	7	
Total	388	

Source: Research primary data, 2017

There were a total of 381 respondents among them 158 constituting 41.5% of the total were females and the rest were males (223 constituting 58.5%), as shown in Table 4.4 above. The reason could be that when the researcher visited the respondents the males as head of the family were the ones who welcomed him home and answered the questionnaire that he may have brought.

This distribution is significant in ensuring the elimination of gender based biasness in the findings of the study.

Table 4.5 Distribution of respondents according by marital status

Marital Status	Frequency	Percent
Married	263	68.3
Single	43	11.2
Widow	68	17.6
Divorced	11	2.9
Total	385	99.2
Missing system	3	0.8
Total	388	100.0

Source: Research primary data, 2017

The distribution of respondents according to the marital status shows that the majority of respondents are married with 68.3%, 17.6% are widowed. 11.2% are single and 2.9 are divorced. The distribution points to the fact that quite a substantial portion of the households could be headed by female confirming the findings by gender distribution. This could perhaps be attributed to the Rwandan genocide of 1994.

Table 4.6 Distribution of respondents by family size

	Frequency	Percent
Less than 5	185	47.7
5 Less than 10	155	39.9
More than 10	20	5.2
Total	360	92.8
Missing System	28	7.2
Total	388	100

Source: Research primary data, 2017

This table 4.6 above gives the respondents' distribution by household size with households having less than 5 members having 47.7%, and those with between 5 and 10 members having 39.9% while those with more than 10 members having 5.2%. This distribution has a significant implication on the electricity use and electricity consumption

Table 4.7 Distribution of respondents by occupation

	Frequency	Percent
Farmer	113	29.1
Artisans	41	10.6
Business People	101	26.0
Public servant	101	26.0
Others	17	4.4
Total	373	96.1
Missing System	15	3.9
TOTAL	388	100

Source: Research primary data, 2017

The distribution of the respondents according to their occupation indicates that 29.1% are farmers, 26.0% are business people recording similar percentage with public servants, and 10.6% are artisans while others categories account for 4.4 % This distribution impacts on the use of electricity for sustainable economic activities in agriculture and commerce. The distribution of artisans at 10.6% implies that in rural areas the level of job creation is on the starting point. This should be improved because electricity increases the artisan production level.

The rural farmers' respondents positively rated the following measures: construction of good access roads leading to various Ngoma communities/villages (3.65 ± 0.0293), installation of radio and television antennas at strategic position in Sake to aid radio and television reception in towns and villages (3.54 ± 0.072), mounting of electric transformers in villages/communities in Ngoma (3.91 ± 0.070), broadcasting of agricultural information on radio and television in Burera (3.6 ± 0.098) and building of community libraries in Burera villages so as to help in furnishing some rural literate farmers with books, leaflets, newsletters etc on agricultural information (3.28 ± 0.081).

Discussion

Other aspects of agricultural information which the rural farmers respondents have benefited from in the past as evidenced from the result of this study include: new methods of crop preservation, introduction of new herbicides and pesticides for the control of farm weeds and insect pests, methods of crop disease treatment and control,

better systems of electrification and the crop rotation and fertilizer application and types of soil and best soil type for planting through radio and television.

Rural farmers are meant to know and also adopt agricultural innovations relevant to their situations. It is the duty of institutional and government organs to ensure that villages in Rwanda have easy access to agricultural information for enhancement of crop productivity and better animal husbandry practice. From the result of this study the major organs used in accessing agricultural information by the rural farmers' Radio and television (though electrification) are popular organs in disseminating agricultural information to rural farmers. Of all the existing channels of agricultural communication, Rwanda farmers rank extension (extension services/agents) highest in terms of providing credible information and advice, especially on agricultural technology.

In most cases, when rural farmers try to have access to agricultural information, they are often groped with some constraints and the resultant effect of this is always poor agricultural yield. The result of this study revealed a good number of constraints which the rural farmers' respondents encounter in accessing agricultural information from their communities. These constraints are lack of access roads for regular visits by extension officers, poor public relation of some extension staff, poor radio and television signals, none availability of electricity supply in most villages, lack of funds to purchase newsletters, leaflets on agricultural information; illiteracy and inability of radio and television stations in rural areas.

Analysis by Research Questionnaire

Research question one

What is the profile of respondents in relations to electrification in term of?

- 1) Length of time electricity has been used
- 2) Time taken to have electricity
- 3) The amount paid to have electricity
- 4) The purpose of having electricity
- 5) The month amount spent for electricity

Table 4.8 Length of electricity use

	Frequency	Percent
Below one year	50	13.3
1-3 years	203	53.8
4-6 years	56	14.9
7-10 years	31	8.2
Above 10 years	37	9.8
Total	377	100.0
Missing System	11	
Total	388	

Source: Research primary data, 2017

This table 4.8 indicates the findings in term of period for which the 203 respondents have got electricity with 53.8 % having used electricity for between 1 and 3 years and 50 respondents constituting 13.3 % below one year perhaps as a result of programs like roll Out Program newly implemented by REG in June 2015. 14.9% have used electricity for between 4 and 6years, 8.2% for between 7 and 10 years, 9.8 % have been using electricity for over ten years implying that the rural areas are newly electrified thus more efforts need to be done to enhance rural electrification operations. A total of 67.7 % of the respondents indicates they have been using electricity for three years or less.

Table 4.9 Time taken to have electricity

	Frequency	Percent
One week	126	32.9
Less than 1month	185	48.3
More than 1 month	72	18.8
Total	383	100
Missing System	5	
Total	388	

Source: Research primary data, 2017

In assessing the case at which households are getting connected to the electricity network, Table 4.9 indicates that the majority of the connection are done in less than one month at 48.3 %, 32.9 % were connected within one week and 18.8 % were connected within more than one month. The finding indicates that it is relatively fast to access electricity in the rural areas due to the essence of rural electrification programs. It also implies that REG is efficient in responding to electricity needs of the community. However, a critical aspect of access to electricity is the cost of acquisition. Table 4.3.2 summarizes the required amount to be connected to electricity.

Table 4.10 Payment for electricity access

	Frequency	Percent
Between 5,000 to 10,000	8	2.1
Between 10,000 and 15,000	14	3.6
Between 15,000 and 20,000	6	1.5
Between 20,000 and 25,000	8	2.1
Between 25,000 and 30,000	28	7.2
More than 30,000	316	81.4
Total	380	97.9
Missing System	8	2.1
Total	388	100

Source: Research primary data, 2017

The study indicates that 81.4 % of respondents paid more 30,000 Rwf in order to get connection to the electricity line, 7.2 % paid between 25,000 and 30,000 Rwf, 3.6 % paid between 10,000 and 15,000 Rwf, 2.1 % paid between 5,000 and 10,000 Rwf 3.7 % Paid between 10,000 and 15,000 Rwf, and 2.1 % paid between 5,000 and 10,000Rwf and 20,000 and 25,000 Rwf. This distribution indicates that REG could be having a good strategy of connection households from varying economic and social backgrounds that is normally a characteristic of most rural regions.

Table 4.11 Appliances owned

	Frequency	Percent
Radio	226	58.2
Tv	73	18.8
Refrigerator	3	0.8
Other	49	12.6
Total	351	90.5
Missing System	37	9.5
Total	388	100

Source: Research primary data, 2017

Table 4.11 below presents the frequency distribution of appliance owned. The study indicates that 58.2% of the respondents own radios, 18.8% own television sets, 12.6% own other appliances, while 0.8% own refrigerators. The use of radios in the rural areas is very significant for enhanced communication and the need to be updated with the government's information and current global affairs.

This is significant in enhancing both social and economic welfare of the population since it facilitates access to prompt information and dissemination of knowledge that is vital in facilitating socio-economic welfare since when people are informed a positive change is expected, and the nation develops socially and economically.

Table 4.12 Purpose of electricity

	Frequency	Percent
Domestic	294	75.8
Business	84	21.6
Total	378	97.4
Missing System	10	2.6
Total	388	100

Source: Research primary data, 2017

The distribution of the findings with regard to the purpose of electricity shows that 75.8% have electricity for domestic use and 21.6% for Business purpose. The use of electricity for domestic purposes signifies the enhanced living standards for the households; it also signifies the great demand for electricity in the rural areas hence

justification for the great concern of rural electrification the direction to which REG is well heading to meet need. Given that the primary intention of having electricity is normally for lighting with rural electrification, the households in the rural areas are able to save money that could have been spent on other sources of fuelling and lighting such as petrol and diesel, and thus use the same to enhance their living standards.

Table 4.13 Type of Business Purpose of electricity

	Frequency	Percent
Shop	86	22.2
Small Industry	38	9.8
Milling	29	7.5
Bar	31	8.0
Total	184	47.4
Missing system	204	52.6
Total	388	100.0

Source: Research primary data, 2017

Table 4.13above presents the frequency distribution of type of business. The study reveals that in the commerce and small industry sector, 32.0 % of respondents use electricity in their shops and small industry, 7.5% of Milling, bars 8.0%. The rural electrification program has impacted the economic activities of the rural households positively as the study reveals the level of various economic activities being pursued. By providing more rural electrification services, business opportunities will increase hence increasing also employment opportunities thus improved living standards of the population.

Table 4.14 below shows that up to 33.0% recorded to have spent between Rwf 2,000 to 5000 Rwf on their monthly electricity bill per household. On the other hand, the majority of the respondents at 64.6% indicate that they are spending up to 5,000 Rwf up or below, which is affordable for an average Rwandan citizen.

Total 4.14 Amount spent for electricity per month

	Frequency	Percent
Less than 1,000	37	9.5
1,000 to 2,000	91	23.5
2,000 to 5,000	113	29.1
5,000 to 10,000	80	20.6
Less than 10,000	3	0.8
10,000 to 20,000	17	4.4
20,000 to 50,000	11	2.8
50,000 to 100, 000	18	4.6
More than 100,000	3	0.8
Total	3373	96.1
Missing System	15	3.9
Total	388	100

Source: Research primary data, 2017

Research questions two:

What are the perceptions of respondents on social benefits of rural electrification in terms of:

- a. Student's performances at school?
- b. Reduction of robbery
- c. Health issues related to eye problems
- d. Health canters' equipment and its performances,
- e. Quality living standards in terms of building
- f. Social life and family's standards,
- g. Poverty reduction and hunger eradication.

Table 4.15 Mean Rating on social benefits of rural electrification

Statement	Mean	Std Deviation
Students' performance at School has improved because they easily study and do their homework.	3.7809	.61501
Robbery has been reduced because of electrification	3.6641	.69850
Health issues related to eye problems have been reduced due to less usage of candles and kerosene lamps.	3.6710	.78495
Health centres are better equipped and perform better because of electricity.	3.8779	.39942
Electricity improve quality of standards of living in terms of building	3.8679	.36844
Health centers are better equipped and perform better because of electricity.	3.8779	.39942
Electricity has improved social life and family standards (refrigerators, freezers, baking ovens, cooking stoves...)	3.6442	.66975
Electricity contributes to poverty and hunger eradication	3.2161	1.04101
Social Benefits	3.6756	.42065

Source: Research primary data, 2017

Table 4.15 provides the distribution of the respondent's perceptions on the socio-economic benefits of rural electrification. The study shows that the respondents generally agree that student's performance at school have improved at 3.7809; they also agree that there have been a reduction in cases of robbery with a mean rating of 3.6641; they also agree that health issues relating to eye problems have reduced due to usage of candles and kerosene lamps with a mean rating of 3.671. the respondents agree with a mean rating of 3.8779 that health centres are better equipped and perform better because of electricity, further they agree that electricity has improved the quality of living standards in terms of building with a mean rating of 3.8679, social life and family's standards with a mean rating of 3.6442. Finally, the respondents tend to agree that electricity has contributed to the reduction of poverty and hunger.

Generally, with mean rating of 3.6756, the respondents agree indeed rural electrification has brought social benefits among the households.

1. Education: The majority of Rwandans are poorly informed about energy and related end-use practices and options. There is a need for adequate physical demonstrations on renewable electricity and efficiency to pupils and students. It is, therefore, necessary to include energy education, in particular, renewable energy and rational use of energy, in curricula for schools, vocational training centers, colleges and other learning institutions. There is also a need for mass educational and promotional efforts on energy issues targeted to the public.

2. Human Resources Development: The development of the electricity sector is dependent on the appropriate utilization and development of human resources. There is a lack of trained and skilled electricity experts in the sector. In addition, there are inadequate incentives to attract and retain qualified electricity experts in the sector.

In addition, cultural and traditional influences inhibit gender-balanced training. There is, therefore, a need to encourage and facilitate training in disciplines necessary for the development of the electricity sector in various institutions and organizations. Local communities, counterparts and partners in executing activities in the sector should be given priority in order to enhance dissemination of knowledge and skills and incentives should be established to enhance effective utilization of domestically and internationally available skills in the energy sector.

3. Research and Development: Identifying and targeting R&D policies and priorities must be supportive of national socio-economic development goals. R&D issues relating to biomass, rural electricity, energy end-use, affordability, and pricing mechanisms need greater attention. The challenge is to overcome the inadequate financial resources and lack of skilled manpower for R&D. There is also a lack of understanding and appreciation of critical electricity R&D issues both within the sector and for the general public as well as lack of institutional coordination in respect of various ongoing research activities in the sector. Co-operation between public and private sectors in R&D of electricity issues such as demand and supply management, pricing, conservation and rural electricity, need to be encouraged and coordinated. There is also a need to support regional and international co-operation in R&D on technological and non-technological advancement in the energy sector.

The government's Economic Development and Poverty Reduction Strategy for 2013–18 aims to increase access to electricity to 70% of households by 2017.

The government has increased investment in the transport infrastructure of Rwanda since the 1994 genocide, with aid from the United States, European Union, Japan, and others. The transport system consists primarily of the road network, with paved roads between Kigali and most other major cities and towns in the country.

Additionally, since the government is currently focusing on citizens' welfare through the implementation of small scale projects targeted at individuals small groups aimed at improving the citizen's lifestyle, the provision of rural electricity is quite vital. Generally,, the findings of this study show that rural electrification is a key indicator of socio-economic benefits with a mean rating of 3.8361.

Research question three

What are the perceptions of the respondents on the economic benefits of rural electrification in term of:

- a) Operation of small business?
- b) Improvement of communication
- c) Increase of service delivery,
- d) Extension of working hours
- e) Increase of small and medium industries,
- f) Increase of family revenue
- g) Creation of employment
- h) Increase of Land value
- i) Life improvement

Table 4.16 below presents the respondent's perception on the economic benefits of rural electrification. Generally, they agree that rural electrification has great economic benefits to them with a mean rating 3.8361. Specifically, the respondents agree that more small business are operating because of rural electrification with a mean rating 3.9534. They agree that electricity has improved communication and access to information, thus the members of the households are able to be informed of the prevailing government development policies and how they are affected by those policies. Additionally, since the government is currently focusing on citizens' welfare

through the implementation of small scale projects targeted at individuals small groups aimed at improving the citizen’s lifestyle, the provision of rural electricity is quite vital. Generally,, the findings of this study show that rural electrification is a key indicator of socio-economic benefits with a mean rating of 3.8361.

Table 4.16 Mean Rating on Economic benefits of rural electrification

Statement	Mean	Std Deviation
More business are operating because of rural electrification.	3.8497	.43629
Electricity has improved communication and access to information (telephones, TV, Radio...)	3.9534	.29348
Rural electrification increase service delivery	3.7358	.74737
Working hours have increase due to rural electrification	3.9247	.29233
Small and medium industries have increased	3.7630	.51968
The family revenue has increased because of electrification	3.6373	.70843
Electricity favors employment creation	3.8831	.38777
My life is now different from when there was no electricity	3.8361	.35610
ECONOMIC BENEFITS	3.8361	.28574
Valid (listwise)		

Source: Research primary data, 2017

Research question four

Is there a significant difference on the perception on social and economic benefits of rural electrification of the respondents grouped according to a) Province, b) District, c) purpose of electricity, d) gender, e) occupation, and f) type of business?

Table 4.16 below is a summary of comparison of the means distribution by provinces on the difference of respondents’ perceptions on social and economic benefits. As regards to the respondents perceptions on the social benefits, when ranked according to provinces, they registered an average mean of 3.67 (agree/high rating) with the highest mean 3.88 (agree/high rating) in North province and the lowest mean 3.25 (

Tend to agree/average rating) in East province. This means that there is a difference in the respondents' perception as given by the mean rating on how they perceived the social benefits realized through rural electrification.

Table 4.17 Comparison by Province

95% Inter for Mean Upper Bound	conf.	Province	N	Mean	Std Deviation	Errors	Min	Max	
		SOCIAL	North	115	3.8857	0.14681	.031369	3.00	4.00
		BENEFITS	Southern	115	3.7333	.28036	.02614	3.00	4.00
3.9128			East	92	3.2510	.56419	.05882	1.71	4.00
3.7851			West	65	3.7978	.27881	.06458	2.86	4.00
3.3679			Total	387	3.6748	.42087	.02139	1.71	4.00
			North	114	3.9669	.08353	.00782	3.56	4.00
			Southern	115	3.8822	.22631	.02110	2.56	4.00
		ECONOMICS	East	92	3.5880	.40086	.04179	2.67	4.00
		BENEFITS	West	65	3.8769	.18954	.2351	3.22	4.00

Source: Research primary data, 2017

Regarding the respondent's perceptions on the economic benefits, when ranked according to provinces, they registered an average mean of 3.83 (agree/high rating) with the highest mean 3.966 (agree/high rating) in North province and the lowest mean 3.58 (agree/high rating) in the East province. This means that there is difference in the respondents' perception as given by the mean rating on how they perceived the economic benefits realized through rural electrification. The implication here is that rural electrification has brought both social and economic benefits and the consumers agree highly that they have realized those benefits. the difference on the respondents' perceptions on socio-economic benefits when compared between and within groups. The table recorded the p-value 0.000 which is less than 0.01 on both social and economic benefits when the provinces are compared between and within

groups. This means the difference between and within groups exists, as confirmed by the means ranking. Hence it can be concluded that it is significant at 1% significance level and 5% and then we reject the null hypothesis H_0 . Hence, the social and economic benefits are different among provinces.

Table 4.18 Comparison by Purpose of Electricity

		N	Mean	Std Deviation	Errors	Min	Max
Social Benefits	Domestic	236	3.6668	.43668	.02547	1.71	4.00
	Business	142	3.6103	.37131	.04051	2.67	4.00
	Total	378	3.6765	.42294	.02175	1.71	4.00
Economics Benefits	Domestic	236	3.8271	.30294	.01770	2.56	4.00
	Business	141	3.6004	.20971	.02288	3.00	4.00
	Total	377	3.8367	.28514	.01469	2.56	4.00

Source: Research primary data, 2017

Table 4.18 presents the means distribution on Comparison by Purpose of Electricity based on the economic benefits and social benefits. The table compares economic benefits and social benefits with the overall mean of 3.83 (highly agree) and 3.67 (highly agree) respectively. Meaning that the respondents perceive that the purposes of having electricity are both economic and social with business purpose rating highest of all with the mean (3.87), while domestic purpose is rated lowest with the mean 3.66 (Highly agree).

The table 4.19 below presents the comparison on the perception on socio-economic benefits according the gender (Male and Female). As it is shown by the table above, the male and female perceive that rural electrification provides socio-economic benefits with an overall mean 3.68 respectively 3.83. This implies both male and female are committed to the socio-economic benefits of rural electrification.

Table 4.19 Comparison by Gender

		N	Mean	Std Deviation	Errors	Min	Max
Social Benefits	Male	223	3.7111	.38967	.02609	2.14	4.00
	Female	158	3.6374	.45480	.03618	1.71	4.00
	Total	381	3.6805	.41892	.02146	1.71	4.00
Economics Benefits	Male	223	3.8380	.27270	.01826	2.78	4.00
	Female	157	3.8373	.30082	.02401	2.56	4.00
	Total	380	3.8377	.28427	.01458	2.56	4.00

Source: Research primary data, 2017

Table 4.20 Comparison by Occupation

		N	Mean	Std Deviation	Errors	Min	Max
SOCIAL BENEFITS	Farmer	113	3.5752	0.55146	0.05188	1.71	4.00
	Artisan	41	3.6121	0.41082	0.06416	2.57	4.00
	Businessperson	101	3.7638	0.32729	0.03257	2.71	4.00
	Public servant	101	3.7666	0.28336	0.02820	2.71	4.00
	Others	17	3.5826	0.31879	0.07732	3.00	4.00
	Total	373	3.6825	0.41554	0.02152	1.71	4.00
ECONOMICS BENEFITS	Farmer	113	3.7566	0.35541	0.03343	2.78	4.00
	Artisan	41	3.8320	0.25230	0.03940	3.00	4.00
	Businessperson	100	3.8978	0.17277	0.01728	3.22	4.00
	Public servant	101	3.9043	0.23096	0.02298	2.78	4.00
	Others	17	3.6961	0.38795	0.09409	2.56	4.00
	Total	372	3.8402	0.28094	0.01457	2.56	4.00

Source: Research primary data, 2017

The table 4.20 compares the types of occupation by perceiving the social and economic benefits. As it has indicated by the table, the overall mean is 3.68 (agree/high rating), with all activities mentioned in table translate the perceptions on social benefits. Those social benefits should be seen through the public servant which

represents the highest mean 3.766 (agree high rating) followed by business with a mean of 3.763 (agree/high rating). The economic benefits, the overall mean of 3.84 (agree/high rating) here also the occupation of public servant has a highest mean which is 3.90 (agree rating) followed by the business activities with mean 3.89 (agree/high rating).

Table 4.21 Analysis of variance of socio-economic benefits by Occupation

		Sum of	Df	Mean	F	Sig
		Squares		Square		
Social benefits	Between Group	3.055	4	.764	4595	.001**
	Within Groups	61.178	368	.166		
	Total	64.233	372			
Economic Benefits	Between Groups	1.892	4	.473	6.337	.000**
	Within Groups	27.391	367	.075		
	Total	29.283	371			

Source: Research primary data, 2017

**Significant at 0.01 level

The two p-values are 0.00 we conclude that it is significant at 1% significance level and 5% and we reject Ho. Hence, we observe that the social and economic benefits exist among between the group occupations but at slight different level.

The table 4.22 below compares the types of business by perceiving the social and economic benefits. As it has indicated by the table, the overall mean is 3.76 (agree/high rating), with all activities mentioned in table translate the perceptions on social benefits. Those social benefits should be seen through the milling activity which represents the highest mean 3.83 (agree high rating) followed by the related to the bar with a mean of 3.82 (agree/high rating). Also for the economic benefits, the overall mean was 3, 8 (agree/high rating) Here the bar activities has a highest mean which is 3.92 (agree / high rating) followed by milling activities with mean of 3.87.

Table 4.22 Comparison type of Business

		N	Mean	Std Deviation	Errors	Min	Max
SOCIAL BENEFITS	Shop	86	3.7226	0.33475	0.03610	2.71	4.00
	Small Industry	38	3.7431	0.37813	0.06134	2.57	4.00
	Milling	29	3.8342	0.34541	0.06414	2.71	4.00
	Bar	31	3.8295	0.25666	0.04610	2.71	4.00
	Total	184	3.7624	0.33528	0.02472	2.57	4.00
Economics Benefits	Shop	86	3.8616	0.20446	0.2205	3.22	4.00
	Small Industry	38	3.8626	0.28584	0.4637	2.89	4.00
	Milling	28	3.8770	0.24444	0.04620	3.00	4.00
	Bar	31	3.9283	0.11312	0.02032	3.56	4.00
	Total	183	3.8755	0.21843	0.01615	2.89	4.00

Source: Research primary data, 2017

Research questions five.

Is there a significant relationship between the respondents perceptions of social economic benefits of rural electrification and a) length of electricity use, b) payment for electricity access, and c) amount spent for electricity per month?

Table 4.23 below shows a correlation matrix of the relationship between the respondent's perceptions on social and economic benefits of rural electrification and the following variables: length of electricity use, payment for electricity access, and amount spent for electricity per month. The Pearson correlation coefficient records in four instances, p-value 0.000 which is less than 0.05 significant levels. This is statistically significant both 0.01 and 0.05 level. That means the relationship really exists between social benefits and length of electricity use as well as amount spent for electricity per month. Also there is a positive relation between economic benefits and the length of electricity use as well as amount spent for electricity per month per households.

Table 4.23 Correlation Analysis of Socio-economic benefits of rural electrification

		Length of electricity use	Payment of electricity access	Amount spent for electricity per month
Social Benefits	Pearson Correlation	0.272	-090	0.359**
	Sig. (2-tailed)	0.000	0.81	0.000
	N	0.247**	-009	327**
Economics Benefits	Pearson Correlation	0.247**	-.009	0.327**
	Sig. (2-tailed)	0.000	0.862	0.000
	N	376	379	372

Source: Research primary data, 2017

Significant at 0.01 levels

Hence, we reject the null hypothesis, because the relationship is real and did not happen by chance. These findings imply that the longer the length of electricity use and the more the amount spent for electricity per month, the more the consumers perceived to realize the social benefits as a result of rural electrification. On the other hand, the more the social benefits are realized the more the amount the households spend on electricity bills per month

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to find out the perception on socio-economic benefits of rural electrification by determining how accessible electricity in rural areas is. This chapter summarizes the study findings and makes conclusions drawn from them. Recommendations and areas for further research are also presented. The summary of the findings is in tandem with the objectives of the study.

5.0 Summary of Key Findings

The study used the sampling of 388 questionnaires have been distributed to the respondents as representative sample. It considered the following household socio-economic characteristics influences electricity adoption using binary logistic regression model: distance from the transformer, gender, age, marital status, education, occupation, family size, house type, source of income, and monthly income. The results indicated that distance from the transformer, household size, gender, education, and total monthly income as the predictor variables for electricity adoption.

On assessing the socio-economic benefits of electricity adoption among households results revealed that all (100%) the households had acquired lighting devices. Mobile phones, radio and television ownership stood at 96.6%. 96.3% 94.4% respectively. The least owned electric appliances were those used to ease domestic labour which included electric iron box, refrigerator, chaff cutter, electric heater and computer ownership at 27.8%, 9.3% and 27.8% 11.1% and 3.7% respectively. Respondents agreed that electricity improved quality of living standards by using electrical equipment like refrigerators, freezers, etc. Respondents tend to agree that electricity contributes to poverty and hunger reduction with a rating of 3.21. The average rating of perceptions on social benefits of rural electrification is 3.67.

The results have shown that that, there is a relationship between rural electrification and economic benefits 87,6% of the respondents agree that more small businesses are operating because of rural electrification, 96.6 % of the respondents agree that

electricity has improved communication and access to information (Telephone, TV, Radio etc), 86.3 % of respondents agree that rural electrification increased service delivery, 80.2 % of the respondents agree that small and medium industries have increased, 73.8 % of the respondents agree that the family revenue has increased because of electrification, 88.6 % of the respondents agree that the value of land and buildings (business and homes) increased.

Radios were used in accessing information. Moreover 7.4% also used radios for entertainment purpose. Ownership of mobile phone was also established to have improved communication. Television set was also a common electric appliance among households whose major use was entertainment as reported by 81.5% of households and access to information at 79.6%.

Several other electrical appliances owned by a smaller proportion of households included refrigerator (9.3 %), computers (3.7%), chaff cutter (27.8%) and electric heater (11%).

Household members were involved in several small businesses that used electricity connected to the household. The study results revealed that a few households (18%) of households had home businesses among those affirmed having business at home about 77.8% (21) were adopters and 22.2% (6) are non-adopters. The mobile phone charging business was the most prevalent at 44.74%, hair dressing and barber shops each at 10.53%, and 34.21% of households respectively had general shop businesses.

Home-based businesses provided income for the households.

The salon business had an average monthly total income of Rwf 6,000 barber shop business mean monthly income Rwf. 5,250. Mobile phone business being the most prevalent was run by 17 households and the mean monthly income was 8,500. Ownership of general shop was the second most common home business with 13 households running it and having a monthly income of 14,769 hence having the highest mean monthly income among all small businesses conducted by households. Profit got was utilized in various ways. Paying school fees for the children was the primary expenditure item was at 86%. Paying electricity bills was at 36.4% while for domestic use was at 63.6%.

On assessing the challenges faced in electricity adoption, the respondents' perception on how various aspects challenge electricity was assessed using the questionnaire statements on a: +5 (strongly agree) to +1 (strongly disagree). The study revealed that respondents had a strong conviction with the fact that distance from the transformer

distance is a challenge when it comes to electricity connection from the grid to their households. This point out that majority up hold that distance from the transformer really challenge to electricity connection.

On the aspect of the cost of connection also both adopters (85.4%) and non-adopters (88.9%) strongly agree that the cost of electricity connection is a challenge to electricity adoption. This indicates that connection cost still remains a challenge when it comes to adoption. It was more so revealed that 92.7% and 85.2% of adopters and non-adopters reported to disagree with aspect of wiring cost being a challenge to electricity connectivity in their households. These results imply wiring cost is not quite a challenge when it comes to electricity adoption. Majority of households in

On the payment of bills, paying bills 88.5% and 87% of sampled households of adopters and non-adopters sampled respectively, disagreed with the contention that paying bills was a limiting factor in connecting to the grid electricity. Moreover 11.5% and 13% of adopters and non-adopters strongly disagreed that paying bill was a challenge when it came to connection of electricity to their households. It is noteworthy that electrified and non-electrified households have similar perception on this crucial factor. This suggests that households have no problem in paying their bills as long as they are connected to electricity. The respondents reported to have experienced unscheduled power cuts where electricity was cut for a whole day without any notice. Other challenges sighted by the respondents were delayed reading of bill and overestimation, power siege and most of the electronic equipment were destroyed due to high voltage and power outage.

A map generated on the spatial distribution of electricity adopters, shows distinctive disparity in the spatial distribution of adopter households in the study area. Majority of adopters are in the upper and middle zones with very few stretching out in the lower zones. A linear distribution is exhibited where the majority of the adopters tend to cluster along the major roads, shopping centers and health centers. More so, adopter households seem to be concentrated around the transformers.

According to the survey results, a high percentage of households are not connected to the grid electricity. Spatially, both the high and lower zones display high percentage of non-adoption. This pattern is unique because even in areas with high accessibility a good number of households are not connected to the grid.

5.1 Conclusion

Results presented in this study have established that there is generally low electricity adoption and that households' socio-economic characteristics such as household size, gender of household head, education attainment and distance from the transformer were the key determinants of rural electricity in Rwanda as explained by binary regression model. With these results the null hypothesis that there is no significant relationship between households' socio-economic characteristics and rural electricity was rejected. The results indicated that rural electrification had brought substantial benefits to the households; many households have improved quality of life especially from lighting which was practiced by all the households.

It was also established that few households owned home business that utilized electricity and reported to be of high benefit to their families. Major concerns observed were challenges that the households experienced which included blackouts, high connection cost and the distance from the electricity access points. Respondents acknowledged that the aforementioned factors discriminated electricity for rural areas, indicating that these challenges were of great concern.

From the empirical findings it is evident that public facilities connected to grid power are perceived to have higher quality of service provision as compared to those facilities not connected to electricity. This leads to the rejection of the null hypothesis that there is no significant difference in quality of service provision in electrified and non-electrified areas. The results further revealed that there was a remarkable spatial heterogeneity in access patterns within rural households. The upper land regions have a higher accessibility compared to the lower regions. Additionally, some areas having a higher share of households without access to electricity than others

The immediate benefits of electricity come through improving lighting, which promotes extended hours of study and in turn contributes to better educational. The researcher confirms that rural electrification contributes to the socio-economic Sustainability of rural households.

The researcher summarizes his conclusion as follow:

1. Access to electricity is easy for rural areas
2. Rural electrification provides social benefits
3. Rural electrification also provides economic benefits

5.2 Recommendations

From the findings and conclusion of this study, the recommendations are the following:

1. The population awareness on that electricity is the stimulus of economic activity has to be sensitized.
2. The electrification projects have to evaluate based on the social and economic benefit provided the electricity.
3. To input in place mechanism of population growth surveillance system to reinforce with existing structures that collect and analyze demographic and welfare data for early warning and timely intervention mechanisms against possible problems related to electricity supply.
4. To input in place mechanism of monitoring and evaluation of the population growth in order to contribute to smooth research and planning for the welfare of the population.
5. To reinforce the REG by continuing to provide sufficient, qualified and competent staff; and also to recruit a demographer for helping in estimate of population/ customers related to electricity supply in Rwanda that help to make a business plan, and the identifying training needs and plan for the
6. The government should increase and reinforce the monitoring and evaluation of Public utilities in order to reinforce good management.
To facilitate internet service providers to use modern infrastructures allowing good bandwidths in interest of the connections in
7. To introduce the usage of electronic transactions in public utilities in order to serve better the community
8. The government of Rwanda has to encourage the establishment of industries in rural areas by giving subsidy so that it can stop the rural migration

5.3 Recommendation for Further Studies

Upon the successful completion of this study, the following recommendations for further studies are considered to be appropriate to enhance the understanding of the causes of electricity supply shortage in Rwanda by,
Conducting a similar study within the whole population to understand

1. How Stakeholders' Perception of Socio-Economic Benefits of urban Electrification Cities Programme in Rwanda
2. Seeking to establish the critical factors that affect the effective implementation of electrification programs in Rwanda

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APPENDICES
APPENDIX 1: QUESTIONNAIRES TO THE RESPONDENTS

PROJECT MANAGEMENT SPECILATION
MASTER STUDIES PROGRAMME

Dear Sir/Madam,

REQUEST FOR DATA

I would like be grateful if you would complete the attached questionnaire for me. I am mastered student at University of Rwanda-College of Business and Economics doing a research on **‘Stakeholders’ Perception of Socio-Economic Benefits of Rural Electrification Programme in Rwanda’**

The purpose of this study is to attempt to understand whether rural electrification could have any socio-economic benefits.

Therefore, your participation by way of answering the questionnaire is extremely important to find how best electrification can benefit rural areas in Rwanda.

I enclosed with this letter is a brief questionnaire that asks a variety of questions about your perception of socio-economic benefits of electrification. Humbly I request you to respond to this questionnaire openly, honestly and frankly on the basis of your best experience, knowledge, and judgment.

The information given to me will be treated confidentially and will be strictly used for academic purposes only. The findings of my study can be sent to you upon your request.

Once again, I would be grateful if you could complete the questionnaire. I shall appreciate your assistance in carrying out this study.

Yours sincerely,

RUMONGE BILL REAGAN

Tel: 0783 876 165/0785 659 993; 0723 659 993 Email: francephanouel@gmail.com

This questionnaire has 3 sections as follows: section 1, and section 2, the filling of the questionnaire is expected to take you a few minutes to complete. Please tick the most appropriate information about yourself

Section 1:

1. Instruction: Indicate your answer by ticking [] or filling in the appropriate space,

1. Province : _____

2. District : _____

3. Sector : _____

2. Your gender: Male [] female []

3. Marital status:

1. Married: []

2. Single: []

3. Widow: []

4. Divorced: []

2. Job status: Top management []

Middle management []

First level supervisor []

Non managerial []

3. Your highest level of education

Diploma []

College degree []

Masters degree []

PHD degree []

Section 2: Access to electricity

Instructions: Indicate your answer by filling [] in the appropriate space or circling the appropriate number

1) How long have you been using electricity?

1. Below 1 year []

2. Between 1-3 years []

3. Between 4-6 years []

4. Between 7-10 years []

5. Above 10years []

2) How much time did you take to have electricity?

1) One Week []

2) Less than a month []

3) More than a month []

3) How much did you pay to have access to electricity?

1) Between 5000 and 10.000 []

2) Between 10.000 and 15.000 []

3) Between 15.000 and 20.000 []

4) Between 20.000 and 25.000 []

5) Between 25.000 and 30.000 []

6) More than 30.000 []

4) For which purpose did you decide to have access to electricity?

1) Domestic []

2) Business []

5) If domestic purpose which of the following appliances do you currently have?

- 1) Radio []
- 2) TV []
- 3) Refrigerator []
- 4) Other, specify_____

6) If the purpose was for business, indicate the type of business you are operating

- 1) Shop []
- 2) Small Industry []
- 3) Milling []
- 4) Snack Bar []

7) What average amount do you spend on electricity per month for domestic purposes?

- 1) Less than 1.000 []
- 2) Between 1.000- 2.000 []
- 3) Between 2.000- 5.000 []
- 4) Between 5.000-10.000 []
- 5) Less than 10.000 []
- 6) Between 10.000- 20.000 []
- 7) Between 20.000- 50.000 []
- 8) Between 50.000- 100.000 []
- 9) More than 100.000 []

Section 3:

Instructions: Indicate your answer by ticking one of the four numbers that best represent your opinion about the statement. The following scale is to be used:

Scoring	Verbal Interpretation	Symbols
4	Strongly Agree	S A
3	Agree	A

2	Strongly Disagree	SD
1	Disagree	D

Statement	D	SD	A	SA
Social Benefits				
1. Student's performance at school has improved because they easily study and do their homework	1	2	3	4
2. Robbery has been reduced because of electrification	1	2	3	4
3. Health Issues related to eye problems have been reduced due to less usage of candles and kerosene lamps	1	2	3	4
4. Health centres are better equipped and perform and better because of electricity	1	2	3	4
5. Electricity improve quality of living standards in terms of building	1	2	3	4
6. Electricity has improved social life and family standards (refrigerators, freezers, banking ovens, cooking stoves...)	1	2	3	4
7. Electricity contributes to poverty and hunger eradication	1	2	3	4

Statement	D	SD	A	SA
Social Benefits				
1. More small businesses are operating because of rural electrification.	1	2	3	4
2. Electricity has improved communication and access to information (telephones, TV, Radio...)	1	2	3	4
3. Rural electrification increase services delivery	1	2	3	4
4. Working hours have increased due to rural electrification	1	2	3	4
5. Small and medium industries have increased	1	2	3	4
6. The family revenues has increased because of electrification	1	2	3	4
7. Electricity favours employment creation	1	2	3	4
8. The value of land and buildings (business and homes) increased	1	2	3	4
9. My life is now different from when there was no electricity	1	2	3	4

APPENDIX 2
INTERVIEW GUIDE

I want to thank you for taking the time to meet with me today.

My name is , and I would like to talk to you about **‘Stakeholders’ Perception of Socio-Economic Benefits of Rural Electrification Programme in Rwanda’** particularly on the contribution of the electricity to reduce poverty and hunger and how the electricity improve the quality of living standards in terms of building

Our overall objective is to assess the impact of rural electrification in the socio-Economic development in order to capture means that can be used in future interventions.

The interview will take less than twenty minutes and I will be taking some notes during the session.

All responses will be kept confidential. This means that your interview responses will only be shared with the researchers and we will ensure that any information we include in our report does not identify you as the respondent.

Are there any questions about what I have just explained? Are you willing to participate in this interview?

.....

Interviewee Witness Date

.....

Legal guardian (If interviewee is under 18)

APPENDIX 3

LIST OF POWER STATIONS IN RWANDA

Hydroelectric station	Community	Type	Capacity (MW)	Year completed	Name of reservoir	River
Ntaruka Power Station	Ntaruka	Run of river	11.5 MW	1959	N/A	Nyabarongo River
Mukungwa Power Station	Mukungwa	Run of river	12 MW	1982	N/A	Nyabarongo River
Mukungwa II Power Station	Mukungwa	Run of river	2.5 MW	2010	N/A	Nyabarongo River
Nyabarongo I Power Station	Nyabarongo	Run of river	28 MW	2014	N/A	Nyabarongo River
Rukarara Power Station	Rukarara	Run of river	9.5 MW	2010	N/A	Rukarara River

Proposed

Hydroelectric station	Community	Type	Capacity (MW)	Year completed	Name of reservoir	River
Nyabarongo II Power Station	Nyabarongo	Run of river	120 MW	2020	N/A	Nyabarongo
Rusizi III Power Station	Rusizi	Run of river	145 MW	2020	N/A	Rusizi
Rusumo Power Station	Rusumo	Run of river	80 MW	2018	N/A	River Kagera

Thermal Power	Community	Fuel Type	Capacity (MW)	Year completed	Name of Owner	Notes
Kivu Watt Power station	Gisenyi Rubavu Distribut	Methane	25 MW	2015	Contour Global	Under expansion to 100mw

Thermal Power	Community	Fuel Type	Capacity (MW)	Year completed	Name of Owner	Notes
Gisagara Peat Power Plant	Gisagara District, Southern Rwanda	Peat	80 MW	2017 (expected)	Hakan	
Gishoma Peat Power Plant	Rusizi District, Western Rwanda	Peat	15 MW	2015 (expected)	Shengli Energy Group and Punj Lloyd	May be expanded to 55 MW
Symbion Power Station	Nyamyumba, Gisenyi, Rubavu District	Methane	50 MW	2016 (expected)	Symbion Power Inc.	Can be expanded to 100MW.

Thermal Power	Community	Fuel Type	Capacity (MW)	Year completed	Name of Owner	Notes
Gisagara Peat Power Plant	Gisagara District, Southern Rwanda	Peat	80 MW	2017 (expected)	Hakan	
Gishoma Peat Power Plant	Rusizi District, Western Rwanda	Peat	15 MW	2015 (expected)	Shengli Energy Group and Punj Lloyd	May be expanded to 55 MW
Symbion Power Station	Nyamyumba, Gisenyi, Rubavu District	Methane	50 MW	2016 (expected)	Symbion Power Inc.	Can be expanded to 100MW.

Solar

Solar Station	Power	Community	Fuel Type	Capacity (MW)	Year completed	Name of Owner	Notes
Ngoma Power Station	Solar	Kibungo, Ngoma District	Solar	2.4 MW	2011	Government of Rwanda	Operational
Rwamagana Solar Power Station		Agahozo, Rwamagana District	Solar	8.5 M	2015	Scatec Solar Company & Gigawatt Global Cooperatief	Online
Kayonza Solar Power Station		Rwinkwavu Kayonza District	Solar	10 MW			

Source: International Energy Agency (2016)