SOCIO-ECONOMIC EFFECTS OF RURAL ELECTRIFICATION IN TALA DIVISION, MACHAKOS COUNTY, KENYA

BY

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DECLARATION

This research report is my original work and has not been submitted for award of a degree in any other University.

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DEDICATION

I wish to dedicate this report to my wife Janet Awour for her love and encouragement.

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I dedicate this work to the almighty for seeing me through my years of University education. His Grace and mercy has brought me this far and I am grateful.

My deepest appreciation goes to my supervisor, Prof. T Maitho for his patience, guidance and constructive criticisms that helped me stay focused from the beginning of this work to the end.

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ABBREVIATIONS AND ACRONYMS

ADB	African Development Bank
AFD	Agence Francaise Developpement
CD	Community Development
EIB	European Investment Bank
GOK	Government of Kenya
HDI	Human development Index
IEA	International energy Agency
IFC	International Finance Corporation
KIHBS	Kenya Integrated Household Budget Survey
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting Company Ltd
LPG	Liquefied Petroleum Gas
MDGs	Millennium Development Goals
NDF	Nordic Development Fund
NGO	Non Governmental Organization
PM	Project Management
REA	Rural Electrification Authority
RELF	Rural Electrification Levy Fund
REP	Rural Electrification Programme
REPLF	Rural Electrification Programme levy Fund
SD	Sustainable Development
SSA	Sub-Saharan Africa
UNDP	United Nations Development Programme

ABSTRACT

The Government has invested in rural communities with a sole aim of improving the social and economic lives of those living in the rural areas. This is through programmes and projects such as rural electrification. These projects are expensive both in design and implementation. One of these areas that has been earmarked by the government is Tala Division of Machakos County. But do these projects always deliver expected outcomes? The purpose of this study was to establish the socio-economic effects of the rural electrification programme in Tala Division of Machakos County in Lower Eastern Kenya. The objectives of the study were to establish the distribution patterns of electricity in Tala Division, the uses at the community and household level of electricity, the social as well as the economic effects of rural electrification at both the household and community levels. The study adopted a descriptive design of the implementation. The target population was 4,780 households connected in 43 villages in the division through the programme. The stratified randomized sampling design was used. The total numbers of questionnaires dispatched were 473, of which 391 were returned making the response rate 83.3%. The data was analyzed quantitatively using statistical package for social sciences and presented through tables showing frequencies, percentages, means and t-scores. The changes in the responses have also been checked to establish whether the differences are significant enough. From the findings, majority of the households are headed by men at 81.8%, with 62.9% of the household heads being within the age bracket of 31 to 50 years .it is evident that over 93% of the electricity connections are within a radius of two kilometers from the main electricity grid as well as the tarmac roads. The households mostly use electricity for domestic appliances with lighting being 100% while few community facilities are connected with shops at 79% connection. The households felt that they are developed and rural electrification has had positive improvement in their lives but that there is need to either improve infrastructure in order to connect more villages or to review the guidelines on rural electrification. The study further shows that rural electrification is not sufficient to have increased disposable incomes but these infrastructural developments should accompany other initiatives such as provision of funds that would enable members of the communities to invest and make use of available electricity for production purposes to realize economic benefits from the connectivity. From the study, rural communities and households with easy access to tarmac road are connected faster to the grid. Most rural households spent less than one thousand shillings on electricity bills monthly which explains the basic electrical appliances used by the households. It is recommended from the study that the government should review the regulations governing the rural electrification in line with infrastructure development. In addition, the full economic benefits of rural electrification should be exploited in order to have meaningful development. Rural electrification is one of the ingredients of development, hence should be embraced by the government to enhance economic growth. The study is useful to the Kenya government. It provides the required data that is necessary for planning purposes and justification for funding such projects. It is also important to researchers and academicians interested in the subject of rural electrification.

CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

Among the basic infrastructural services geared to developmental needs, electricity is a critical input. The use of electricity serves the economic as well as social needs. While in the context of much developed world, and possibly, in the urban areas of the developing world, the above statement may sound somewhat trite, the availability and use of basic services in rural areas of the developing world presents a completely different and more complex set of issues. There is, indeed, even a conflict in policy perceptions: are these inputs a basic need or a want? If the former, can the recipient respond effectively to the provision of the service; should service be subsidized; and finally, are the economic and social benefits that the electrification is meant to provide commensurate with developmental expectations. These issues have been the basis for a considerable amount of developmental debate. However, what is clear is that development policies will continue to stress investment in infrastructure. Given this fact, an understanding of the consequences that result from and the determinants that shape the use of any such basic input is imperative for the design of more effective future policies as well as for the analysis of those of the past. Rural electrification is one such infrastructural input (Bensch, et al, 2011).

It is universally accepted that electrification enhances quality of life at the household level and stimulates economy at a broader level. The immediate benefit of electrification comes through improved lighting, which promotes extended hours of study and reading and other household chores, and in turn contributes to better educational achievements. Lighting can also benefit many other household activities, such as sewing by women, social gatherings after dark, and many others. Communication devices such as radios and television also improve the access to information by rural households and can provide entertainment to family members. In addition, household's economic activities both from inside and outside home benefit tremendously from electricity. For example, crop productivity can be increased by the application of electric irrigation pumps, businesses can be operated longer hours in the evening, electric tools and machinery can impart efficiency and production growth to industrial enterprises, and so on. The benefits of electricity have been discussed in a large body of literature (Cabraal and Barnes 2006; Barnes et al, 2003; Kulkarni and Barnes, 2004; Khandker, 1996; Filmer and Pritchett, 1998; Roddis, 2000; World Bank, 2002; Agarwal, 2006).

Given its substantial benefits, electrification together with other sources of modern energy has been identified as essential for fulfilling the Millennium Development Goals (MDGs) (UNDP 2005). The World Bank views electrification as an integral part of development and has supported electrification projects in many developing countries. This study examines one such electrification project called Rural Electrification Programme in Kenya with specific focus of Tala in Machakos County. Most of the electrification projects financed by the Bank in many developing countries often expand coverage of grid electrification with specific objectives in mind, for example, improving welfare such as income and education, establishing institutional mechanisms for rural electrification, providing inputs to power sector reform, formulating guidelines for tariffs, subsidies, and others. Among the multiple objectives, making a positive impact on the livelihood of rural people is the foremost.

There is need for a proper assessment of such projects to determine if, and to what extent, these objectives are achieved. Although there have been many general studies on rural electrification as it relates to development (Barnes et al, 2003; Barnes ,1988; Saunders et al, 1975), there have not been many systematic impact studies of particular rural electrification projects and this includes Kenya. Most of the past evaluation works on specific rural electrification projects has concentrated on project outputs, mainly number of communities or households connected. Such assessments usually do not measure the nature and extent of the accrued benefits, let alone establish the causality as to whether the measured benefits are attributable to electrification.

While industrialized countries and rich developing countries have electricity access to their rural populations at nearly 100%, the access in rural parts of poor countries is to a large extent below 10%. A great deal of effort to improve the level of access is being made but the impact of the efforts is still minimal. (Abdalla, 2005)

Kenya is not an exception in facing energy dilemma just like most countries in Sub-Saharan Africa (SSA), one of the key obstacles to the shift to modern energy consumption is the limited access to electricity for households, particularly in the rural areas. The overall electrification rates in SSA stand at 23%, with the urban and rural area figures standing at 51% and 8% respectively (International Energy Agency (IEA), 2002). However, Kenya has electrification rates below the SSA average with 14% overall connection and a breakdown of 42% and 4% for urban and rural areas respectively (Kenya National Bureau of Statistics (KNBS), 2000). One reason for this low level of electrification in rural areas is the lack of available finance to cover capital and operating costs for generation, transmission and

distribution of electricity, which are higher than in urban areas. The high connection costs coupled with low consumption of electricity and low incomes among rural households are further obstacles to the electrification of these households. Most rural households consume traditional energy sources derived from wood fuel, charcoal, agricultural residues and cow dung. In fact, the dominant energy source for non-electrified households in Kenya is primarily wood fuel and charcoal. Wood fuel provides 70% of the energy for all sectors in the country, except for the transport and commercial sector. Its use is common among households in rural areas, because it is relatively cheap and widely available and in fact 80% of these households consume this type of fuel. The impact of these traditional fuels on rural households includes adverse effects, such as: indoor air pollution (IAP), poor lighting and deteriorating environmental and economic well-being.

There have been various policy programmes set up by the government and other relevant institutions, such as the Kenya Power and Lighting Company (KPLC), to increase rural electrification. One of the major areas has been the rural electrification programme (REP) established in the early 1970's. The REP funds are obtained from a 5% levy, namely the rural electrification programme levy fund (REPLF), which is charged to all electricity users nationwide. The REPLF is one of seven decentralized operational funds in Kenya aimed at alleviating socio-economic disparities at the local level.

The major aims of REP are to make electricity connection easier, affordable and faster (KPLC, 2006). In Kenya the REP cost has been estimated to be between US¢ 30 to US¢ 40 per kWh, compared with an amortized life-cycle cost of US$ 1 to US$ 2 per kWh for solar and battery operated systems (Jacobson, 2005). According to the World Bank (1995), only 10 to 50% of the economic cost of REPs is recovered from the users; thus these programmes have to be heavily subsidized by urban industrial users or by the government. About 60% of the REPLF finances new grid-extensions, with the rest being spent on operation and maintenance. Kenya's REP has been handicapped by financial burdens (Kenya Integrated Household Budget Survey (KIHBS), 2007). According to Eberhard and Gratwick (2005) the greatest challenge for energy market in Kenya is the sustainable balance between investment and supply. Investment through greater involvement of new providers including the private sector is an arduous task. In the case of Kenya, privatization of the electricity sector is still embryonic and more has to be done to improve the reform efforts, (Abdullah and Markandya, 2007).

The Rural Electrification Authority was established under Section 66 of the Energy Act, 2006 (No 12 of 2006) as a body corporate. It was created in order to accelerate the pace of rural electrification in the country, a function which was previously undertaken by the Ministry of Energy. Its mandate is to accelerate the pace of rural electrification in order to promote sustainable socio-economic development. It is specifically supposed to manage the Rural /electrification Programme Fund, develop and update the rural electrification master plan, promote the use of renewable energy sources including small hydros, wind, solar, biomass, geothermal, hybrid systems and oil fired components taking into account specific needs of certain areas including the potential for using electricity for irrigation and in support of off-farm income generating activities, implementation and sourcing of additional funds for the rural electrification programme and management of the delineation, tendering and award of contracts for licences and permits for rural electrification (REA, 2012)

Tala is a District in Machakos county, Eastern Province of Kenya and is located about 56 kilometers east of Nairobi. There are approximately 4,734 people (1999 census report) and the main language spoken is Kikamba. It is within Kangundo Constituency and Kangundo town council at approximately 3,000ft above sea level. Many of its residents are Kambas who practice subsistence farming on rural farms. The land holding size is relatively small and population density is high. Open-air markets are located in downtown Tala and main market days are Tuesday and Friday. There are two rainy seasons during the year from November-January and again from March-April. February and May are the main harvesting periods and June-August are the colder months. Several schools exist in the town, including Tala High School, Mackenzie Education Centre - Tala, Tala Girls' High School, Kwatombe Primary School, Tala Boys' Primary School and Children's Home, Tala Academy and Holy Rosary College (formerly, Tala Secretarial College). A police post is also located in the town. (KNBS, 2000).

1.2. Statement of the problem

Rural electrification has been the cornerstone of rural energy strategies in developing countries. It is also a source of controversy among development analysts. Advocates of rural electrification claim that it has major impacts on agricultural and industrial productivity, reduces rural-urban migration, creates more jobs and significantly raises the overall quality of life in rural areas. Critics claim that rural electrification may not have the hoped for effects on social and economic life and in its unequal incidence could contribute to social tension.

The United Nations has established the positive relationship between per capital energy consumption and the human development index (HDI) of many countries and there is empirical evidence to show that access to modern energy and human development are closely linked. (IEA, UNDP, 2005).

In Kenya , the government through the Ministry of Energy formed the Rural Electrification Authority which is fully funded by the government of Kenya. The mandate of the rural electrification authority is to implement rural electrification. The programmes focus on providing development assistance through the supply of electricity services to stimulate economic productivity and enhance the society of life in rural areas. These projects currently do not start with an assessment of the needs of the people they are meant to serve. They often fail to evaluate specific impacts resulting from these services on the target populations. The rural electricity evaluation programmes at present are confirmed to measure only qualifiedly variables such as number of households electrified. They are not designed to measure social development effects. This incomplete understanding of the programme impacts on members of the target community hinders the development of initiatives that respond to rural needs and have positive equitable and sustainable socioeconomic development impacts.

The reason that such research is important is that most successful rural electrification projects have solved problems that inevitably develop in implementation. The idea is to improve the quality of rural electricity projects so that they are sustainable. Without long-term sustainability, the benefits of rural electrification cannot be fully realized. The funding components of donors need justification and the development assistance is linked to project outcomes, hence need to develop local capacities to conduct evaluations.

Most studies on rural electrification are qualitative in nature. Literature has not used any special index to capture the effects of rural electrification. Studies by Abdalla (2005), Abdullah and Markandya (2007) have dwelt on the levels of accessibility and the benefits thereof. Attempts to segregate the impact of other social amenities from electrification in assessing the social and economic effects has been a challenge to many researchers. As such the credibility of exposing rural electrification as a main benefactor of rural socio-economic progress remains questionable. The researcher has identified this gap in knowledge and seeks to determine the socio-economic effects of rural electrification in Kenya, with a special focus on Tala Division in Machakos County.

1.3. Purpose of the Study

The purpose of this study was to assess the economic and social effects of rural electrification in Tala Division, Machakos County.

1.4. Objectives of the Study

The specific objectives of the study were:

1. To establish the patterns in the distribution of electricity in Tala Division.
2. To identify the household and community uses of electricity in Tala Division.
3. To establish the social effects of rural electrification Tala Division.
4. To assess the economic effects of rural electrification in Tala Division.

1.5. Research Questions

The research questions of the study are:

1. How is electricity distributed in communities and households in Tala Division?
2. What household appliances and communities facilities are connected to electricity in Tala Division?
3. What are the social effects of rural electrification in Tala Division?
4. What are the economic effects of rural electrification in Tala Division?

1.6 Significance of the Study

This study will be useful to the Kenyan government. It reveals the local electricity consumption in the villages after the infrastructure set up of the rural electrification project. This provides proper feedback on the planning process for the rural electrification programmes in the country.

It is also important to the researchers and academicians as it will be a useful guide for future researchers interested in undertaking a study on the socio-economic effects of rural electrification in other parts of Kenya.

The findings from the study are of great benefits to the project planners and implementers. Project planners will take special interest in how electrification serves as a main project driver in implementing development projects as well as livelihood projects that target rural communities.

1.7. Limitation of the study

Due to the sensitivity of some questions in the questionnaire, some of the limitations encountered include the unwillingness of some respondents to respond to some questions. To overcome this problem, the research assistants were trained well and were hailing from the respective villages and the research team was also part of it.

Some questionnaires were translated into the local Kikamba language a challenge that some of the translators could not translate the technical terms into the local language. However, the research team included research assistants who hailed from the community who made correct interpretations of the questions to the respondents

1.8. Delimitation of the Study

The study dealt with electrified households and villages that have been electrified for the last six years. The study was confined to Tala area due to the uniqueness of the rural electrification schemes in the area. This made it possible to undertake the study. The area's proximity to Nairobi also made the choice of the area viable due to financial constraints in the implementation of the study. In summary, the area is ideal for conducting the social economic effects of rural electrification against the number of connections and financial justifications.

1.9. Basic Assumptions of the Study

There were several factors which were assumed when carrying out the study. The following are some of the assumptions on which the study was premised on. This study was founded on the following key assumptions as the constructs of the study validity.

First of all, the sample size would be representative of the population to allow generalization of the findings. In addition, it was assumed that the data collection instruments would have the construct validity meaning that both content and predictor validity would be realized in order to draw findings that are logical indeed.

Furthermore, it was assumed that the respondents in the study would respond to the questions. It was assumed that they would demonstrate requisite threshold of skills, knowledge and favourable attitude to truthfully respond to the questions in the instruments.

1.10. Definition of Significant terms

Electrification is the process of powering by electricity and is usually associated with changing over from another power source. Some of the most significant terms related to the study are operationalized below.

Community / Village — A given population of people occupying a particular locality over a specific period of time. They are identified by a common border, usually the majorities speak the same language and have common cultural practices.

Donor funded projects	Project ideas and activities that are generated by non specific community members aiming at addressing a given need within that community. The main ones among the donor agencies are World Bank, AFD, NDF, EIB, IFC etc.
Gender	The community's specific view of the determined roles assigned to members of different sexes.
Human Development Index	A composite index measuring average achievement in three basic dimensions of human development- along and healthy life, knowledge and a decent standard of living. The HDI is a product of UNDP and presented in annual Human Development Reports.
Household	A social group, which resides in the same compound, share the same meals, and make joint or coordinated decisions over resource allocation and income pooling.
Modern energy	Includes a variety of energy carriers including LPG, kerosene, petroleum and electricity, either grid or off-grid electricity.
Project sustainability	It refers to the project activity continuing to generate benefits to the target beneficiaries long after it's commissioning and or funding is over.
Rural Area	A rural area is relatively far deprived in terms of modern energy infrastructure. A rural locality could be a township, a market centre, an area of dispersed settlement, or even a peri-urban area.
Rural Electrification	Expanding the electricity network to the rural areas.

1.11. Organization of the study

The first chapter introduces the study in the context while defining the problem under investigation. The objectives are stated and the significance of the study outlined. Further, the limitations as well as the delimitations of the study have been described. Further, the key assumptions have been explained. Finally, the key terms as used throughout have been defined.

In the second chapter, a review of the related studies is done with a view to generate the relational aspects of the concepts. The review has done critical review of the study variables as organized according to the objectives. Further, the theoretical framework within the study context has been explained. This has helped to draw the relational variables of the study as presented in the conceptual framework.

The third chapter deals with research methodology, which includes the research design and approaches, data collection procedures and methods of analysis. This includes the study design, the target population, the sampling procedures and the sample size, the data collection procedures as well as the instruments used to collect the data. Finally, the data analysis procedures have been explained.

Chapter four covers data analysis, presentation and interpretation. The data is presented using tables and a thematic approach focusing on the study variables used.

Chapter five has summary of findings, discussion of the findings based on the themes from the study variables, conclusions and recommendations. The suggestions for further research have been outlined.

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

In this section, a review of the literature of the past studies that are related to this study is made. The main issues within these studies are presented thematically using the study objectives drawing the gaps, the need and relevance of the study to focus on the gaps. Finally, the conceptual framework of the study is presented being drawn from relevant theoretical approach and intended to reduce the gaps.

The literature on rural electrification encompasses issues on access and affordability; success stories and problems; institutional dimensions; subsidies; social, economic and environmental impacts; project planning, design and implementation; and more recently on the energy, poverty and gender nexus. This chapter highlights some of the important issues discussed in various international papers, journals and books that the author finds relevant to this study to reduce the gaps,(Bhandari, 2006).

2.2. Distribution of Electricity in Rural Electrification

Access to modern forms of energy in general and electricity in particular to the poor, especially in developing countries has gained considerable attention. Rural electrification is well recognized as one of the important pre-requisites in uplifting living standards of the geographically and economically disadvantaged communities in developing countries. More focused studies since the late 1970's have begun and are still continuing.

Approximately 1% of the rural populace in Kenya have access to electricity, implying that very few households for the poor are electrified. This ratio seems to have stalled over the past few years. This demonstrates key shortfalls in the provision of electricity to the poor. First and foremost, the amended Electricity Act of Kenya does not sufficiently address the issue of the electrification of the poor. Reports from the utilities, Ministry of Energy and the regulatory agency make no attempt to track electrification of the poor, (Karekezi et al, 2011).

Secondly, power sector reforms show no discernable impact on the poor and, if any, it appears negative. Reforms have led to increased electricity tariffs and as a result have made electricity costly for the poor. In normal circumstances, subsidies should be provided to the poor to cushion them from the impacts of the high tariff increases triggered by reforms. However, available data on subsidies indicates that the non-poor are absorbing the bulk of the subsidies, (Karekezi et al, 2011).

The study tables the following recommendations to accelerate the poor's access to electricity services. Firstly, there is the need to keep track of data on electrification of the poor. This is absolutely essential for monitoring rural electrification programmes. Utilities, Ministries of Energy and the regulatory agencies should develop databases that track the requisite electrification of both urban and rural households categorised by income and include the data in public domain annual reports, (Karekezi et al, 2011).

Secondly, the proposed Rural Electrification Agency in Kenya should avoid the pitfalls of previous electrification initiatives that largely became an avenue for revenue collection for utilities with no clear link to expanded electrification of the poor. To avoid this shortfall, the autonomy of the bodies responsible for rural electrification - an important stipulation not provided for by the Electricity Act - should be strengthened. To ensure autonomy, the Act should be amended to ensure that the funds for financing the electrification of the poor are "ring fenced". The Acts should also provide for the appointment of the institution's governing board by Parliament which would strengthen the independence of the rural electrification agency. The boards of the rural electrification agencies should include representatives of the poor to ensure that their concerns are addressed. The performance of the electrification agencies should be evaluated by the number of new connections, particularly in rural areas and among the urban poor. It should also set significantly higher rural electrification targets than the ones currently indicated. The targets should include explicit and ambitious stretch goals for the electrification of the poor, (Karekezi et al, 2011).

Thirdly, it is recommended that other countries in the sub-region whose reforms are not at advanced stages (e.g. Ethiopia and Tanzania) should ensure that they establish structures and mechanisms for increased rural electrification before embarking on large-scale market-oriented reforms such as privatization. Evidence from other developing countries indicates that high rural electrification levels have been achieved when rural electrification initiatives precede the privatization process, (Karekezi et al, 2011).

Fourthly, reforms should adopt innovative approaches to promote increased electrification. One approach could be making electrification targets a pre-requisite for the purchase of attractive distribution rights. For example, the purchase of attractive city distribution rights can be linked to the mandatory electrification of low-income urban settlements as well as selected rural areas. This will ensure that private investors are simply not cherry-picking the

most profitable portions of the electricity industry and leaving the unprofitable portion (e.g. rural electrification) to the state. Another measure for ensuring that reforms support the electrification of the poor would be to ascertain that a significant proportion of the proceeds from license fees, concession fees and sale of utility assets directly contribute to the Rural Electrification Fund, (Karekezi et al, 2011).

2.3. Uses of Electricity in Rural Areas

Most impact studies have shown a discrepancy between theoretical justifications for projects and the measurable impact once those projects have been carried out. Fluitman (1983) argued that most of the existing impact studies were of a descriptive nature and he concluded "costs it appears, becomes trivial compared to the happiness of a villager who can see (an electric) light at the end of the poverty tunnel". Gaunt's (2003) says that with the ethics behind international aid only social objectives are valid to carry out rural electrification in developing countries.

Scholars Cecelski (2003) and Zomers (2003) find it difficult to quantify and isolate the improvement in the well-being of the people as a consequence of electrification. For a particular case of Bangladesh, Zomers (2001) and Barkat (2002) agree that, where, in addition to electrification, other infrastructure such as roads, health services and educational facilities are developed, the economic effects are greater. Ranganathan (1993) has pointed out that post electrification studies have criticized rural electrification programmes for not meeting its anticipated effects, for over-emphasizing the social benefits and for being too expensive. He considers rural electrification to be a merit good where the positive externalities are not internalized as part of an infrastructure besides being a commodity and a production input. As such the return on investment criterion may not be appropriate to be the only yardstick in judging a rural electrification programme's success. He states that the developing countries' governments want to subsidize rural electrification at the utilities' costs. He rightly argues that electricity cannot cause development unless it is used and that there are corresponding inputs as well. In Thailand, Yang (2003) the net present value of rural electrification projects financial analysis was negative but its economic analysis showed an internal rate of return of 12.5%.

2.4. Social Effects of Rural Electrification

Most scholars agree that rural electrification has positive bearings on health and education. Barnes (2004) reports that in Costa Rica after the electrification of rural areas, significant social improvements took place: the number of education institutions with lighting and night

classes increased considerably, new hospitals were set up and the number of health centers increased.

Spalding-Fecher (2005) suggests the inclusion of avoided health costs of fuel in cost-benefit analysis of energy projects. He classifies health impacts into morbidity and mortality and suggests evaluating both of them based on willingness to pay within which the mortality could be based on value of statistical life (VOSL) or to the value of lost years (VOLY).

It is expected that with electricity, the extended evenings would be spent in socially and economically productive ways. Most impact studies agree that there have been positive changes with family spending more time together and the introduction or expansion of the small local / cottage industries. For example, (Djeflat, 1985) one of the findings is that the many households have changed their way of spending the evening after electrification. Lim (1984) concludes that electricity had not given rise to important changes in the life-style of Malaysian villagers. His study finds that electricity was hardly used for new or better income generation purposes.

Energy is one area that does not have appropriate gender-analytic tools according to Skutch (2005). In one paper she discusses some approaches that could be used for energy projects arguing that there are differences in energy demand between men and women. Instead of the common demand driven energy projects, the author suggests an approach of “need” driven projects. She recommends including women in different phases of the project. The implications to gender, especially empowerment, have received more attention UNDP (2005); Madon (2003); Masse (2003); World Bank, (2003) in recent papers.

Lack of access of electricity is one of the major impediments to growth and development in rural economies in developing countries. That is why access to modern energy, in particular to electricity has been one of the priority themes of many countries. A few countries are considered, that is, India, Bangladesh, Phillipines and Zimbabwe. The cases of the social effects globally point to how rural electrification has transformed lives.

India has experienced rapid economic growth over the past decade, with an expanding middle class larger than the population of the United States. In 2000, the population grew at a rate of over 6 per cent, which required a rate of 9 per cent of energy growth. In the past 20 years alone, urbanization has driven a 208% growth in India’s energy consumption. Under these conditions, it is imperative that India meets its growing energy necessities in a self-reliant, sustainable manner. However, providing 1 billion plus people with a constant energy supply

is very difficult, especially for a developing country facing rising gas prices. Inclusive growth starts with providing energy access to the most disadvantaged and remote communities.

More than 18,000 villages live without electricity in India; according to the International Energy Agency, 404.5 million people do not have access to power. Many who do receive electricity face constant blackouts and uncertainties of a steady energy supply from their utility companies. Erratic voltage levels and an unreliable power supply are major problems, due to the inadequate energy supply and ageing transmission leading to power cuts. Rural areas face serious problems with the reliability of power supply. India's climatic conditions make it a very suitable place to rely on renewable energy, with very high solar irradiation levels and 45,000 megavolts megawatts (MWV) of possible wind capacity, renewable energy business growth has much potential. The Indian economy also depends heavily on agricultural production, and the livelihood for a majority of the population is farming. Installing renewable energy for rural agricultural purposes is necessary to make a significant impact.

India is an agricultural nation, yet the farmers and the rural poor remain the underserved. The benefits of renewable energy in rural Indian communities are tremendous, renewable energy not only expands energy generation and greenhouse gas mitigation, but also contributes to improvements in local environment, drought control, energy conservation, employment generation, health and hygiene, social welfare, security of drinking water, and increased agricultural yield. Implementing wind farms and solar power in villages brings development in the form of infrastructure, efficient agriculture, and an overall better quality of life for the rural people. Thus, the broader developmental goals, such as poverty alleviation, sustainable development and employment generation should be integrated into the rural electrification programmes while seeking direct support under bilateral and multilateral cooperation. The government of India , NGOs, the international community, private businesses, and the villagers themselves all have a significant part to play in creating this better life, and must work together in order to do so.

After the independence of Bangladesh in 1971, the first major initiative to extend grid electricity in rural areas was taken in 1975 under a scheme called 'Total Electrification Programme. This programme looked beyond grid connectivity towards development of the basic distribution facilities for effective delivery of power to rural areas by 1978. At around

the same time, establishing an institutional structure was considered, which would develop the technical, economic, financial and social analysis, and organizational requirements for a rural electrification project in Bangladesh. Then at the request of the Bangladesh Government Rural Electrification Project Committee, a decision was taken for the establishment of a new national agency under the Power Ministry to develop and administer a rural electrification programme. Accordingly, Rural Electrification Board (REB) was established on 29 October, 1977 and started functioning on 1 January, 1978 with following basic objectives; to provide reliable, sustainable and affordable electricity to rural people, to help improve the economic condition of rural people by providing electricity for agriculture and small industries, help improve the living condition of rural people, expand electrification to entire rural Bangladesh and to ensure consumer participation in policy-making

The REB programme operates through locally organized rural electric associations called *Palli Bidyut Samity* (PBS). The concept of PBS is based on the model of Rural Electric Cooperatives in USA, which operates with cooperatives and ownership of consumers. A PBS is an autonomous organization registered with REB, and it owns, operates and manages a rural distribution system within its area of jurisdiction. Its members are its consumers, who participate in its policy-making through elected representatives in its governing body. REB's role is to provide PBS with assistance in initial organizational activities, training, operational and management activities, procurement of funds, and providing liaison between PBS and the bulk power suppliers like Bangladesh Power Development Board (PDB), Dhaka Electric Supply Authority (DESA), and other concerned Government and Non-Government agencies. The area coverage of one PBS is usually 5-10 *thanas* (sub-locations) with a geographic expanse of 600-700 sq. miles.

The first PBS was established in 1980 to operate in Dhaka, and as of 2007 a total of 70 PBSs are working in some 46,000 villages in 61 locations and serving more than 7 million rural customers all over Bangladesh (REB 2007). Since the inception of REB, rural electrification has grown significantly – starting from less than 10 percent connectivity in 1977, about 61 percent villages have received electricity by 2007.[2] Under REB's programme, about 800,000 new rural customers get electricity every year, which is phenomenal for a poor country like Bangladesh. The REB consumers are mostly domestic users of electricity (85 percent), although industrial and commercial customers are also served, including those needing

connection for irrigation pumps. REB plans to cover 75,000 villages of Bangladesh by the year 2020. The rural electrification programme of REB is often viewed as one of the most successful government programmes in Bangladesh.

2.5. Economic Effects of Rural Electrification

Empirical studies and intuitive appeal highlight the role of energy in economic development. The International Energy Agency has underscored the high correlation between access to energy and development (Silva and Nakata, 2009). Over 2 billion people all over the world live with no electricity and they continue to subsist below the poverty line (UNDP cited in Haayika, 2006). In cognizance of this, rural electrification has been a government priority for two decades so much so that the Philippines has finally achieved 100% electrification of the 41,980 barangays or villages in 2009. To accomplish this, the government has had to mobilize a lot of multi- and bilateral support as well as programmes from the major IPPs operating in the Philippines (Anonuevo, 2009).

According to the National Electrification Authority, the government has spent pp (Philippine peso) 49.3 billion (US$ 1 billion) or pp2 million for each barangay from 2001 to 2009. Of that amount, 37.64 billion came from loans and pp11.68 billion from subsidies (Anonuevo, 2009).

Historically, a great majority of the new barangays were connected via line extensions from the existing distribution network. Under this approach, last mile connections became harder and harder to reach. Moreover, as the lines became extended longer and longer, quality became problematic. Increasing losses and subsidies limited what could be achieved. Under this metric, only the existence of a tapping point within the barangay was recorded, while utilization and the number of actual household connections were ignored.

Similar to the dissonance noted in the impressive GDP growth, full electrification of the barangays did not impact on poverty incidence mitigation. Clearly, a more pro-active stance on providing electricity is needed. In 2003, ADB commissioned a study to find out why some “New and Renewable Energy” (NRE) projects failed to achieve their desired objectives. Among the areas that need attention include lack of stakeholder mobilization and beneficiary participation, institutional problems, including unsuitable management practices, technical problems, including lack of spare parts for operation and maintenance and use of obsolete technologies, financial problems, such as high initial and maintenance costs, or high tariffs for consumers.

Asian Development Bank (ADB) notes that it is important to ensure installed NRE systems are sustainable in the long-term, it is important to also develop renewable energy-based livelihood opportunities." Sample of these undertakings could be rice mills and mini-ice plants for cold storage of fish. Provision of skills and training for operation, maintenance skills and market access are also important components of these projects.

In 2009, the WB approved a US$40 MM loan to the Development Bank of the Philippines for the Rural Power Project (RPP) aimed at reducing poverty and improving the quality of life of 10,000 rural households in hard-to-reach, isolated and poorest areas of the country, particularly in Mindanao. The RPP will target households, use more public-private sector partnerships, emphasize rural electric cooperatives and upgrade these distributors to become financially viable and operationally efficient (US Fed News). At this point, one may ask if perhaps this is the key to coupling provision of electricity with poverty alleviation. Certainly, it would provide sustainability of the projects financed by these loans. Moreover, areas with high poverty can be identified and focused on. It would also be useful to rethink the nature of the problem at hand.

The Population of Zimbabwe is approximately thirteen million and an area of 398 000 sq km. This country was under the Colonial rule from 1890 to 1980 when it attained independence. The thrust to electrify all rural growth points & service centers started in the early 1980's. The RE Masterplan Study (ADB-funded) of 1995,was approved by Cabinet in 1997 .In 2002 the new Electricity Act passed initiated the privatization of electricity utility (ZESA), setting up of RE Agency with own board having majority of Provincial Administrators. RE Agency embarked on the Expanded RE Programme, funded by levy on electricity tariffs (rose 1%-6% in last 5 years) and additional government allocations. The approach to rural grid extension in Zimbabwe was focused on unelectrified rural centers .These are rural centers where local government infrastructure such as police stations, agriculture extension and health services are located. Government houses and premises are connected free. Household connections for the general rural public are not subsidized. Rural electrification has continued but at a very slow pace.

Lim (1984) argues that the poor economic returns of rural electrification in Malaysia could possibly improve when other socio-economic inputs to rural development were also provided. In USA, rural electrification in the 1930's was expected to improve the economic competitiveness of farm families, but unfortunately it was not enough (Yang, 2003). Fluitman (1983) mentions that the benefits of extending the grid tend to be overestimated and the costs

understated. His study did not find much evidence to suggest that electricity, which could be used for productive purposes, had any major beneficial impact on the income generation or employment of the rural poor. On the contrary, with the "partial and patchy empirical evidence", he says that, there is some indication of net job losses and of worsening income distribution as a result of rural electrification. This, it is further stated, is not to suggest that rural electrification should not be promoted but that there is a need for a more judicious planning and evaluation of such programmes.

Rural electrification may not gap the income disparity if most of the people cannot afford to use it. Only as income rises, the type of fuel used also shifts towards electricity. A survey conducted in South Africa deduces that the energy transition theory is mostly driven by income rather than the access to electricity (David, 1998). Fuel switching towards electricity, the study found out, was evident in a substantial way in wealthier households and electricity substituted other fuels in only a few households. In the middle and low income households, electricity appeared to be more of an additional energy source rather than a replacement for other fuels.

Barnes (2004) suggests additional intervention to assist the rural people gain the benefits by helping them consume more energy. He tries to explore ways and means by which the viability of rural electrification could be enhanced. Costs of wiring, lack of credit were some reasons why households in electrified villages remained un-electrified. He suggests introducing credit and loan promotion schemes as part of the rural electrification project. Other areas to enhance the impact is to introduce social infrastructure and community street lighting, electrifying public buildings, functions like vocational training, adult literacy campaigns.

Zomers (2003) points out those criteria for decision making as to whether a rural electrification project should be implemented have changed. He says that growing environmental concerns are also playing key roles in rural electrification decisions. Fluitman (1983) concluded that the economic and environmental benefits of rural electrification tend to be overestimated and the costs understated. Many other studies (World Bank, 2003; DFID, 2002) express the need to assess the externalities in rural electrification programmes.

There are other issues that are directly not reflected in common socio-economic impact studies. Davidson and Mwakasonda (2004) say that "strong institutions are the backbone of an efficient and effective energy sector". They point out that countries similar in political and social setup may still require different policies to create the right enabling environment. Foley

(1992), unlike most papers on Rural Electrification, narrate some of the important institutional concerns and options to carry out rural electrification works. Several options other than having the rural electrification programme implemented under the central utility's direct control are suggested with examples of their usage in different countries. The strength and weaknesses of each of the different institutional setups are mentioned. He mentions that the institutional aspects of rural electrification programmes need as much attention as the technical aspects for successful implementation. Barnes (2005) agrees. His study shows that "a variety of approaches have been successful" and factors such as autonomy and accountability, amongst others, were common in the successful rural electrification projects.

2.6. Empirical Review

Samanta and Sundaram (1983) did a study on socio-economic impact of rural electrification in India. The study addressed the following questions: Does rural electrification increase productivity, income, and employment and bring structural change in rural areas? Does rural electrification reduce excessive migration to urban areas? How does rural electrification fit into the broad strategy of rural development? What complementary conditions make for success in rural electrification schemes? How does rural electrification affect the roles of women and children? The analysis is based on primary data collected by the Operations Research Group (ORG) in 132 villages in four states--Andhn'a Pradesh, Maharashtra, Punjab, and West Bengal. Data were collected a-both the village and household levels, and from State Electricity Board and research and manufacturing enterprises in the sample villages. For 108 of the 132 villages, these data were supplemented by a baseline 1966 survey of agricultural innovation.The ORG study finds that rural electrification has made a major contribution to rural development. It is found to be positively associated with the two most critical inputs--irrigation and innovation--in the agricultural sector. It is also found to have positive effects on development of rural industry and services. In the social sectors, the effects were less pronounced though still consequential.

Khandker et al. (2008) examined the welfare impacts of households' rural electrification based on panel surveys conducted in 2002 and 2005 for some 1,100 households in rural Vietnam. The findings indicated that grid electrification has been both extensive (connecting all surveyed communes by 2005) and intensive (connecting almost 80 percent of the surveyed households by 2005). Vietnam is fairly unique in that once electricity is locally available, both rich and poor households are equally likely to get the connection. The econometric estimations suggest that grid electrification has significant positive impacts on households'

cash income, expenditure and educational outcomes. The benefits, however, reach a saturation point after prolonged exposure to electricity. Finally, this study recommends investigating long-term benefits of rural electrification – not just for households, but for rural economy as a whole.Studies have shown that in electrified homes, energy consumption constitutes, on average, 4% of the household budget, while, in non-electrified homes, 15% of the household budget is spent on energy (MRC 1998). Other studies indicate that, apart from self collected wood at no financial cost, electricity is the most cost effective energy source for cooking. The relatively low cost of electricity, coupled with the access programmes for the rural areas, has resulted in a much higher proportion of households using electricity for cooking in South Africa than in many other African countries. However, when considering simultaneous cooking and space heating, coal and wood burning stoves appear to be more cost effective than electricity in the higher regions of the country (Graham and Dutkiewicz 1998)

Electricity serves a heterogeneous population, which includes: industrial, commercial and domestic users and each is services under different costs and unit supply. For a variety of reasons, electricity use is cross subsidized among the various categories and there are subsidy differentials for the different types of users. The KPLC tariff schedules distinguish five classes of tariff rates: A (ordinary domestic consumers and small commercial), B (medium commercial and industrial consumers), C (large consumers and industrial consumers), D (interruptible off-peak supplies to ordinary consumers) and E (street lighting). The commercial and industrial consumers are the major users of electricity for economic production and consume 75.5% of the total of the distributed electricity, whereas the domestic class or residential users consume only 23% (KPLC, 2006). The residential group is often considered less important, because of their low consumption rates and low contribution to the economic output.

There has been progress in reducing the costs for both grid and off-grid services, but the biggest hurdles are the initial connection fees and monthly consumption costs for low-income households (Townsend, 2000). In order to assess the affordability for connection to electricity services, it is necessary to compare household income with connection cost. Affordability refers to the actual ability of a household to pay for goods/ services and it can be distinguished between the affordability for access and the affordability for consumption (Estache et al., 2002), which are a key determinant in this study.

2.7. Theoretical Framework

In seeking to understand the phenomenon in the rural areas, there are various models which can be very applicable in the case of this study. For the purpose of this study, two models come into play. They seek to unravel the philosophical as well as the orientation of the development and provision of infrastructure in the rural areas. For these areas to be seen to be participating in the national economic development, they ought to be involved.

Rational Choice theory is an economic theory that assumes that individuals always make prudent and logical decisions that provide them with the greatest benefit or satisfaction and that are in the best self- interest. Most mainstream economics and theories are based rational choice theory. Rational Choice theorists believe that most human decisions are based on maximizing a person's own benefits, while minimizing that which can hurt the individual. Small business owners should consider adapting the theory of rational choice into their business models as it can help predict and explain future consumer spending decisions.

Rational choice theory is a framework for understanding and often formally modeling social and economic behavior. It is the paradigm in the currently dominant school of microeconomics. Rationality is widely used as an assumption of the behavior of individuals in micro economic models and analysis which appears in almost all economics dealing with decision- making. The rationality described by rational choice theory is different from the colloquial uses of the word. For most people rationality means sane, in a thoughtful clear-headed manner or knowing and doing what's healthy in the long term.

Rational choice theory uses a specific and narrower definition of rationality, simply to mean that an individual acts as if balancing costs against benefits to arrive at action that maximizes personal advantage. In rational choice theory, the costs are only extrinsic to the individual rather than being intrinsic.

Rational choice theory makes two assumptions about individual's preferences for actions: completeness in all actions that can be ranked in an order of preference and transitivity- if action A is preferred to B, and action B is preferred to C and action C is preferred to D. An individual's preferences can also take forms: strict preference occurs when an individual prefers A, B, C or D. In some models though, indifference occurs when an individual does not prefer A to B or B to A. Other assumptions include an individual has full or perfect

information about exactly what will occur due to any choice made. An individual has the cognitive ability and time to weigh every choice against every other choice.

While there may be many reasons for a rational choice theory approach, two are important for the social sciences. First assuming humans make decisions in rational rather than a stochastic manner implies that their model can be modelled and thus predictions can be made about future actions.

2.8. Conceptual Framework

The conceptual framework which will be used in the study is shown in Figure 1.

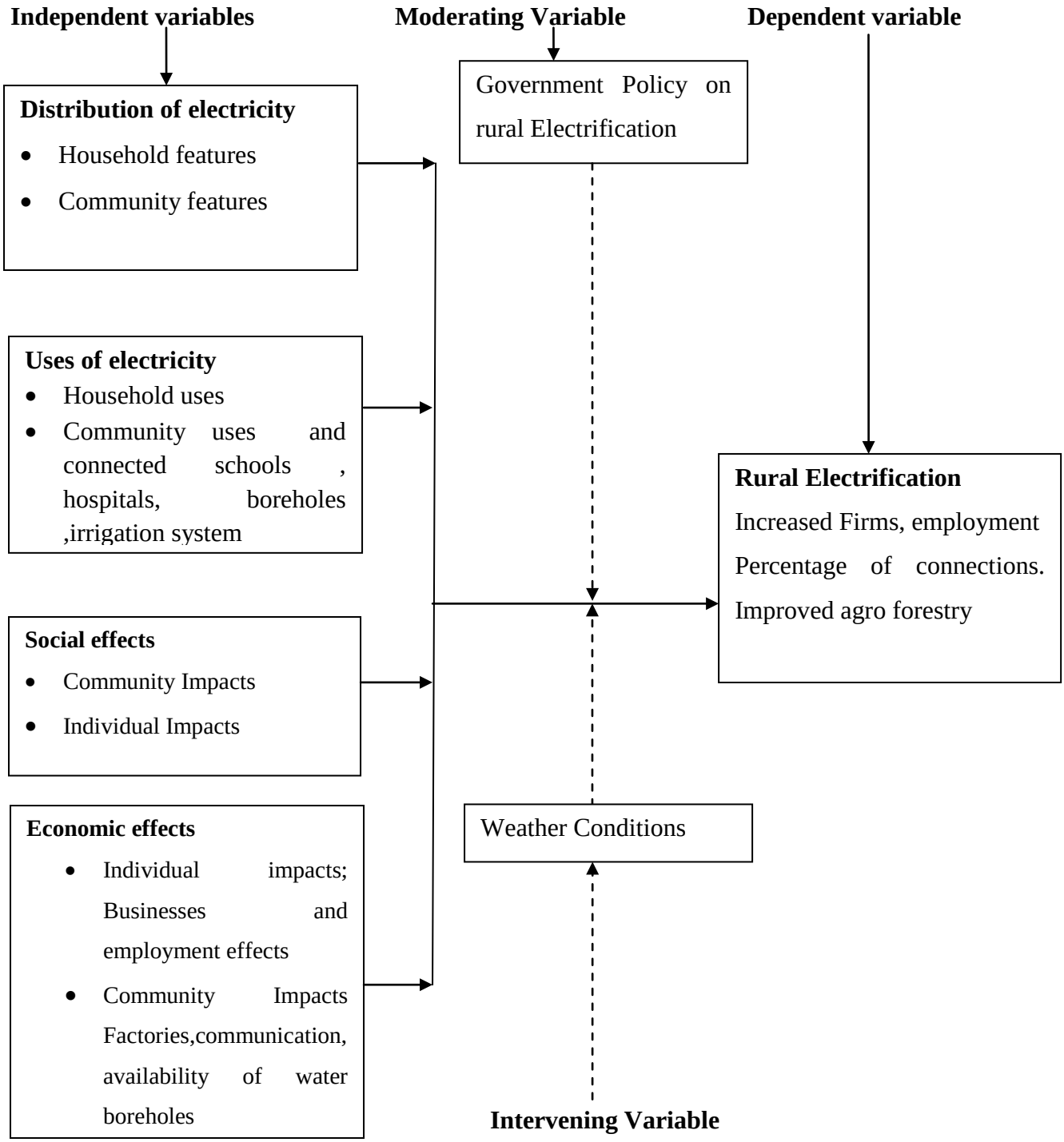

Figure 1: Conceptual Framework

The independent variables, distribution of electricity and uses of electricity were considered at the household and community levels. The main indicators for distribution of electricity were type of household, family size, income level and distance from road and grid. The main

community indicators were distance from both the tarmac and the grid. To establish the main uses of electricity the indicators were household appliances and community facilities connected with electricity. To assess the social effects of rural electrification the indicators were level of awareness, health improvement and security. Community effects included computer classes established, school children performance and feeling of development. For economic effects, diversification of income generating activities as a result of rural electrification at both household and community level.

2.9. Research gaps

The main energy need of the rural population is fuel for lighting ,cooking and water heating. Accessibility and cost play an important role in determining the type of fuel used. The use and collection of biomass fuel including wood and dung has little monetary cost associated with it, but can be very costly in terms of man-hours taken up, health and environmental impacts (Howells *et al*., 2002, Cecelsic, 2000). Most rural population have low and irregular income, which poses two main problems . Firstly, limited fuel options and hence can only afford small amounts of fuel. Secondly limited expendable income to buy appliances: Energy using appliances often require significant capital outlay relative to household income hence the changeover from biomass fuel to electricity for cooking is likely to be gradual (Howells *et al*., 2002, Peng and Pan 2006).

The process of rural electrification in Kenya has been extremely slow due to high network extension costs , low customer density due to the scattered nature of human settlement and low electricity consumption per household due to the low and irregular income in many rural households hence low revenue collected. In addition high operations and maintenance costs of the extended distribution network compared to the revenue.

Rural electrification customers remained at 13% of the total number of customers who have access to electricity for the years 2000-2005. There has been an annual growth of approximately 7.3%, which is not sufficient given that approximately 80% of the total Kenya population reside in the rural areas. Most of the studies have concentrated on customer connectivity and revenue rather than the benefits accrued from the rural electrification. This study will be conducted in Tala Location since a rural electrification scheme has been carried out in the location yet there is limited information on effects of rural electrification in the location. The cheapest tariff in KPLC is the first 50 units (kilowatt hours used). This is supposed to cater for the poor and low income. The cost varies depending on fuel adjustment cost.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the research methodology which was used to carry out the study. The chapter includes; research design, target population of study, sample design, data collection methods and data analysis.

3.2. Research Design

The research design used in this study was a descriptive survey design. According to Mugenda and Mugenda (2003), this method is used in studies that cover large population by selecting and studying the sample from the population to discover their characteristics. Most information on the households is collected using this method. It attempt to find out the socio-economic impact of rural electrification in Kenya with a specific focus on Tala Division in Machakos County. Primary data from surveys and secondary data from government and non-government sources will be used in the study. This study measured the impact of rural electrification in Tala Division.

3.3. Target Population

The target population of the study included; total households in Tala Division which are connected with electricity. According to the KNBS 2008 Census report, Tala Division has 43 villages connected with electricity with about 4,780 households connected out of about 16,780 households. Therefore, the target population was 4,780 households which are connected as well as the 43 village elders where the households are located. The target population is presented in Table 3.1.

Table 3. 1: Target Population

Category	Population Size	Percentage
Households	4,780	99.11
Village Elders	43	0.89
Total	**4823**	**100.0**

3.4. Sample Size and Sampling Procedure

Most socio-economic impact studies adopt a multistage sampling method and the sampling unit is a household, a village or the area serviced by an electricity supply unit (Wamukonya and Davis, 2001; Heltberg et al., 2000; Barkat et al., 2002; World Bank, 2002).

3.4.1. Sample Size

It is unnecessary to sample each household and community which benefit from rural electrification (Bulmer and Warick, 1983). The choice of the sample size is determined by the interplay amongst the following key factors: the characteristic and size of the population, sampling frame, and time, budgetary and logistic constraints

The socio-economic characteristics of rural households are assumed to follow a normal distribution pattern (Devi, 1997). The sample size is calculated using the formula developed by Cochran and corrected for a finite population. In this study, the sample size is chosen as though a simple random sample is being obtained (Dallal, 2004). The electrified households and the village elders are considered to be two separate populations for the purpose of sampling. A confidence level of 95% will be adopted.

The following formula was used to calculate the sample size.

$$n = \frac{Nz^2pq}{(N-1)\,c^2+z^2pq}.$$

Where

n=sample size

p=a dichotomous probability and a conservative value of 0.5 is taken to allow the maximum variation and q=1-p

N= Size of the population (number of households)

Z=Standard normal variate = 1.96 for 95% confidence level and 2.58 for a 99% confidence level.

c=Precision level, 7% is used here which is acceptable to most social studies particularly reduce costs related to the trade off between type I and type II errors. A type I error is one in which a true null hypothesis is incorrectly rejected and a type II error is one in which a false null hypothesis fails to be rejected. From the above, using a total household number of 4, 780 a confidence level of 95% and a precision of 7%, the sample size of 430 household was arrived. But in order to account for the 43 village elders who would provide the community profiles, the sample size reached 473.The Morgan table was used as a comparison which gives a sample size of 357. The sample size is shown in Table 3.2

Table 3. 2: Sampling Table

Category	Population Size	Sample Size
Households	4,780	430
Village Elders	43	43
Total	**4823**	**473**

3.4.2. Sampling Procedure

A multistage random sampling was used in the research while the sampling unit was a household and the village. In each of the village visited, 10 households were selected using systematic random sampling. Lists of households were generated and the Nth household established, and each of the Nth household which was selected was visited.

3.5. Research Instruments

The questionnaires were used for data collection. These were administered to the household heads and village elders .The questionnaires had closed-ended questions and were used to obtain information for each research objective from the respondents.

3.5.1. Piloting

In addition, a pilot study was conducted. Pilot testing is the process of subjecting the research instrument to a trial to determine its reliability in giving the right data in a given study area. This is done by administering the instrument to a sample with similar characteristics.

Piloting was conducted in one village which had 20 households. The pilot results were used to make the questions clearer and to remove ambiguous questions. It was also used to improve the questionnaires.

3.5.2. Validity of instruments

Validity is the extent to which a test measures what it claims to measure. It is vital for a test to be valid in order for the results to be accurately applied and interpreted. The validity of the data has been checked for consistency and comparisons. Other measures taken to realize validity is proper sampling thus increasing the confidence level in the sample size, ensuring completeness of the questions, and ensuring that processes such as quality control in data cleaning, validation and confidentiality. The data collection was above board with research

assistants supporting in the data collection being properly trained and the lead researcher taking lead. All the village elders were surveyed by the lead researcher.

3.5.3. Reliability of Instruments

Reliability refers to the degree to which the tool is consistent in measuring and delivering the same results. This is critical since it lays firm foundation in validity of the results obtained. This study used the pilot results to remove ambiguity in all the items on the questions in the questionnaires. A thorough understanding of the variables under study has been used to determine the criterion validity of the rural electrification data against the social economic impacts. Due to the nature of fatiguing the respondents, a split half test was used on the respondents. A correlation coefficient to indicate the relationship between the two set of scores. To obtain the correlation, the following formula was used.

$$r_{xx}^{1} = \frac{S_{1}^{2}}{S_X^{2}}$$

Where;

X= Result of the first score

x^{1} = Result of the second score

r_{xx}^{1}= Result of First score

S_{1}^{2}= Estimation of the True score

S_X^{2}= Calculated variance of the score observed

r_{xx}^{1}= Correlation between X and x^{1}

A correlation coefficient ($r_{xx}^{1)}$ of 0.85 was obtained which indicates that the two sets of scores were highly correlated. This provides an estimate of reliability as a ratio of the true variance.

3.6. Data Collection Methods

The researcher identified a field assistant who helped in collecting the data in the 43 villages. The training emphasized the translated questions to the respondents. The researcher visited the 43 village elders and the households with the support from the assistant who would help in the translation. It took 20 days for the entire data collection to be completed.

3.7. Data Analysis

The data collected was entered into the Statistical Package for Social Sciences and analyzed using descriptive statistics. The data was cleaned and only complete questionnaires were analyzed. All questionnaires which were incomplete are treated as no response. An important statistical test used in this study is the independent t-test. The data was presented using tables, percentages, standard deviations, means and independent t-scores where appropriate.

3.8. Ethical Considerations

As an ethical process the study took into consideration drastic measures to ensure that respondents' dignity is upheld. Ethics are norms governing human conduct which have significant impact on human welfare. It involves making judgment about right and wrong behaviour. Bryman (2007) states that it is the responsibility of the researcher to carefully assess the possibility of harm to research participants and the extent that is possible.

In this case, there was introduction letter to all the participants. All chiefs of the respective villages were also informed. Throughout the data collection period, voluntary participation was emphasized. Confidentiality was highly emphasized and none of the respondents had his/her name appear on the questionnaire. Its only after verification from the Chief or Assistant Chief that child headed households were included in the survey.

3.9. Operationalization of Variables

The operationalization of variables is given in Table 3.3.

Table 3. 3: Operationalization of variables

Objectives	Variables	Indicators	Measurement scale	Tools of analysis	Type of analysis
	Independent				
To establish the distribution pattern in the rural electrification in Tala Division	Distribution of Electricity	**Household Profiles** • Type of household, family sizes, income level, type of household occupation, distance from tarmac road, distance from the grid, period of connectivity **Community Profiles** • Distance from the tarmac road, distance from the grid, period of connectivity	Nominal	• Mean • Percentage • Mode	Descriptive
To establish the uses of electricity in Tala Division	Uses of electricity	• Household uses-household appliances, • Community facilities connected with electricity	Nominal	• Mean • Mode • Percentage	Descriptive
To assess the social effects rural electrification in Tala Division	Social Effects	**Household Effects** • Level of awareness, health improvement, children school performance, security **Community Effects** • Computers centres established, computer classes established in schools, children passing examinations, feeling of community members, feeling of development, feeling of relocation	Nominal Ratio	• Percentage • Mean • T-score	Descriptive Inferential
To assess the economic effects rural electrification	Economic Effects	**Household Effects** • Diversification of income activities, economic activities dependent on electricity **Community Effects** • Income levels of community members, emergence of enterprises, land value	Nominal Ratio	• Percentage • Mean • T-score	Descriptive Inferential
	Dependent variable			•	
	Rural Electrification	Increased firms, employment, percentage of connections.	Ratio	• Percentage • mean	Descriptive

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1. Introduction

This chapter presents the data collected from the respondents. The chapter puts the data in perspective with the research questions asked and seeks to interpret it according to the socio-economic effects of rural electrification. The data analysis was done using both descriptive and inferential statistics. The data presentation and interpretation is also given;

4.2. Response Rate

The questionnaires were administered to selected households distributed in 43 villages benefiting from rural electrification in Tala Division and their respective village elders. The findings of the response rate are presented in Table 4.1.

Table 4. 1: Response Rate

Type of Questionnaire	Tools Dispatched	Tools Returned	Percentage
Household Questionnaires	430	351	81.6
Village Elders Questionnaires	43	43	100
Total	**473**	**394**	**83.3**

From the findings in Table 4.1, it is evident that of the 473 questionnaires, 394 of them returned making the response rate 83.3%. However, the response rate for the questionnaires to the village elders was 100% whereas it was 81.6% for the questionnaires of the households.

4.3. Characteristics of Respondents

The features of the respondents who took part in the study was established. The features of the respondents are presented in Table 4.2 and Table 4.3. These features included age profiles, marital status, and level of education and the gender of the household heads.

Table 4. 2: Household Heads

Gender	Frequency	Percentage
Male	287	81.8
Female	59	16.8
Child	5	1.4
Total	**351**	**100.0**

From Table 4.2. It is evident that majority of the households are headed by men at 81.8%, 16.8% are headed by females while a meager 1.4% are child headed households in Tala Division.

Further, the study sought to establish the age profile of the respondents. The results are presented in Table 4.3 and Table 4.4.

Table 4. 3: Age of Household Heads

Age in Years	Frequency	Percentage
Below 20	5	1.4
21-30	39	11.1
31-50	221	62.9
51-70	69	19.7
Above 70	17	4.8
Total	**351**	**100.0**

From the findings in Table 4.3, it is evident that majority of the households in the division are headed by persons aged between 31-50 years at 66.9% while the least headed households are less than 20 years of age at 1.4%.

Table 4. 4: Age of Village Elders

Age in Years	Frequency	Percentage
Below 20	-	-
21-30	2	5
31-50	14	32
51-70	23	53
Above 70	4	9
Total	**43**	**100**

In the 43 surveyed villages, most of the village elders are aged over 50 years but less than 70 years of age. It is evident that as one increases in age, chances of them being selected to be village elders are so high. In fact, in the entire division, there is no single village elder who is less than 20 years of age whereas even those past 70 years of age are selected to head the villages and this stands at 9%.

Further, the study sought to establish the level of education of the respondents who were both the household heads as well as the village elders. These findings are presented in Table 4.5 and Table 4.6.

Table 4. 5: Level of Education for Village Elders

The findings of level of education is shown in Table 4.5

Level of Education	Frequency	Percentage
Never been to school	4	9
Primary	20	47
Secondary	17	40
Post-secondary	2	5
Total	**43**	**100**

From Table 4.5. It is evident that majority of the village elders have only attained primary education. This stands at almost half of them at 47% while it is only 5% who have attained post-secondary education.

Table 4. 6: Level of Education for Household Heads

The findings of level of education is shown in Table 4.6

Level	Frequency	Percentage
Never been to school	11	3.1
Primary	56	15.9
Secondary	157	44.7
Post-secondary	127	36.2
Total	**351**	**100.0**

From Table 4.6, it is evident that majority of the households are headed by those who have attained secondary education at 44.7%. In fact, there is indeed a significant number of household heads who have obtained post-secondary education at 36.2%. It is only in about 3.1% of the households that heads have never been to school.

In addition, the study sought to investigate the marital status of the respondents. This has been presented in Table 4.7 and Table 4.8.

Table 4. 7: Marital Status for Household heads

Status	Frequency	Percentage
Single	9	2.6
Married	281	80.1
Divorced	23	6.5
Separated	15	4.3
Widowed	23	6.5
Total	**351**	**100.0**

From the Table 4.7, most of the respondents are married at 80.1%, 6.5% are widowed and the same percentage are divorced while 4.3% and 2.6% are separated and single respectively.

Table 4. 8: Marital Status for Village Elders

Marital Status	Frequency	Percentage
Single	3	5
Married	33	77
Divorced	-	-
Separated	2	8
Widowed	5	12
Total	**43**	**100.0**

From Table 4.8, it is evident that majority of the village elders are married at 77% whereas there is no single village elder who is divorced. In the villages surveyed, 5% of the village elders are single while 8% of them are seperated while the widowed are second in majority to those married at 12%

Further, the study inquired on the number of people living in a single household. This is presented in Table 4.9.

Table 4. 9: Number of people living in a Household

Number	Frequency	Percentage
1	15	4.3
2-3	84	23.9
4-7	202	57.6
More than 7	50	14.2
Total	**351**	**100.0**

From the Table 4.9, it is evident that majority of the households in Tala are inhabited by between 4-7 members whereas those in living in a household as an individual are a meager 4.3%. That means that households with between 4 and 7 members are the majority followed by those with 2 to 3 members at 23.9% while those households with more than 7 members are 14.2%.

Another household characteristic investigated was the type of roof for the main household. The findings are presented in Table 4.10.

Table 4. 10: Type of main Household by Roof

Type of roof	Frequency	Percentage
Tiles	37	12
Iron sheets	314	88.0
Grass	-	-
Total	**351**	**100.0**

As shown in Table 4.10, majority of the households in Tala Division have irons sheets roofs at 88% while only 12% have tiled roofs. There are no grass thatched households in Tala Division connected to electricity.

Another feature of the households surveyed was the type of walls for the main household. The findings to this feature are shown in Table 4.11.

Table 4. 11: Type of Household by wall

Type of wall	Frequency	Percentage
Concrete	158	45.0
Grass	-	-
Mud	130	37.0
Timber	29	8.3
Iron sheets	34	9.7
Total	**351**	**100.0**

It is evident that 45% of the households are made of concrete wall while walls made of mud were 37% of the households, 9.7% of households are made of iron sheets wall while 8.3% of the households are made of timber walls.

In addition to establishing the type of walls and type of roofs, the study investigated the floors to the main houses in the Division. The findings are presented in Table 4.12.

Table 4. 12: Type of household by Floor

Type of Floor	Frequency	Percentage
Cement	219	62.4
Earthen	132	37.6
Wood	-	-
Total	**351**	**100.0**

From the Table 4.12, it is clear that most of the floors are cemented at 62.4% while only 37.6% are earthen. The study further sought to investigate the level of family incomes. This is presented in Table 4.13.

Table 4. 13: Average Family Monthly income

Net Income in Kenya shillings	Frequency	Percentage
Less than 5,000	84	23.9
5,001- 10,000	132	37.6
10,001-15,000	73	20.8
15,001-20,000	32	9.1
20,001-24,000	19	5.4
Over 24,000	11	3.1
Total	**351**	**100.00**

From the Table 4.13, it is evident that majority of the household have an income of between Ksh 5,000 and Ksh 10,000 per month. In fact, it is only about 35% of the households that have a monthly income of more than Ksh. 10,000.

4.4. Distribution of Electricity

This section covers the distribution of electricity in the Division at both the household and the community level. The section looks at the profiles of the households and villages connected. Among the indicators surveyed are the distance of the households and villages from the grid and the tarmac road, the time when electricity was connected as well as the cost of electricity for the households on monthly basis. This is presented in Table 4.14 Table 4.15 and Table 4.16.

Table 4. 14: Distance of Household to the Tarmac Road

Distance	Frequency	Percentage
Less than 500metres	38	10.8
Less than I km but more than 500metres	87	24.8
1-2km	203	57.8
2-5km	23	6.6
More than 5km	-	-
Total	**351**	**100.0**

It is evident that majority of the households connected with electricity are found within less than 2 kilometers from the Tarmac Road. In fact, these number stands at over 93% of the households connected. Of these, 57.8% are located in a radius of 1-2 kilometers while 10.8% and 24.8% are located in less than 500 meters and less than a kilometer but more than a half a kilometer respectively.

Table 4. 15: Distance of the Electrified Village from the Tarmac Road

Distance of Village to Tarmac Road	Frequency	Percentage
Less than 500metres	7	16
Less than I km but more than 500metres	19	44
1-2km	12	28
2-5km	4	9
More than 5km	1	2
Total	**43**	**100.0**

While profiling the villages that are connected, it is evident that majority of the villages connected are located less than a kilometer from the road. In fact, it is only about 9% which are located in more than 2 kilometers away from the tarmac road.

Table 4. 16: Distance of Electrified Household from the Grid

The results of distance of electrified household from the grid are shown in Table 4.16

Distance of household from the Grid	Frequency	Percentage
Less than 500metres	132	37.6
Less than I km but more than 500metres	112	31.9
1-2km	83	23.7
2-5km	24	6.8
More than 5km	0	0
Total	**351**	**100.0**

From the findings in Table 4.16, it is evident that majority of the households are located in less than 500 meters from the main power grid. This is at 37.6% whereas no household is located further than 5kilometers away from the grid.

The study as well sought to establish the distance of the village from the main grid. The results are presented in Table 4.17.

Table 4. 17: Distance of Village from the grid

Distance of Village from Main grid	Frequency	Percentage
Less than 500metres	8	19
Less than I km but more than 500metres	12	28
1-2km	16	37
2-5km	5	11
More than 5km	2	4
Total	**43**	**100.0**

From Table 4.17, it is apparent that most of the households are located in a radius of less than 2kms from the main power grid. In fact, 19% of the villages are only 500meters away while 28% do not go beyond 1km and 37% do not go beyond 2kms. This shows that majority of the households are near the electricity grid.

Apart from establishing the distance to the grid and tarmac road, the study as well sought on when electricity was connected in the villages and the households as presented in Table 4.18 and Table 4.19.

Table 4. 18: Year when households were connected

Time when connection was made	Frequency	Percentage
Less than 1 year	54	15.4
1-2 years ago	65	18.5
2-4 years ago	147	41.9
4-6 years ago	65	18.5
Over 6 years ago	20	5.7
Total	**351**	**100.0**

As evidenced in Table 4.18, it is clear that most households surveyed had connectivity in about 4 years ago. These households stand at 41.9% while its just about 33% of the households which have been connected over the last 2 years. In fact, 24% of the households had connectivity over the last 4 years.

Table 4. 19: Shows Year when Village was connected

When Electricity was connected in the village	Frequency	Percentage
Less than 1 year	5	12
1-2 years ago	9	21
2-4 years ago	17	39
4-6 years ago	8	18
Over 6 years ago	4	9
Total	**43**	**100.0**

According to findings shown in Table 4.19, it is clear that most of the villages just like the households were connected in not more than 4 years back. This has a cumulative percentage of 66% of the villages were connected in more than 2 years back. It is only about 33% of the households that have been connected over the last 2 years.

In addition to the period when electricity was connected, the study took a keen interest in establishing the monthly bills by the households on electricity. The findings are shown in Table 4.20.

Table 4. 20: Household Monthly Cost of Electricity

Cost of Electricity	Frequency	Percentage
Less than Ksh 500	109	31.0
Ksh 500-1000	194	55.3
Ksh 1000-2000	43	12.3
Over Ksh 2000	5	1.4
Total	**351**	**100.0**

From the findings, it is clear that majority of the household spent between Ksh 500 and Ksh 1,000 per month. This stands at 55.3% while 31.1% spent less than Ksh 500 while only 1.4% of the households spent over Ksh 2,000.

4.5. Uses of Electricity

The study sought to investigate the uses of electricity in the households and the community. At the household level, the uses of electricity were limited to the household electronic appliances that require power from electricity. The study in the questionnaire required the respondents to tick all their uses of electricity on the appliances in the household.

The findings on the household uses of electricity are presented in Table 4.21.

Table 4. 21: Household Appliances using electricity

Appliance	Frequency	Percentage	N
Cell phone	343	97.7	351
Television	132	37.6	351
Radio	297	84.6	351
Lighting	351	100.0	351
Hot showers	3	09	351
Water pump	15	4.3	351
Refrigerator	28	7.9	351
Electricity cooker	9	2.6	351
Microwave heater	12	3.4	351
Water heater	46	13.1	351

From the above Table, the uses of the electronic requiring electricity is varying in usage with low consumption electronics indicating high usage that some electronics. It is evident that the use of electricity for lighting is the most common with all households recording using it whereas hot showers are the least used for powering using electricity. Other low consumption use include charging of the cell phones and the radio followed by the television. However, high consumption appliances such as refrigerators, microwave, electric cookers, kettles are least used.

The study established the village facilities connected with electricity. The findings are shown in Table 4.22.

Table 4. 22: Village facilities connected with Electricity

Facility	Yes	Percentage	N
Church	12	28	43
Mosque	3	7	43
Primary school	28	65	43
Secondary school	19	44	43
Polytechnic	3	7	43
Shops	34	79	43
Posho mills	21	49	43
Water selling point	10	23	43
Computer shop	21	49	43

In the village, the facilities that have connectivity were also identified. In the 43 villages surveyed, it is evident that shops are the most connected amenities in the villages following rural electrification at 79% followed by primary schools at a 65%, posho mills and computer shops at 49%, secondary schools at 44%. Amenities with little connections include the churches at 28%, mosques at 7%, and water selling points at 23% while polytechnics are only at 7% like the mosques. It is thus apparent that much connection has gone into shops and other business buildings while religious gathering places such as churches and mosques have less connection.

4.6. Social Effects of Rural Electrification

One of the strategic objectives of the study was to establish the social effects of the rural electrification. Using a questionnaire on a Likert scale of 1-5 with 1 for not at all, 2 for just a little, 3- a little 4- a lot and 5 for extremely a lot, the findings at the community level and household level are presented in Tables 4.23 and Table 4.24.

Table 4. 23: Social Effects on Households

Social Effects	N	Mean	Std Dev
I know a lot happening around me because of listening in/watching television	351	3.53	1.2
There are few regular visits to the health centre because of coughs from using paraffin	351	3.40	1.6
My children perform better in class because they have more time to read at home	351	3.82	1.3
There is more security at the market because of the lights	351	3.57	1.1

From Table 4.23, it is clear that majority of the respondents were of the view that the rural electrification has had positive improvements in their lives. From results above, majority of the respondents are of the view that they are now aware of much going on since they have energy to power the television sets and radios since power is available. Mobile use has also gone high. There is little variation in the responses by the respondents with no standard deviation reaching 2 which is a testimony to the homogeneity of the responses.

Further, the study sought to investigate the social effects on the community and the findings are presented in Table 4.24.

Table 4. 24: Social Effects on the Community

Social Effects	N	Mean	Std. Error	Std Dev	df	T
Establishing computer centres in the village	43	3.98	2.05	1.5	41	-3.9
Children are passing examinations more since schools have electricity connected	43	4.7	1.87	0.9	41	-2.9
Computer classes have been established in the schools	43	4.23	2.01	0.86	41	-1.6
People in the village have become more enlightened	43	3.93	2.25	1.1	41	-1.8
People feel that they have developed	43	4.63	1.79	0.89	41	-1.6
We have a feeling that our village is developed	43	4.6	2.16	0.96	41	-2.3
Few people are willing to relocate from this village	43	4.42	1.96	0.34	41	-2.7
Many people want to migrate to this village	43	4.58	2.82	0.56	41	-5.2

It is evident that the effects are of significant difference. Using a 2 tailed test, it is therefore possible to accept a hypothesis that the rural electrification has brought about significant effects to the community. In Table 4.24, it is clear that with almost all effects

being rated high with a standing mean of over 3.5 in all the effects with a degree of freedom of 41 for all effects, all effects yield an independent t-score of over 1. These is evidence that the social effects have statistical significance on the communities with rural electrification connectivity.

4.7. Economic Effects of Rural Electrification

Finally, it was paramount to establish the effects of the rural electrification on the household and the communities economically. By this, the questionnaire had a set of questions for which respondents were expected to rate the effect level on a Likert scale of 1-5 with 1 being no effect while 5 meaning extremely a lot. The findings are analyzed using an independent t-score using the means, standard deviations and errors from the rate and the degrees of freedom derived from the sample sizes. This is based on the hypothesis that rural electrification leads to improved economic conditions.

Table 4. 25: Economic Effects on the Households

Economic Effects	N	Mean	Std Dev	SE	df	T
My income has increased because I have an enterprise I opened because of electricity	351	1.66	1.2	2.43	349	-0.003
I can pump water for irrigation which has increased my annual incomes	351	1.4	1.1	2.45	349	-0.002
I have a battery charging shop that has increased my income	351	1.68	1.3	2.65	349	-0.002
I have a welding machine that has increased my income level	351	1.13	0.9	2.75	349	-0.001
I have a salon/hairdressing shop that increased my income on monthly basis	351	1.31	1.1	2.34	349	-0.001
I have a carpentry which increases my income	351	1.16	1.1	2.14	349	-1.233
I feel that I am more developed	351	4.43	0.9	2.56	349	-1.345
I have a reliable source of lighting than being connected with electricity	351	4.87	1.1	2.33	349	-0.002

Table 4.25 shows a mixed results case. In some instances, it shows that the members of the households feel that they are more developed with the connection. However, on the other end, there seems to be less investments emanating from the connections. This can be corroborated with the findings in the use of electricity in the household that is mainly used

for lighting, Table 4.21. There is insignificant change in the economic effects of the household with electricity connection.

Table 4.26: Economic Effects on Communities

The economic effects on Communities is shown in Table 4.25

Economic Effects	N	Mean	Std Dev	SE	df	T
Family incomes have improved in the village	43	3.26	1.1	2.3	41	-2.3
Enterprises like salons, battery charging have emerged	43	4.53	1.2	2.5	41	-1.9
Land value has gone up especially in market places	43	4.49	1.4	1.9	41	-2.2

Unlike with the households, it is apparent that the at the community level, the facilities show an increase in the economic abilities with new ventures emerging at the market centers. In fact, the changes have independent t-scores of more than 2. This is clear that the economic effects are felt at the community level.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter gives the summary of the findings gathered from the analysis of the data, discussion, conclusions and recommendations. The findings are summarized alongside the objectives of the study, conclusions are drawn from the study and recommendations for action and further studies are given.

5.2. Summary of Findings

This section presents the summary of the findings based on the analysis done. The analysis was both qualitative and quantitative, and presents the characteristics of the respondents as well as the analysis of the independent variables against the dependent variable. Understanding the profiles of the respondents is critical considering that the interpretation of the findings regarding other variables is made in light of these profiles.

5.2.1. Characteristics of the Respondents

There were two categories of the respondents in this study. The household heads as well as the village elders in the 43 villages. From the findings, it is clear that majority of the households are headed by males at 81.8% are aged between 31-50 years at 62.9% are married at 80.1% have secondary school education 44.7% and a majority of the households have between 4-7 members at 57.6%. Most of the households have iron sheets roofs at 88% while majority of the walls are made of concrete at 45%. Majority of the houses have cemented floors at 62.4% and have a monthly income of between Ksh 5,000 and Ksh 10,000. On the village elders, majority of them are aged between 51-70 years at 51-70 years at 53% are married at 77% and have primary education at 47%.

5.2.2. Distribution of Electricity

It emerges that the distribution of electricity in the rural electrification projects follows a clear pattern. From the findings, over 93% of the electricity connections are within a radius of 2km from the main grid as well as the tarmac roads. It follows that the households which are more than 2kms away are indeed few in the connectivity. Most of the villages with connectivity are those near the tarmac roads as well as connectivity. This is at 89% of the villages which is slightly lower than the households' connectivity.

Similarly, most of the villages connected are near the main grid of electricity just like the households.

5.2.3. Uses of Electricity

The uses of the electronic requiring electricity is varying in usage with low consumption electronics indicating high usage amongst the list. It is evident that the use of electricity for lighting is the most common with all households recording using it whereas hot showers are the least used for powering using electricity. Other low consumption use include charging of the cell phones and the radio followed by the television. However, high consumption appliances such as refrigerators, microwave, electric cookers, kettles are least used. In the village, the facilities that have connectivity were also identified. In the 43 villages surveyed, it is evident that shops are the most connected amenities in the villages following rural electrification at 79% followed by primary schools at a distant 65%, posho mills and computer shops at 49%, secondary schools at 44%. Amenities with little connections include the churches at 28%, mosques at 7%, and water selling points at 23% while polytechnics are only at 7% like the mosques. It is thus apparent that much connection has gone into shops and other business buildings while religious gathering places such as churches and mosques have less connection.

5.2.4. Social Effects of Rural Electrification

It is clear that majority of the respondents were of the view that the rural electrification has had positive improvements in their lives. In addition, majority of the respondents are of the view that they are now aware of much going on since they have energy to power the television sets and radios since power is available. Mobile use has also gone high. There is little variation in the responses by the respondents with no standard deviation reaching 2 which is a testimony to the homogeneity of the responses. It is evident that the effects are of significant difference. Using a 2 tailed test, it is therefore possible to accept a hypothesis that the rural electrification has brought about significant effects to the community. It is clear that with almost all effects being rated high with a standing mean of over 3.5 in all the effects with a degree of freedom of 41 for all effects, all effects yield an independent t-score of over 1. This is evidence that the social effects have statistical significance on the communities with rural electrification connectivity.

5.2.5. Economic Effects of Rural Electrification

An analysis of economic effects of rural electrification presents a mixed results case. In some instances, it shows that the members of the households feel that they are more developed with the connection. However, on the other end, there seems to have been less investments emanating from the connection. This can be corroborated with the findings in the use of electricity in the household that is mainly used for lighting. Unlike with the households, at the community level, the facilities show an increase in the economic abilities with new ventures emerging at the market centers. In fact, the changes have independent t-scores of more than 2. This is a clear testimony that the economic effects are felt at the community level.

5.3. Discussion of Findings

The following discussion is presented based on the objectives of the study.

5.3.1. Distribution of Electricity

The distribution of electricity to the rural communities is embedded in many models. From a rational economic theory, the ultimate investment in any venture must be one that generates sufficient and absolute good in justified value for money terms. Hence, there must be opportunity cost established on any investment. This is even more pronounced when dealing with public resources that are always in competition on which sector will derive maximum benefits for many both in the short term and long term. However, in the recent past, there has been a quest for creating a more egalitarian society with clear focus on why citizens must access particular services. In this case, electrifying rural communities has been seen as an effort to meet the rights of the rural communities.

From the findings, it is apparent that the government perspective for rural electrification is guided on both fronts by the rights based model as well as the rational economic view. The sole intent of electrifying the rural communities was the possibility to spur economic development. From the findings, it is clear that the household mainly use electricity for domestic uses like lighting. The households mostly connected are those in areas already served by the public infrastructure. As much as the communal facilities such as schools and shopping outlets are connected, on the household level, household still regard to electricity as light. These findings agree with studies carried out in Bangladesh by Zomers (2001) and Barkat (2002).

5.3.2. Uses of Electricity

The rational decisions to power rural communities are often embedded in deep philosophies that household will use electricity for their livelihood on the powering of basic appliances but most important is the ability for the communities to use electricity to improve their lives. These would be seen to be through industrial growth and the startup of income generating activities and projects in the areas already connected. However, the findings from this study point out to the contrary. Many of the households only use electricity mainly for lighting and powering other electronic appliances. There is no much drastic changes in the economic livelihoods of the communities that are connected. This is clear indication that rural development and improvement in disposable incomes is much more than provision of the electricity. Usually, the startup costs for mechanization of ventures such as agricultural farms are extremely high. This could point to the low uptake of economic ventures. This agrees with Ranganathan (1993), who pointed out that that rural electrification programmes over-emphasize social benefits instead of being a production unit.

5.3.3. Social Effects of Rural Electrification

The main areas reported to record changes in the social lives of the people and communities are on the view that they are enlightened. This view is shared on a mean of 3.53 on a scale of 1-5 with very little variations exhibited in the standard deviation of 1.2. on the other hand, families are reporting less visits to the health facilities at 3.4 with equally slightly higher variations in the perception. Perhaps the highly rated social effect with the most significant statistical difference is the increased security. The shared consensus mean rating of increased security is 3.5 with the least variations in the groups at 1.1.

Previous studies by the World Bank have looked at the global trends in the effects of rural electrification on the rural communities. This approach is both communal and individual. From the study findings, the individual approach shows dramatic changes in the daily life of everyone who has experienced the transformation from the 'dark' to the 'light' - not only in terms of practical changes like cooking and heating habits, hygiene and health, spare time, new education facilities etc., but also in terms of changes within the epistemological dimension of thinking about life, anticipating the future, being connected to the outside world (through new media), etc. For the vast majority of those interviewed, electrification has meant a tremendous change in their personal lives and lifestyles. Living in poor rural

societies, some had felt 'neglected' before electrification, especially those who had some experience of the 'outside world' (as labor migrants or as visitors to the national capital). In most cases, this feeling of 'forgotten remoteness' has now been replaced by a positive identification with the new conditions of village life after getting connected to the grid. These findings agree with studies in Costa Rica by Barnes (2004).

5.3.4. Economic Effects of Rural Electrification

According to World Bank (2006), the societal approach involves two different areas of data interpretation. It is evident from this study that although households do not necessarily record a change in the household incomes resulting from projects implemented at the households, at the community level, this is not the case. The empowerment at the community levels follows a shared view that the communities with connectivity are developed than those that are not connected. On the other hand, there is a shared view that land value has significantly increased over the last 6 years with the connections being prevalent in the last 4 years. The socio-cultural impact on the societal level is also tremendous - village life has changed not only individually but also collectively. Electricity empowers communities, resulting in more community activities and strengthening solidarity among members of the community. On the other hand, the socio-economic impact - interpreted from the macro-economic level - is less evident. In the current situation, community economies are too weak to permit investment in new machinery or equipment that could raise agricultural productivity. Very few farmers can afford to buy new electrically powered rice-mills, for instance. As yet, the impact of rural electrification on the local economies cannot be seen directly, in terms of higher family incomes through the use of new techniques, or greater agricultural productivity - only indirectly: This is in agreement with findings of Fluitman (1983), who points out that electricity in the rural had no major impact on the income generation and employment of the rural poor. Having more spare time enables the villagers to engage in additional income activities like weaving, kitchen gardening, small services, etc. But here it must be borne in mind that electricity is a prerequisite for further investments in the agricultural sector, and that only two years at most had passed since electricity was introduced in these villages. Once the density of monetarization (the actual amount of money circulating in local rural economies) increases, there will be more investments in new machines and technologies to strengthen local agricultural productivity.

5.4. Conclusions of the Study

The following conclusions were made from the study. It is evident that the rural communities with easy access to the tarmac road are mainly served with the connection. It is also evident that the communities near the power grid are mostly served faster than those in interior from the main grid. At the household level, households that are near the tarmac road and close to the main grid of connection are well served. From the findings it is evident that most households with connectivity had this in not less than a year ago. That means that the connectivity has been around for some time both at the community and the household levels. Most households spent less than Ksh 1,000 on electricity bills each month.

Connectivity of the electricity at the households and the communities has many uses that vary from the households and the community levels. At the household level, electricity use is through the appliances that are acquired and used by the households that require electricity to run. From the findings, at the household level, the household mainly use the electric power for lighting. This is reported in all the households. On the other hand, heavy consumption witnessed with high consumption appliances such as hot instant showers, refrigerators as well as microwave warmers are rarely in use. At the community level, electricity connection is mainly in enterprises such as battery charging outlets, shops, barber shops among others. Religious buildings are the least in connection. Schools are also well served with electricity.

Results on social effects show that the households are of the view that lives have improved a lot. There are fewer visitations to the health centres resulting from coughs caused by smoke. On the other hand, households feel that the performance of children in school has greatly improved with even the introduction of computer classes in some of their schools. At the community level, communities feel more empowered, communities feel more enlightened, their children can now learn better while opportunities for learning have significantly improved with the proliferation of computers becomes a norm in the schools even at the primary schools.

Finally, it is apparent that whereas there are no direct income changes or economic changes for the households, there is a collective feeling within communities that lives have improved with communities perceiving that they are more developed. The direct impact has been the acceleration of land rates with the value of land significantly rising. This has made the feeling of many people relocating from the connected villages to be less

while more people would like to move to connected villages. For instance land value in the last 5 years has moved from less than Ksh 100,000 to over Ksh 700,000 in some of the connected villages. This may also be attributed to the increasing Nairobi metropolis that is likely to develop into a megalopolis that will sweep over almost all areas near the city as the centripetal forces take effect.

5.5. Recommendations

The following recommendations were made from the study:

1. The government should review the regulations that govern rural electrification. For rural electrification to be successful the infrastructural development should be considered. Communities near the tarmac road are likely to benefit more. Therefore, there is need to either review the rural electrification policy or guidelines or develop the infrastructure in all areas to enable the realization of rural electrification.
2. The Government should be proactive in determining the economic value of the rural electrification project. A thorough economic analysis does not yield much to the investment in the rural areas. Perhaps, the government should enlighten the communities on what more they can do with electricity. From the findings, communities and households are only using electricity for mainly lighting and seem not aware of the enormous benefits they would accrue to having electricity.
3. There is need for the government to speed up the rural electrification. This will make communities to feel that they are developed, since communities feel that they are more empowered with electricity connectivity, even if the lives do not necessarily change, security is improved, and increased land value which also spurs investor confidence.
4. It is apparent that rural electrification is not sufficient to increase economic changes, the government should initiate programmes that will enable the communities to acquire machinery adequate to install income generating activities such as mechanization of agriculture, installing outlets for business. The use of devolved funds through county governments as well as other funds such as the youth, women and constituency development fund will be most beneficial.

5.6. Suggestions for Further Research

There are gaps which can be addressed in subsequent studies. The suggested topics for further studies include the following:

1. A study on Relationship between rural electrification and economic development in other areas of Kenya should be done.

2. A study on effective rural electrification models for Kenya can also be done.

3. A study on the impact of rural electrification on educational outcomes should be undertaken in other areas of the country.

5.7. Contribution to Knowledge

This study contributes to the body of knowledge in as far as the Socio-economic effects of rural electrification are concerned; this is shown in Table 5.1

Table 5.1: Contribution to the knowledge

No	Objective	Contributions
1.	To establish the patterns in the distribution of electricity in Tala Division	The study is a good guide to the Government in infrastructural investment priorities in rural areas
2.	To identify the household and community uses of electricity in Tala Division	The study provided a guide in design of electrical networks as it gives data in electrical consumption patterns in the rural areas
3.	To establish the social effects of rural electrification Tala Division	The study provided a guide to the new trends in analysis of the benefits vis a viz investment in many third world countries that still depend on external funding for projects. The study defines benefits of rural electrification beyond the connectivity only and expands it to social and economic benefits
4.	To assess the economic effects of rural electrification in Tala Division	

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APPENDICES

Appendix 1: Letter of Introduction

P.O. Box 9085 -00200
Nairobi
Tel: 0721790136

06th April 2013

To whom it may Concern.

Dear Respondent,

My name is Valentine Kembo a Master of Arts degree Student at the University of Nairobi. I am undertaking a study with an aim of understanding more on the rural electrification scheme in Tala Division Machakos County.

I am kindly requesting you to assist in filling the questionnaire for this study. Kindly note that the information that you give will be treated with utmost confidentiality and will not be shared with anyone except for the purpose of the study alone unless you are consulted.

Kindly feel free to consult me on telephone number 0721790136 for any clarifications.

Yours faithfully,

Valentine Kembo
Reg. No. L50/63889/2010

Appendix 2: Questionnaire to the Household

Instructions:

The following questions were used to collect information on the Electricity benefits in the household. Kindly provide honest answers. Please fill the space provided and tick (√) the relevant box.

Location_____Sub-Location_____Village _____

A. Household Profile

1. Who heads this household?
   - Male [ ]
   - Female [ ]
   - Child [ ]
2. What is the gender of household head?
   - Male [ ]
   - Female [ ]
3. What is the age of the household head?
   - Below 20 years [ ]
   - 21-30 years [ ]
   - 31-50 years [ ]
   - 51-70 years [ ]
   - Above 70 years [ ]
4. What is your highest level of education?
   - Never been to school [ ]
   - Primary [ ]
   - Secondary [ ]
   - Post-secondary [ ]
5. What is your marital status?
   - Single [ ]
   - Married [ ]
   - Divorced [ ]
   - Separated [ ]
   - Widowed [ ]

6. How many people live in this household?

1	[ ]
2-3	[ ]
4-7	[ ]
More than 7	[ ]

7. What is the roof of your main household?

Tiles	[ ]
Iron sheets	[ ]
Grass	[ ]

8. What is the wall of your main house?

Concrete	[ ]
Grass	[ ]
Mud	[ ]
Timber	[ ]
Iron sheets	[ ]

9. What is the floor of the main house?

Cement	[ ]
Earthen	[ ]
Wood	[ ]

10. What is the household head occupation?

---

11. What is the average monthly net income in Kenya shillings of the household?

Less than 5,000	[ ]
5,001- 10,000	[ ]
10,001-15,000	[ ]
15,001-20,000	[ ]
20,001-24,000	[ ]
Over 24,000	**[ ]**

B. Electricity Connection

12. Does your household have electricity?

Yes [ ] No [ ]

13. How far is your house from the tarmac road?

Less than 500metres	[ ]
Less than I km but more than 500metres	[ ]
1-2km	[ ]
2-5km	[ ]
More than 5km	[ ]

14. How far is your house from the main grid?

Less than 500metres	[ ]
Less than I km but more than 500metres	[ ]
1-2km	[ ]
2-5km	[ ]
More than 5km	[ ]

15. When was electricity connected to your main house?

Less than 1 year	[ ]
1-2 years ago	[ ]
2-4 years ago	[ ]
4-6 years ago	[ ]
Over 6 years ago	[ ]

16. On average, how much do you pay for your electricity bill monthly?

Less than Ksh 500	[ ]
Ksh 500-1000	[ ]
Ksh 1000-2000	[ ]
Over Ksh 2000	[ ]

C. Uses of Electricity in the Household

17. Tick all the appliances in your household that use electricity

No	Appliance	Tick all that apply
17.1	Cellphone	
17.2	Television	
17.3	Radio	
17.4	Lighting	
17.5	Hot showers	
17.6	Water pump	
17.7	Refrigerator	
17.8	Electricity cooker	
17.9	Microwave heater	
17.10	Water heater	

D. Benefits of Electricity

18. Using the scale below, rate how you feel electricity has really been helpful to you?

5- Extremely a lot 4- A lot 3- Moderate 2- Just a little Not at all

No	Appliance	5	4	3	2	1
18.1	I know a lot happening around me because of listening in/watching television					
18.2	There are few regular visits to the health centre because of coughs from using paraffin					
18.3	My children perform better in class because they have more time to read at home					
18.4	There is more security at the market because of the lights					
18.5	My income has increased because I have an enterprise I opened because of electricity					
18.6	I can pump water for irrigation which has increased my annual incomes					
18.7	I have a battery charging shop that has increased my income					
18.8	I have a welding machine that has increased my income level					
18.9	I have a solon/hairdressing shop that increased my income on monthly basis					
18.10	I have a carpentry which increases my income					
18.11	I feel that I am more developed					
18.12	I have a reliable source of lighting than being connected with electricity					

Thank you for taking time to respond to Questions.

Appendix 3: Questionnaire to the Village Elder

Instructions:

The following questions were used to collect information on the Electricity benefits in the Village. Kindly provide honest answers. Please fill the space provided and tick (√) the relevant box.

Location_____Sub-Location_____Village _____

A. Village Elder Profile

1. What is the gender of household head?
   - Male [ ]
   - Female [ ]
2. What is your age?
   - Below 20 years [ ]
   - 21-30 years [ ]
   - 31-50 years [ ]
   - 51-70 years [ ]
   - Above 70 years [ ]
3. What is your highest level of education?
   - Never been to school [ ]
   - Primary [ ]
   - Secondary [ ]
   - Post-secondary [ ]
4. What is your marital status?
   - Single [ ]
   - Married [ ]
   - Divorced [ ]
   - Separated [ ]
   - Widowed **[ ]**

B. Electricity Connection

5. Does village have electricity connection?

   Yes [ ] No [ ]

6. How far is your village from the tarmac road?

Less than 500metres [ ]

Less than I km but more than 500metres [ ]

1-2km [ ]

2-5km [ ]

More than 5km [ ]

7. How far is the village from the main grid?

Less than 500metres [ ]

Less than I km but more than 500metres [ ]

1-2km [ ]

2-5km [ ]

More than 5km [ ]

8. When was electricity connected to your village?

Less than 1 year [ ]

1-2 years ago [ ]

2-4 years ago [ ]

4-6 years ago [ ]

Over 6 years ago [ ]

C. Uses of Electricity in the Village

9. Which of the following facilities in the village where electricity is connected?

No	Appliance	Yes	No
9.1	Church		
9.2	Mosque		
9.3	Primary school		
9.4	Secondary school		
9.5	Polytechnic		
9.6	Shops		
9.7	Posho mills		
9.8	Water selling point		
9.9	Computer shop		

D. Benefits of Electricity

10. Using the scale below, rate how you feel electricity has really been helpful to this village?

5- Extremely a lot 4- A lot 3- Moderate 2- Just a little 1-Not at all

No	Appliance	5	4	3	2	1
10.1	Establishing computer centers in the village					
10.2	Family incomes have improved in the village					
10.3	Enterprises like salons, battery charging have emerged					
10.4	Children are passing examinations more since schools have electricity connected					
10.5	Computer classes have been established in the schools					
10.6	People in the village have become more enlightened					
10.7	People feel that they have developed					
10.8	We have a feeling that our village is developed					
10.9	Few people are willing to relocate from this village					
10.10	Many people want to migrate to this village					
10.11	Land value has gone up especially in market places					

11. **Kindly provide us with the details of the following**

No	Details	Before Electricity was connected?	Now?
10.1	How many computers centers were in the village		
10.2	What was the average income for households in the village		
10.3	How many salons were in the village market of the		
10.4	How many battery charging outlets were at the market		

Thank you for taking time to respond to questions**.**

Appendix 4: Table for determining sample size from a given population

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

Key: “N” is population size

“S” is sample size.

Krejcie, Robert V., Morgan and Daryle W ,1970

Appendix 5: List of Villages

NO	DIVISION	SUB-LOCATION	VILLAGE
1	TALA	ISINGA	ISINGA
2	TALA	KYAUME	MISUUNI
3	TALA	KAWETHEI	MUTHWANI
4	TALA	KATHAANA	SYANTHI
5	TALA	MBUSYANI	MBUSYANI
6	TALA	KAVILINGUNI	KITHATANI
7	TALA	KYEVALUKI	KAKUNGU
8	TALA	ISINGA	ISINGA NORTH
9	TALA	ISINGA	ISINGA SOUTH
10	TALA	MUISUNI	LOWER KALIMANI VILLAGE
11	TALA	MATETANI	KANZIA 'C'
12	TALA	NDUNDUNI	KITHI 'A'
13	TALA	KATITU	KWAMUSUNZA A’
14	TALA	KATITU	KWAMUSUNZA B’
15	TALA	IIA-ITUNE	KIAMBANI
16	TALA	KAWAUNI	KIVULUNI 'A'
17	TALA	MBILINI	UNYUANI 'A'
18	TALA	MBILINI	UNYUANI 'B'
19	TALA	KITHIMANI	KITHIMANI TALA 'A'
20	TALA	KITHIMANI	KITHIMANI TALA 'B'
21	TALA	NGULUNI	KALIE 'A'
22	TALA	NGULUNI	KALIE 'B'
23	TALA	SENGANI	MUKALWA NORTH
24	TALA	SENGANI	MUKALWA NORTH
25	TALA	KATINE	MANZA LOWER
26	TALA	KOMA	KWA MUTALIA
27	TALA	MATUU	WENDANO A
28	TALA	MATUU	WENDANO B
29	TALA	MWATATI	UAMANI 'A'
30	TALA	MWATATI	UAMANI 'B'
31	TALA	KINGOTI	ITHINGU 'A'
32	TALA	KINGOTI	ITHINGU 'B'
33	TALA	MATHEINI	KAKULUTUINI
34	TALA	KIANZABE	WENDANO 'A'
35	TALA	KAYATA	NGOMANO
36	TALA	KAYATA	NGOMANO
37	TALA	KIBOKO	KANGAU 'A'
38	TALA	KIBOKO	KANGAU 'B'
39	TALA	KYELENI	KISEKINI 'A'
40	TALA	KYELENI	KISEKINI 'B'
41	TALA	KWOSAU	KWOSAU
42	TALA	KALANDINI	MATAKUTHA 'B'
43	TALA	KALANDINI	MATAKUTHA 'A'