

**CONTRIBUTION OF RURAL ELECTRIFICATION TO HOUSEHOLD INCOME
IN MOSHI DISTRICT, TANZANIA**

VALERIAN VITALIS KIDOLE

**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
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ABSTRACT

Tanzania is among the countries with lower rural electrification rates. It is estimated that less than five percent of the rural population are using grid electricity services. This study assesses the contribution of rural electrification to household income in Moshi District, Tanzania. Specifically, the study aimed at identifying income generating activities undertaken using grid electricity, assessing the contribution of grid to household income as well as identifying the challenges in utilization of grid electricity services in income generating activities. A multistage sampling technique was used to select a total 120 (60 with grid and without grid services respectively) respondents for the study. The study identified among others, iron wedding, compact disc burning and grain milling as income generating activities influenced by presence of grid electricity. The household annual income ranged from 800 000 Tshs to 46 000 000 Tshs and there were statistically significant differences in income between households with grid electricity services and those without. In addition, the study identified reliability of services, high application standards, and higher bill as challenges associated with grid electricity services. The study concludes that grid electricity contributes to increased household income. Furthermore, the study recommends that, the government and development partners should secure necessary financial resources to invest in rural electrification.

DECLARATION

I, Valerian Vitalis Kidole, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

Valerian Vitalis Kidole
(M.A. Rural Development)

Date

The above declaration is confirmed

Prof. Dismas Mwaseba
(Supervisor)

Date

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DEDICATION

This dissertation is dedicated to my parents Mr. Vitalis Kidole and late Mother Clencensia Nachenga. It is also dedicated to my beloved wife Rehema Godbless and my children Ivan, Novatus and Cynthia whose moral and material support for my studies helped me to reach this successful stage. May the Almighty God be with all of us in every aspect of our life.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune-Deficiency Syndrome
CCM	Chama cha Mapinduzi
CD	Compact Disc
DFID	Department for International Development
ECON	Economic
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agriculture Organization
HBS	Household Budget Survey
HIV	Human Immune-Deficiency Virus
ICT	Information and Communication Technology
MDGs	Millennium Development Goals
MV	Mega Voltage
NBS	National Bureau of Statistics
NEP	National Energy Policy
NPES	National Poverty Eradication Strategy
OECD	Organization for Economic Cooperation and Development
PPP	Private Public Partnership
PV	Photovoltaic
REA	Rural Electrification Agency
REF	Rural Energy Fund
SME	Small and Medium Enterprises
SPSS	Statistical Package for Social Sciences
TANESCO	Tanzania Electricity Supply Company

TAS	Tanzania Assistance Strategy
TPRSP	Tanzania Poverty Reduction Strategy Paper
Tshs	Tanzania Shillings
URT	United Republic of Tanzania
USD	United States Dollar

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

There are still many people in the world who do not have access to electricity or other forms of modern energy. In total, nearly 1.6 billion out of the total population of 6.5 billion do not have access to electricity, and 2.5 billion are dependent on biomass energy (OECD, 2006). It is typically the poor who lack access to modern energy and that the lack of access to modern energy is one of the contributory factors to the poor remaining poor. Thus it is believed that creating access to energy will make it possible for the poor to improve their lives by creating an income (OECD, 2006).

One strategy for reducing poverty is to increase incomes of the poor. Electricity is an important factor input for many energy services that can contribute to enterprise operation, and therefore access to electricity and its cost play a role in the viability and profitability of the enterprise. However, there is little empirical evidence to underline strategies of poverty reduction through supplying energy, especially by targeting non-farm income generation (World Bank, 2003; Meadown, 2003; Reddy, 2000). Indeed, the mechanism that lead from energy supply to income generation is less understood, and insights are focusing on factors which contribute to improving the impacts of energy uses on poverty reduction (Van Dijk, 2005).

Rural electrification can simply be defined as the supply of electricity to the countryside. However, this definition does not clearly delineate the boundaries and intent of the process of rural electrification. In this study, rural electrification is understood as the supply of electricity to small towns and villages, and agro-based industries outside the regional

capitals to bring about important social and economic benefits (Kjellstrom *et al.*, 1992; URT, 2004). Rural electricity supply can be achieved by using the national grid, mini-grid, isolated generator systems or renewable energy systems, including solar photovoltaic (PV), wind power plant, small hydropower, and bio-fuel engines, among others.

In the Tanzanian context, rural electrification encompasses electrification of the district headquarters, townships, villages, and commercial centres. It is worth noting that, the rural electrification programme in Tanzania started since the early 1970s, with the aim of providing reliable and high quality electricity supplies which can be used for domestic, industrial and commercial purposes (Kjellstrom *et al.*, 1992). In government's view, rural electrification is a key input in enhancement of growth and economic development of the country and thus, addresses it in the framework of poverty reduction (URT, 2003). Unfortunately, the impact of the energy policy has not reached the grass root level. In fact, the present level of rural electrification in Tanzania is an outcome of the policies adopted by the colonial and early post-independence governments.

The first national energy policy for Tanzania was launched in April 1992. It was formulated with reference to various overall national plan documents (the Long Term Perspective Plan, 1981-2000; the Economic Recovery Programme; and the Chama Cha Mapinduzi - CCM - Party Programme, 1987-2002) and sector plan documents for transport, agriculture, water, science and technology. The 1992 Energy Policy described the main energy resources of Tanzania as being biomass (including fuel wood and agro-forestry wastes), coal, natural gas, water, solar, wind, geothermal and uranium.

However, the present day policy encompasses public private partnership. The government believes that rural Tanzania cannot be transformed into a modern economy and that rural Tanzanians' livelihoods cannot be significantly improved without a dramatic increase in

their access to modern energy services, particularly electricity (Amous *et al.*, 2002). In addition, most of electrified households use electricity services for lighting but those who do not have electricity services meet their lighting demand using other options such as kerosene, diesel, dry cells, biogas, and solar PV.

Overall, there is no significant change in the energy use patterns in Tanzania since 1992 (Mandara *et al.*, 2000). It is argued that one of the areas where notable progress has been made even though not to the extent of changing national energy use patterns is in the area of electrification of major district centers, and in the growing use of solar photovoltaic (PV) systems in remote locations.

According to Tanzania's Poverty Reduction Strategy Paper (PRSP), income poverty is largely a rural phenomenon. Among the factors such as subsistence agriculture where the poor are concentrated, also widespread and increasing in urban communities, afflicting more intensely the youth, the elderly and persons in large households, having different impacts between men and women. Also, a study done by Sizya (2001) revealed that female-headed households were not necessarily poorer than male-headed households but that women were generally perceived to be poorer than men. Similarly, more than 80% of Tanzanian's poor live in rural areas and the sales of food and cash crops are still the main source of cash income for rural households (NBS, 2009) cited by Aikaeli (2010).

Equally important, the incidence of income poverty (basic needs and food poverty) is high in rural areas compared to urban areas. For example, data from two Household Budget Surveys for 2000/01 and 2007 indicated that food poverty 2000/01 was 13.2% in urban areas and 20.4% in rural areas (URT, 2001) while 2007 was 12.9% and 18.4% (URT, 2007) in rural and urban respectively. On the other hand, in 2000 basic needs poverty was

25.8% in urban areas and 38.7% in rural areas (URT, 2001) while in 2007 was 24.1% and 37.6% (URT, 2007). This implies that rural areas were worse off when it comes to the problem of income poverty.

According to URT (2000), since independence in 1961, the Government of Tanzania has been preoccupied with three development problems: ignorance, disease and poverty. National efforts to tackle these problems were initially channeled through centrally directed, medium-term and long-term development plans, and resulted in a significant improvement in per capita income and access to education, health and other social services until the 1970s.

Thereafter, these gains could not be sustained because of various domestic and external shocks, and policy weaknesses. Recently more efforts to tackle poverty and the other development problems have been pursued under relatively decentralized, but largely complementary policy initiatives including Tanzania Development Vision 2025, National Poverty Eradication Strategy (NPES), Tanzania Assistance Strategy (TAS) and Poverty Reduction Strategy Paper (PRSP).

Basically, most poverty reduction strategies are principally concerned with the need to increase income levels of the poor through improved access to income earning opportunities and to improve quality of life through better access to basic social services such as health, education and clean water and sanitation. Albeit access to modern energy services is not specifically listed as a MDG, governments, donors and other stakeholders recognize energy as an essential ingredient for making the poverty reduction strategies more effective and the MDGs more achievable (Muller, 2001).

Linkages between income poverty and rural electrification are based on the ground that since rural poverty is prevalent; governments have struggled to develop viable rural energy programmes. In view of this, visible energy interventions such as grid and off-grid electrification programme have been the most significant interventions as integral components of rural development (Muller, 2001). Although rural electrification *per se* has not necessarily reduced poverty, its relationship to poverty reduction cannot be denied (URT, 2004 cited by Aslam, 2000). Generally, energy particularly electricity is required for meeting basic needs such as health, agriculture, education, information and other infrastructural services and shows a clear correlation with per capita income and human development index (Anderson, 2000; Chaurey and Mhanty, 2004; Rehling, 2002 cited by Aslam, 2012).

The Government of Tanzania has taken some steps towards distribution of Rural Electrification services through establishment of Rural Energy Agency (REA) and Rural Energy Fund (REF) as well as encouraging the Private Sector to invest in Renewable Energy (Aslam, 2000). The National Energy Policy (URT, 2003) intends to facilitate increased availability of energy services, including grid and non-grid electrification to rural areas. Energy services have an impact on all rural economic activities, including agriculture, business, social services, gender equality and poverty. Therefore, improved energy supply in the rural areas will ensure improvement of the welfare of the rural population and the attainment of sustainable economic growth.

1.2 Statement of the Problem

Existing literature (eg Maleko, 2005; Weingart, 2000; Abvana, 2000; Allderdice and Rogers, 2000) had only assessed accessibility to grid electricity services and micro enterprise development, drivers and barriers to rural electrification, impacts of access to

electricity to rural enterprises. However, little has been done to determine the contribution of grid electricity services to household income. Therefore, this study conducted in Moshi District attempted to bridge such knowledge gap in literature.

1.3 Justification of the Study

In Tanzania some of the studies (see for example, Maleko, 2005; Weingart, 2000; Abvana, 2000; Allderdice and Rogers, 2000) have only sought to assess accessibility to grid electricity services. The findings from this study will enable decision makers, government, donor organizations and other energy stakeholders support efforts to increase accessibility of electricity by the informal sector.

Furthermore, the findings of the study are expected to stimulate the discussion about the linkages between grid electricity services and rural income generation and on how electricity services can contribute to household income.

1.4 Research Objectives

1.4.1 General objective

The general objective of the study was to assess the contribution of grid rural electricity services to household income.

1.4.2 Specific objectives

The specific objectives of study are:

- i. To identify types of income generating activities undertaken by household using grid electricity.
- ii. To determine household income obtained from activities carried out using grid electricity.

- iii. To identify challenges facing utilization of grid electricity services in household income generating activities.

1.4.3 Research questions

The research questions are:

- i. What are the types of income generating activities done by household with and without grid electricity services?
- ii. What is the level household income obtained from activities carried out using grid electricity?
- iii. What are the challenges in utilization of grid electricity?

1.4.4 Research hypothesis

Null hypothesis

H_0 = There is no significant association between grid electricity services and household income.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Rural Electrification

A more positive view of the role of rural electrification and its relation to poverty reduction has interesting implications for rural development strategies as a whole. Accelerating the introduction of basic, clean energy services is seen as a key strategy for promoting sustainable development in rural areas. Still, many people worldwide lack access to modern energy, such as electricity, and Africa lags behind other developing regions of the world. Support to rural electrification is therefore given high priority by the national governments and donor organizations. Besides, there is a trend to encourage the involvement of other actors than national utilities for the implementation of rural electrification.

2.2 The Concept of Income poverty

Extreme poverty is a worldwide phenomena such that in 2000 the United Nations General Assembly promulgated the Millennium Development Goals (MDGs), the first one of which is to eradicate extreme poverty and hunger. The target is to halve, between 1990 and 2015, the proportion of people whose income is less than one US dollar a day and those who suffer from hunger.

Poverty is defined in terms of income or more generally of disposable resources to support a minimum standard of decent living (AFRICA, 2015). It is a state of deprivation and prohibitive of decent life that results from many mutually reinforcing factors including lack of productive resources to generate material wealth, illiteracy, prevalence of diseases, discriminatory socio-economic and political systems and natural calamities such as

drought, HIV/AIDS and wars (URT, 1998). Several socio-economic features are commonly accepted to be reflective of poverty. These features include high rates of morbidity and mortality, the prevalence of malnutrition, illiteracy, high infant and maternal/mortality rates, low life expectancy, poor quality housing, inadequate clothing, low per capita income and expenditure, infrastructure, communication, transport and social services. Others include high fertility, lack of access to basic services such as safe water, food insecurity and poor technology (URT, 1998).

Poverty is a global issue, despite changes in development paradigms in the first half of the 20th century, the promise to bring well being remained unfulfilled. For more than 100 million children of primary school age never stepped inside a classroom; about 29 000 children die each day from preventable malnutrition and disease; more than 1.2 billion people in the world are struggling to survive at the margins of human existence under a dollar a day (Bacher, 2002).

2.3 Status of Poverty in Tanzania

Currently about 28 % (28.2%) and 10% (9.7%) of Tanzanians respectively fall below the basic needs poverty line and the food poverty line. The absolute number of people living in poverty has increased slightly because of population growth. Based on official population projections, the overall poverty gap index for Tanzania Mainland population is 6.7 % while the gap for population living in Dar es Salaam is 0.8%. The gap in rural areas is 7.9% meaning that the population living in rural areas is deeper in poverty (URT, 2013).

2.4 Type of Income Generating Activities Undertaken Using Grid Electricity

A study done in 1992 by TANESCO and University of Dar es Salaam and Stockholm Environmental Institute in four rural districts in Tanzania (Njombe, Babati, Same and

Sumbawanga) revealed that about three quarters of electricity consumers were businesses such as shops, bars and guesthouse. On the other hand, just three percent were light industry consumers such as grain milling, welding workshops and garages.

Anecdotal evidence is commonly used to support the argument that modern energy can and does play an important role in stimulating micro-enterprise. For example, Beck and Martinot (2004) suggest that access to modern energy produced by micro hydropower in Nepal has contributed to the establishment of bakeries, photo studios, battery charging, grocery stores, agricultural and saw mills and small-scale agricultural activities such as poultry farming and goat keeping. Balla (2003) reports a similar variety of SMEs established and/or expanded following micro-hydro rural electrification projects in Kirinyaga and Meru Districts of Kenya. Obeng (2007) cited in Davidson and Fthenakis (2009) suggest that the security lighting in high-masts (poles) in poor urban areas of South Africa has resulted in the urban poor setting up small enterprises in the evenings.

Similarly, the Nairobi City Council in Kenya has embarked on a program to repair and install streetlights along the inner roads, walkways and slums with a view to relocating hawking businesses from the congested central business district into the outer parts of the city. Installation of street lights has increased visibility, attracted more customers, improved security and extended the hours of operating businesses into the night, thus improving sales and profitability (Kirubi, 2005).

2.5 The Contribution of Grid Electricity Services To Household Income

Greenstar (2004) demonstrated the significance of better lighting for increased income generation attributable to extension of business hours in the evenings. The author cites examples of tailors who worked for four more hours and thereby increased their revenue

by 30% in Bangladesh. Opening hours for shops were also found to increase by an average of three hours a day and in terms of new businesses. Khan (2005) concluded that adequate lighting is a “deciding factor” in whether or not people opened a home-based business.

Furthermore, Foley’s (1990) study reports increased economic activity and higher living standards following electrification and concludes that “the arrival of an electricity supply in certain areas seems to be a crucial factor in precipitating decisions by local entrepreneurs to invest in a variety of productive enterprises” (Page number 18). Gustave (2004) cites evidence from KwaZulu/Natal of positive impacts of existing SMEs that benefited from the switch to electricity including welding shops and tailors. In other sectors such as brick making and garment manufacturing, the availability of electricity determines levels of technology and also has a strong influence on the cost and levels of production.

Rural SME owners indicated that lack of electricity was among the main limitations to their competitiveness while those operating in the industrial estates mentioned the presence of electric service as one of the benefits of location in the estate, in addition to other important infrastructure available there (Gustave, 2004).

Several case studies from Grameen Shakti’s PV program illustrate well the value of modern energy to microenterprises (Kishore, 2006). For example, a local appliance repair shop, using grid electricity services to undertake repairs, was reported to increase income by US\$25 per day. A lamp renting enterprise which rented out 5 lamps earned an extra US\$12. 50 a month and the operation of the power cellular phone system earned the owner an estimated US\$30 a day extra. Extended working hours at a local barber shop using lighting was found to increase income by US\$5 a day. In addition to these financial

indicators, other direct impacts experienced by these enterprises included better work quality and efficiency, a better working environment and greater income from ancillary sales associated with attracting customers in the evenings. Other indirect impacts of these enterprises using grid systems were identified as greater customer satisfaction, increased income for workers, increased social status of owners and customers, increased living standards for locals and increased employment opportunities.

Nevertheless, there are conflicting reports and differences in opinion in the literature regarding the impact that modern energy does have on entrepreneurial activities, and hence its developmental importance. One view is that modern energy is one of a number of critical enabling factors necessary for micro-enterprise development. For example, Barnes (1988) reports finding greater numbers of businesses in rural areas with electricity than those without it, but also highlights that there were other complimentary local conditions such as readily availability of adequate credit finance and access to markets.

Another perspective is that while electricity is crucial to existing and well established micro-enterprises, it is not so much a contributing factor in the emergence of new ones. Following a literature review of international work on rural electrification, Gustave (2004) concludes that access to electricity encourages the “modernization” of existing rural SMEs but it exerts only a modest stimulus for the growth of new enterprises. This skepticism is echoed by Lorenzo (2002) who observed that “overall, rural electrification does not seem to have had significant impact on the growth of income generating activities in Namibia”. They note that very few home-based businesses used electricity and when they did, they mainly made use of electrical “lighting only”. In their view, access to finance and markets are more important for SMEs than electricity.

Regarding the impact of grid on rural development, FAO (2005) cited in Cecelski (2000) shares this view and emphasizes the need to go “beyond the light bulb” in order to have an impact on poverty reduction. While acknowledging the limitation of solar PV as anti-poverty intervention, Munda and Russi (2005), nonetheless conclude that the grid appears to play a small but potentially significant role in supporting income and work related activities in rural Kenya. He cites a 2003 survey (n=76 households) where 32% of the households with grid reportedly used lights for income generation or work related activities. In total, 48% of the households in the same sample reported some sort of work or income-related activity that was supported by use of a grid. In addition to lighting services, Munda and Russi (2005), further draws our attention to another important application of solar PV: supporting connective appliances such as TV, radio and cellular phones in rural areas. The (economic) value of information from the use of these appliances is particularly difficult to evaluate, however.

To bring better clarity and reconciliation in the energy-SMEs debate, it is methodologically insightful to bear in mind that while the term “micro-enterprise” may be useful to describe a broad spectrum of similar income-generating activities, the businesses themselves are not homogenous but often have different characteristics and different needs. Consequently, it is inevitable that there will be differences in the degree to which access to modern energy affects each micro-enterprise. In fact, Meadows *et al.* (2003) question the validity of studying small or micro-enterprises as a group, arguing that a sub-sector approach is more useful. Thus, it may be more relevant, for instance, to look at the milling, Information Communication and Technology (ICT), carpentry or metalworking businesses.

2.6 Challenges in Utilization of Grid Electricity Services

In Tanzania a study done by Maleko (2005) revealed that some of the challenges with regard to access and use of grid electricity for production purposes are;

- The service was still not available in some areas due to lack of service line materials such as fuses, cables, poles and transformers, illegal connection and vandalism of cables and cooling transformer oil in the distribution network. This caused blackouts, which discourages new customers to apply for connection. There were low voltage supplied and fluctuations outside the acceptable range found in the study areas.
- The electricity services supplied was not available and reliable, and most of the time, especially in the evening hours the electricity supplied was under voltage and there are frequent blackouts. This caused problems to enterprises operating in the night like tailoring during peak demand periods like Christmas or harvesting period. This also is a problem for enterprises which used electricity for lighting after sunset for example, retail shops, salons, and tailor shops.
- Another barrier observed was a complicated tariff structure; that there were high initial connection and installation fees. The initial connection fees for residential single phase meter was Tshs 204 000 and for commercial is Tshs 492 000 for three phase meter.

According to tariff categories, microenterprises belong to domestic low usage tariff, which has two classes: low energy charge per (0-50) costs Tshs.38 per unit, above 50 costs Tshs.115 per unit, most of enterprises were observed to use more than 50. For example, the findings from Lyasongoro village in Moshi District revealed that electricity consumption per month ranged from 400 to 450 ; So, using the above rate means the monthly bill ranges between Tshs. 46 000 and Tshs. 51

750. This was expensive as compared to average month earning of enterprises, which range between Tshs. 70 000 and Tshs. 100 000.

- Low income for most of community members to meet applicable standards was another constraint observed in the study areas. In order to qualify for connection the customer must meet certain minimum standards stipulated by TANESCO which include having a permanent house roofed with iron sheet and completed the wiring approved by electrical engineer or technician. This system automatically excludes most of very low-income families. For example, in Mahango village in Moshi District an estimate of 90 households out of 792 households observed where traditional houses, which did not meet TANESCO standards.

Furthermore, other challenges include the fact that since 2000 electricity has become relatively expensive (Obeng, 2007). The initial connection fee and monthly bill increase inhibited most of the villagers to use it for productive activities. For example, in the year 2003 the initial connection fees were Tshs. 90 000 while in 2004 and 2005 it rose to Tshs. 140 000 and Tshs. 204 000 respectively. Also, among the households that are connected to the grid only few use the power for production, the primary reason being the high initial cost for the connection to the grid and high electricity prices.

Also a study done by World Bank (2010) revealed that, rural electricity connection cost and connection charges are high in Tanzania compared to similar countries in the region and other countries in the world (the connection costs are the total costs of connecting a customer including the MV, LV lines, drop, internal installation, meter etc; the connection charge is the amount that the customer is required to pay in order to get connected). The connection charges in Tanzania ranges from USD 270-1957 per connection, about a half

to four times the national per capita GDP. They are well reflected in low electrification rates. The high connection charges are mainly due to high connection costs incurred by customers and the lack of connection subsidy or other financing schemes that would make the access to electricity affordable (World Bank, 2010).

The Public Private Partnership (PPP) was not well coordinated. The government continued to be both the financier and provider of socio-economic services. The PPP implementation arrangement was not guided by a policy or comprehensive plan; it was limited to a few areas. In the absence of PPP policy, the existing partnership was largely guided by the requirements of the Public Procurement Act (2004) and regulations. The capacity to design, develop and implement PPP projects continued to be limited (URT, 2010).

2.7 Conceptual Framework

The figure below is an illustration of the causal relationship between grid electricity services and household income generation. It indicates as well some social and economic benefits that may accrue to rural beneficiaries. Though grid electric rural electrification has linkages with several sectors, it focuses specific role, particularly goals relating to access to information, agriculture and microenterprise known hereafter as the improved rural income. The illustration is based on a modified combination of models and findings from relevant literature (DFID cited in Urassa, 2010; Fishbein, 2003; Martinot, 2004).

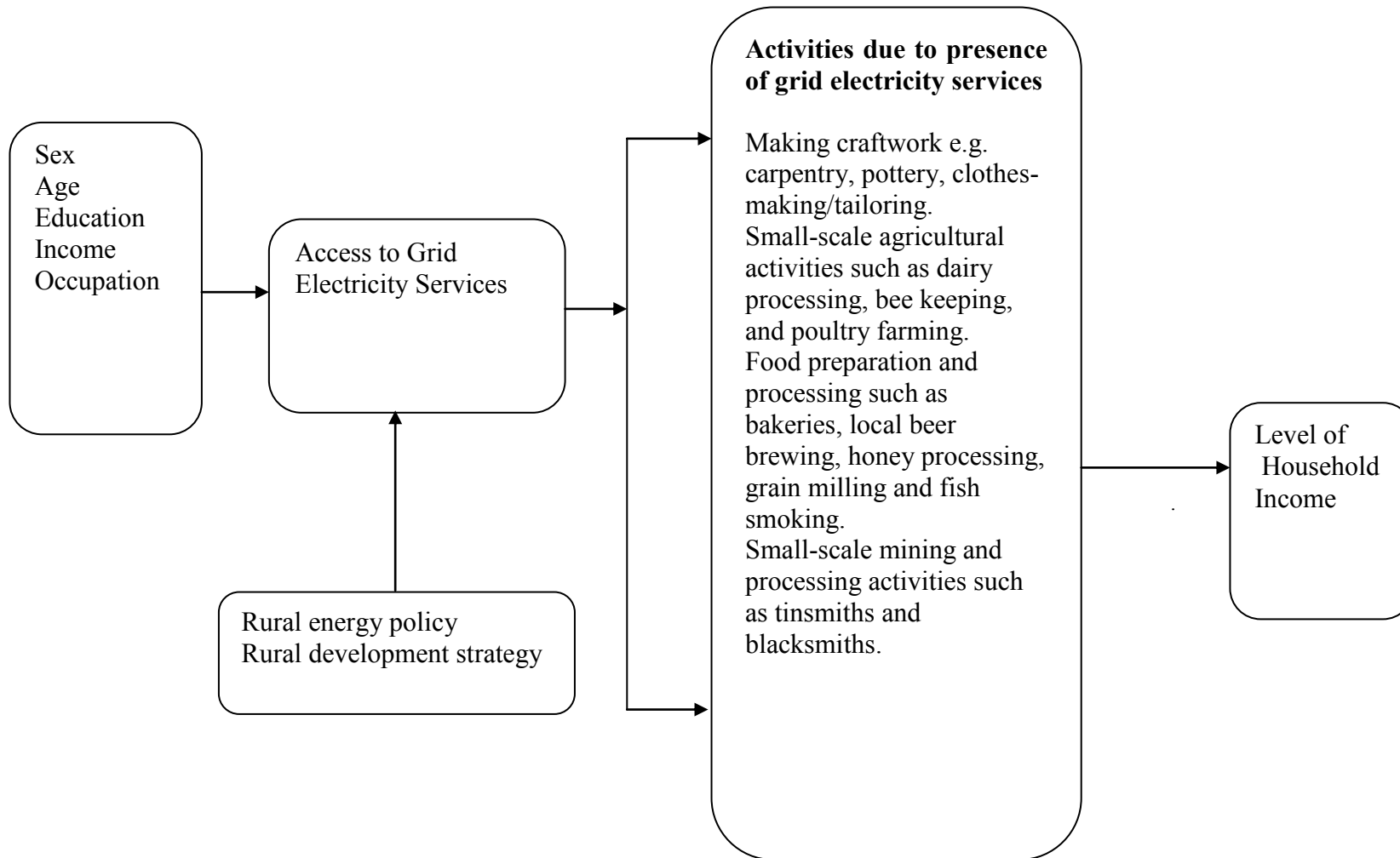


Figure 1: Conceptual Framework

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Study Area

The study was carried out in Moshi District, in Kilimanjaro Region. Moshi district was selected randomly from seven districts where the rural electrification programme has been being implemented since the early 1970s.

3.2 Research Design

Research design is an all-inclusive plan for data collection in an empirical research project. It is a “blueprint” for empirical research aimed at answering specific research questions or testing specific hypotheses, and must specify at least three processes, which include the data collection process, the instrument development process, and the sampling process (Bhattacharjee, 2012). The study employed a cross-sectional research design, which is commonly used in social science studies since it allows collection of in-depth data on different groups of respondents at one point in time.

3.3 Study Population

Population is a class, families living in a city, village, or electorate from whom a few respondents, households, families, electors are selected in order to find the answers to questions of a study (Kumar, 2005). The population for this study constituted rural households with and without national electricity grid services in Moshi District.

3.5 Sampling Procedure and Technique

Multi-stage sampling technique was employed in this study to select respondents. The first stage involved random selection of three divisions out of four. The same procedure was

used to select three wards from each division and one village from each ward was selected to make a total number of three villages. Finally, at village level the population was stratified into those with electricity and those without. From each stratum, 20 households with and 20 households without national grid electricity services were sampled randomly making a total of 40 households in each village. The sampling frames used for this study were prepared with assistance of the Village Executive Officers in each of the study villages.

The key informants were purposively selected on the basis of having significant information about the topic. To this end, a total of 8 key informants were selected (1 REA Officer, 1 District Trade Officer, 1 TANESCO Officer, 1 Agriculture Officers, 1 Community Development Officers and 3 Ward Executive Officers).

3.4 Sample Size

This study used a sample size of 120 households in Moshi District. The reason for the choice of the sample size was based on observation by Sudman (1976) that a minimum of 100 is needed for each major group or sub-group in the sample and each minor sub-group should have 20 to 50 cases. Nevertheless, Matata *et al.* (2010) argue that having 80 to 120 respondents are adequate for most socio-economic studies.

3.5 Pre-testing of Data Collection Instruments

According to Kothari (2004), it is always suitable to do pre-testing of the instruments. This is because it (pre-testing) brings to light the weaknesses of the instruments and based on experience gained improvement can be made. Therefore, data collection instruments for this study were pre-tested in one village (Mvuleni) which had similar characteristics to the study villages.

According to Pearce (2002) pre-testing of data collection instruments can be categorized into two types. The first is the participatory pre-testing that requires the researcher to let the respondents know that it (pre-testing) is being done. The second is the undeclared pre-testing that obliges the researcher not to inform the respondents. In this regard, the first type of pre-testing was employed in this study. This assisted to revise some of the questions in the tools based on the objectives of the research.

3.6 Data Collection Methods and Instruments

This research used both a structured questionnaire and checklist of items respectively for data collection. The structured questionnaire, which consisted both open- and closed-ended was administered to the selected respondents. Direct administration of the questionnaire (as opposed to self-administered mode) was particularly applicable to rural populations in developing countries because of their low levels of literacy (Bless and Higson-Smith, 1995; Laws *et al.*, 2005 cited by Start and Hovland, 2004). Also, a checklist was used to guide the key informant interviews.

3.7 Data Processing and Analysis

3.7.1 Data processing

Primary data collected from households using a structured questionnaire were verified, compiled, coded, reorganised and summarised for computer analysis. Data collected from other sources like checklists were processed using excel sheet.

3.7.2 Data analysis

Primary data obtained from the household survey using the structured questionnaire were analysed by using the Statistical Package for Social Science (SPSS). Descriptive statistics were used to generate frequencies, percentages and means to for income. Furthermore, to

determine the contribution of grid electricity services to household income, Independent sampled t-Test was used to compare the mean difference of household income between household with and without grid electricity services.

3.8 Ethical Considerations

During the survey, respondents had the right to participate or not to participate in the study or to withdraw at any time during the interview. Confidentiality was maintained by doing the interview in private. This approach is supported by Bhattacharjee (2012) who identified voluntary participation and harmlessness (informed consent), anonymity and confidentiality (privacy), disclosure, honesty with professional colleagues as important ethical issues to be adhered to by researchers. Accordingly, these ethical considerations were observed in this study.

Also Bhattacharjee (2012) opined that respondents in a research project must be aware that their involvement in the study is voluntary, that they have the freedom to withdraw from the study at any time without any unfavorable penalty, and that they will not be harmed as a consequence of their participation or non- participation in the research.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter summarizes the findings on the contribution of rural electrification to household income in Moshi District. The results presented in this chapter include demographic characteristics of respondents and background variables, type of income generated activities undertaken using grid electricity, the contribution of grid electricity services to household income and the challenges facing utilization of grid electricity services in income generating activities.

4.1 Demographic Characteristics of Respondents

The following demographic characteristics of respondents were covered in the study: sex, age, main occupation, marital status, residence location and years of schooling.

4.1.1 Age

Age is an important demographic variable and the primary basis for demographic classification as vital statistics, census, and surveys (URT, 2005). A total of 120 respondents were interviewed of whom 57.5 % were male and 42.5% were female. In this study, the age distribution of household heads as presented in Table 1 illustrates that the minimum age of household heads for the surveyed households was 25, while the maximum age was 85 years. Out of the 120 households surveyed 40.8% were 21 to 34 years and 55.0% were 35 to 64 years old. The 2012 Population and Housing Census showed that the proportion of the population aged below 15 was 43.9% while those aged 65 years and above were 3.9% indicating that Tanzania has a young population (URT, 2013).

Table 1: Age (n=120)

Age	Male		Female		Total	
	n	%	n	%	n	%
21 to 34 years	39	56.5	10	19.6	49	40.8
35 to 64 years	30	43.5	36	70.6	66	55.0
64 years and above	-	-	5	9.8	5	4.2
Total	69	100.0	51	100.0	120	100.0

4.1.2 Years of schooling

The level of education was obtained by asking the household heads to mention the number of years they had spent in formal education. Education levels of the household heads are expected to play a great role in ensuring households' access to basic needs, such as food, health, shelter and clothing (Person and Swanson, 1996). The findings show that educational attainment was quite better, 81.7% attended primary school, 15% attended secondary school and 3.3% attended college/university. Generally, most of the population had standard seven education qualification, indicating that most were literate.

Table 2: Years of Schooling (n=120)

Years	Male		Female		Total	
	n	%	n	%	n	%
Primary level	58	84.1	40	78.4	98	81.7
Secondary level	11	15.9	7	13.7	18	15.0
College/university	-	-	4	7.9	4	3.3
Total	69	100.0	51	100.0	120	100.0

4.1.3 Marital status

Marital status of the 120 respondents is presented in Table 3 below. It shows that 22.5% of the respondents were single, 69.2% were married (M=60.9% and F=80.4%), while 8.3%

were widowed. This indicates that majority of the respondents were married compared with 60% of women and 50% men at national level (NBS, 2005).

Table 3: Marital status (n=120)

Marital status	Male		Female		Total	
	n	%	n	%	n	%
Single	27	39.1	-	-	27	22.5
Married	42	60.9	41	80.4	83	69.2
Widowed	-	-	10	19.6	10	8.3
Total	69	100.0	51	100.0	120	100.0

4.1.4 Length of residence

In this study, 25% of the respondents lived in the area for a period ranging from 1 to 5 years, while 15.8% lived for range of 6 to 10 years, 13.3% from 11 to 15 years, 30.8% for 16 to 20 years while 15% lived for more than 21 years.

Table 4: Length of residency (n=120)

Years	Male		Female		Total	
	n	%	n	%	n	%
1-5	24	34.8	6	11.8	30	25.0
6-10	12	17.4	7	13.7	19	15.8
11-15	8	11.6	8	15.7	16	13.3
16-20	17	24.6	20	39.2	37	30.8
21+	8	11.6	10	19.6	18	15.0
Total	69	100.0	51	100.0	120	100.0

4.1.5 Occupations of household heads

In this study, 52.5% of the surveyed household heads were traders, followed by farmers (45.0%) and employees (2.5%). The results showed that the largest proportion of the

respondents in this study were traders and hence depended much on electricity for their livelihoods. This is contrary to the National Strategy for Growth and Reduction of Poverty II (URT, 2010) which shows that a large proportion of the poor in rural areas depends on agriculture as their mainstay. However, it has been shown that in Tanzania the fast-growing sectors include mining, construction, communication, trade, tourism and the financial sector, but they are not able to absorb job-seekers from all colleges and schools, let alone from majority who are less educated in rural and urban areas (URT, 2010).

Table 5: Occupations of Household (n = 120)

Occupation	Male		Female		Total	
	n	%	n	%	n	%
Farmers	24	34.8	30	58.8	54	45
Business	45	65.2	18	35.3	63	52.5
Employees	-	-	3	5.9	3	2.5
Total	69	100.0	51	100.0	120	100.0

4.2 Engagement in Income Generating Activities

The findings show that 98.3% of surveyed households were engaged in income generating activities due to the presence of grid electricity services. Further findings show that of those engaged in income generating activities (n=59, 98.3%), 46.4% belongs to the residential category while 53.6% were commercial. The proportion of residential connections indicated that there was a highly mixed up percentage of electricity uses including micro enterprises which were mostly home based, unregistered and unlicensed (URT, 2005).

Table 6: Engagement in Income Generating Activities (n=60)

	Male		Female		Total	
	N	%	n	%	n	%
Yes	52	100	7	87.5	59	98.3
No	-	-	1	12.5	1	1.7
Total	52	100	8	100.0	60	100.0

UNDP (2002) identified productive uses of electricity services such as lighting and refrigeration in small shops and service activities, and for lighting, heating and motive power in rural workshops such as carpentry and welding shops. Other studies in Thailand (Cecelki,1992), Indonesia, Columbia and India (Barnes,1998) have shown that the availability of electric lighting in the households enabled household industries to increase working hours which lead to increased output and income

This study revealed that electricity consumers were businesses such as bars (40.0%), mobile phone charging (20.0%), shops and iron wedding (11.7%), grain milling (10.0%), saloon (3.3%), mobile phone maintenance and CD burner (3.3%). There is evidence from literature which support the above findings. For example a joint study done in 1992 by TANESCO and University of Dar es Salaam and Stockholm Environmental Institute in Tanzania, revealed that about three quarters of electricity consumers were businesses such as shops, bars and guesthouse and just three percent were light industry consumers including grain milling, welding workshops and garages.

Table 7: Income Generating Activities Influence by Grid (n=60)

Activities	Frequency	Percentage
Bar	24	40.0
Mobile phone charging	12	20.0
Shops	7	11.7
Iron wedding	7	11.7
Grain milling	6	10.0
Mobile phone maintenance	2	3.3
CD burning	2	3.3

4.3 Contribution of Grid Electricity Services to Household Income

The findings of this study indicate that the average annual income depending on the grid, ranged from 800 000Tshs to 46 000 000Tshs, while total average annual income due to all economic activities ranged from 2 000 000Tshs to 49 000 000Tshs. Currently, the average annual income generated from activities dependent on a grid services contributed 51% to the total average household annual income. Several case studies from Grameen Shakti's PV program illustrate well the value of modern energy to microenterprises (Meadows *et al.*, 2003). For example, a local appliance repair shop, using grid electricity services to undertake repairs, was reported to increase income by US\$25 per day.

Table 8: Contribution of Grid Electricity Services to Household Income (n=60)

Annual Income	n	Minimum	Maximum	Mean	Std. Deviation
Annual income (activities using grid)	59	800 000	46 000 000	4 073 684.21	4 833 883.30
Annual income (all economic activities)	60	2 000 000	49 000 000	6 540 416.67	4 740 019.57
% share of annual income from grid source	59	17	58	50.95	17.056

Generally grid electricity has had positive impacts on livelihoods including the following:
Some owners of the enterprises have accumulated physical assets such as modern houses, radio cassette, cattle, and saloon cars

As a result of increased household income due to access to grid electricity households' ability to pay to pay medical expenses, school fees and good meal has increased.

Comparison of income between household with and without grid electricity

To compare the income between household with and without grid electricity services an independent sample T-test was conducted. Household monthly income accrued from different income generating activities was summed and tested against the electricity enrollment status of the household. The study results presented in Table 9 showed a statistically significant difference in income between households having access to grid electricity services (M=4.2, SD=1.3) and those without (M=2.2, SD=0.84). A degree of freedom value of 8 and t-value of 2.487 implies that there was a significant influence of grid electricity on household income ($p < 0.01$). Due to this finding a null hypothesis that "there was no significant association between grid electricity services and household income" was therefore, rejected and an alternative hypothesis was accepted.

Table 9: T-test Results on Household Income

Households with and without grid services	Levene's Test for Equality of Variances	t-test for Equality of Means		
		N	mean	t-test
With	60	4.20	2.487	0.20
Without	60	2.20	2.487	0.24

4.4 Challenges in utilization of grid electricity services

The study set out to identify the challenges facing the utilization of the grid electricity services. Of the respondents interviewed 88.3% reported that they faced challenges in utilization of grid electricity services while 11.7% did not experience any challenge.

Table 10: Challenges in Utilization of Grid Electricity Service (n=60)

Response	Frequency	Percentage (%)
Yes	53	88.3
No	7	11.7
Total	60	100.0

Fig. 2 presents various challenges faced in the utilization of grid electricity. According to the figure the highest proportion (46.7%) of the respondents reported that electricity was not reliable followed by low voltage (20.8%), bill charge is higher compared to consumption (15.8%), old service (10.8%) and higher application standard (5.8%). In a study by Maleko (2005) it was found that challenges faced in using grid electricity included access to and use of grid electricity for production purposes.

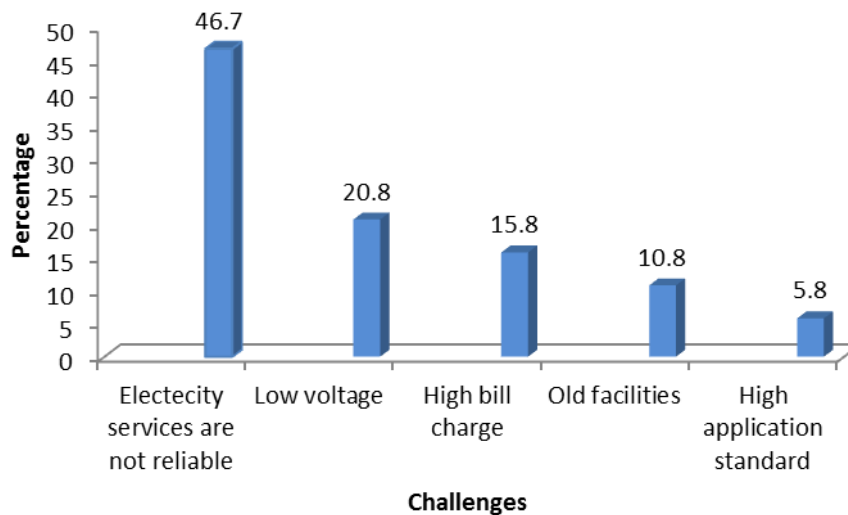


Figure 2: Challenges facing household in utilization of grid electricity services

Also, key informants indicated some of the challenges facing grid electricity as follows:

“The service was not available in some areas due to lack of service line materials such as fuses, cables, poles and transformers, illegal connection and vandalism of cables and cooling transformer oil in the distribution network.”

“Increased consumption and connection without changes in supply lines contributes to the low voltage supplies”

“In order to qualify for connection the customer must meet certain minimum standards stipulated by TANESCO such as having a permanent house roofed with iron sheet and must have completed the wiring approved by electrical engineer or technician. This automatically excludes most low income households”

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Basing on the objectives of this study the following conclusion can be drawn:

- i. Various income generating activities are undertaken due to accessibility to grid electricity including grain processing, iron welding, shops and soft drinks business, hair cutting and dressing saloons as well as cellular phone charging and CD burning. Besides, other income generating activities established are carpentry, tailoring shops, salons and retail shops.
- ii. Access to grid electricity has contributed to increased household income. Furthermore, household with access to grid electricity had higher income compared to those without.
- iii. Various challenges face the use of grid electricity including low voltage, outdated facilities, higher bill charges compared to actual consumption, higher application standards and unreliable electricity services.

5.2 Recommendations

In the light of the above conclusions, the following recommendations are made.

- i. In order to increase household income and therefore reduce poverty in Tanzania, the government should hasten the pace of rural electrification
- ii. The government and in particular TANESCO should come up with solutions to the various problems that limit expansion of the services and therefore ensure

that more people in rural areas access electricity while at the same improving the quality of grid electricity services to its customers.

5.3 Areas for Further Research

This study covered only one District and therefore quite limited in generalizing the findings to the Tanzanian rural population. Therefore, there is a need to conduct a similar study at a much larger scale.

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APPENDICES

Appendix 1: Questionnaire for Household Survey

A: General Information

A1 Ward: _____

A2 Village: _____

A3 Date of interview: _____

B: Characteristics of Household Head

B1 Age _____ (In complete years)

B2 Sex

1. Female []

2. Male []

B3 Marital status

1. Single []

2. Married []

3. Cohabiting []

4. Widows []

5. Divorced []

B4 What is your household size? _____

B5 Education level

1. None []

2. Primary []

3. Secondary []

4. University []

5. Others. Specify _____ []

C6 How is your household income generating activities affected by the quality of services?

D: Contribution of Grid Electricity Services to Household Income

D1 Please indicate all sources of household income and amount earned for the past one year including activities performed using grid

No	Sources of income	Average amount generated per month (Tsh)

E. Challenges facing utilization of grid electricity services in household income generating activities

E1: Do you face any challenges in utilization of grid electricity services

1. Yes []
2. No []

E2 What are the challenges facing households in utilization of grid electricity services in household income generation?

.....

.....

.....

.....

F. Households without grid electricity services

F1. Why is your household not connected to grid electricity?

1. Yes []

2. No []

F2. Are you willing to be connected to the grid electricity?

1. Yes []

2. No []

F3. Do you know that electricity services can contribute to household income generating activities?

F4. What is the average household income per month.....Tshs

Thank you

Appendix 2: Checklist for Key Informant Interviews

(District Community Development Officer, District Agriculture Officer a, District Trade Officer, TANESCO officer and REA officer)

Name of the respondent.....

Position held.....

Education level.....

Age of the respondent..... (in years)

1. For how long have you been working here?
2. What is the household demand for grid electricity services in Moshi District compared to supply?
3. Would you say that policies have contributed access to grid electricity services in this district?
4. What income generating activities are being done due to the presence of grid electricity services?
5. What is the contribution of grid electricity services to household income?
6. What should government do to improve grid electricity services?
7. What are the challenges facing households in utilization of grid electricity for household income generation?

Thank you