SOCIO- ECONOMIC IMPACT OF ELECTRIFICATION ON MICRO AND MEDIUM-SIZED ENTERPRISES IN KIBERA SLUM, NAIROBI

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DECLARATION

This project is my original work and has not been presented for a degree or any other award in a university.

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This project has been submitted for examination with my approval as university supervisor.

Signature: ……………………………………….Date:…………………………

Dr. Kamau Gathiaka

DEDICATION

I dedicate this research project to my mother Mrs. Elizabeth Kibe and my father Mr. Muhia Mwaura

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I sincerely thank my supervisor, Dr. Kamau Gathiaka for invaluable input and guidance throughout the preparation of this project. His insights have significantly contributed towards shaping this project.

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ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
GPOBA	Global Partnership on Output-Based Aid
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting Company
MSEA	Micro and Small Enterprises Authority
SMEs	Small and Medium Enterprises
OLS	Ordinary Least Squares
SSA	Sub-Saharan Africa
VAR	Vector Auto Regression
VECM	Vector Error Correction Model

ABSTRACT

Illegal electricity connection is a challenge in urban slums in developing countries. Kenya is facing illegal electricity connections especially in informal settlements. This is associated with risks such as danger to human beings through electrocution, overload of the system leading to tripping and fire breakout among others. To mitigate against such risks, the Kenya Power and Lighting Company came up with GPOBA electricity expansion project to legally connect electricity to all slums in Kenya including Kibera in 2013. This became a component of the ongoing rural electrification program. This study examined the socio-economic impact of slum electrification with focus on GPOBA project in Kibera slum. The study used quarterly time series data for the period 2008 to 2017 obtained from Kenya Power and Lighting Company (KPLC), Micro and Small Enterprise Authority (MSEA) and Kenya National Bureau of Statistics (KNBS). Standard growth regression model was utilized to analyze the impact of legal electricity connections on the growth of micro and medium-sized enterprises in Kibera slum. The results indicated that compared to the period prior to the project, GPOBA project has promoted SMEs growth in Kibera. The growth has contributed to increased number of businesses and employment creation to the working force. This calls for intensification of legal electricity connections in the informal settlements.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Electricity is important in enhancing economic development. In the developing countries, more specifically in the rural areas, households do not have electricity connections. OECD/IEA stipulates that more than 1.3 billion households all over the world do not have electricity connection (OECD/IEA 2011). Moreover, there is mismatch between the demand and supply of energy amongst various regions and nations globally (Global Network of Energy for Sustainable Development 2007).

Sub-Saharan Africa (SSA) is ranked last globally in terms of electricity connection with approximately 585 million households without access to electricity. Normally, the total electrification level in this region is around 30.5% (60% urban and 14% rural) and the highest percentage of un-electrified regions falling in the rural areas (IEA, 2010). In addition, it is estimated that the households not connected to electricity in the Sub-Saharan Africa will rise by 11% to 650 million by the year 2030 (IEA, 2012). This trend is set to get worse and it might prevail unless significant strategies are put in place to enhance growth in the energy sector (International Energy Agency, 2010).

In Kenya, the electricity utility firm Kenya Power and Lighting Company (KPLC) aimed at increasing connection to electricity especially in the informal settlement so that it can meet its new connectivity targets, lessen vandalism and electricity theft as well as improve the standards of living in the slum areas (Wanyoike, 2017). KPLC has been struggling to handle illegal connections and vandalism of the electricity infrastructure in the slum areas for a long time. It is common to find an unlawful connection which is easily recognized due to the low-hanging cables that do not have protective insulation in the slum areas. In some cases, the transformers are vandalized, and this is where illegal connection is tapped. Kibera slum is one of the informal settlements in Nairobi that has faced such problems. A slum is described as an area that do not have good and decent houses, it is overcrowded, there is insecurity, inadequate and unsafe water, poor sanitation and underdeveloped infrastructures (International Energy Agency, 2010).

Kibera slum is about five kilometers away from the Nairobi's central business district and it is among the largest informal settlements in Nairobi and in the entire Africa. The last census undertaken in 2009 established that there are approximately 170, 070 households in Kibera slums. The slum is further categorized into thirteen small villages: Kianda, Soweto East, Gatwekera, Kisumu Ndogo, Lindi, Laini Saba, Siranga, Makina A, Makina B, Raila, Soweto West, Kambi Muru and Mashimoni. In the slum, some households face extreme poverty and earn less than a dollar a day. Nevertheless, there are also other well-off individuals. Unemployment and underemployment are conspicuous in this area and in addition, there are numerous cases of diseases such as cholera, typhoid, HIV/AIDS and malaria among others. Other challenges include the rape cases and assault. The schools around the area are relatively good but most people cannot afford to educate. The water is unclean for human consumption and there is hygiene linked diseases. Until recently, many households did not have better living conditions and accessibility to basic services was a nightmare especially the medical care, electricity connection and running water (Ogalo, 2011).

By 2012 only approximately 20% of Kibera households were connected to electricity. An effort was made by the UN-Habitat to fund electricity connections to various sections in Kibera including security lights, street lighting, and shacks connections. Nevertheless, this project was not significantly successful and KPLC had to come on board (APHRC, 2014). In the slums, the infrastructure was in poor condition. This prompted the Ministry of Devolution to commence various projects via the National Youth Service to improve accessibility in 2013. By the end of 2014, several roads in the slum had been upgraded. Development projects have been at the center of the Kenya Vison 2030 and this includes energy generation at lower cost. The government came up with various programs that would raise the standard of the slums in 2008. The projects included relocating residents to modern houses that were part of slum upgrading, and introduction of Kenya Power Electricity Expansion Project-Additional Financing (KEEP-AF) as a program meant to provide safe power. The World Bank joined efforts with KPLC to support electricity connection to approximately 150,000 persons in the informal settlements at a cost of about Ksh 2.1 billion. The project is ongoing in several regions in the country.

1.1.1 GPOBA Project in Kibera Slums

The Global Partnership on Output-Based Aid (GPOBA) can be referred to as the network of donors who work together with an aim of supporting Output-Based Aid (OBA) solutions. GPOBA was formed in the United Kingdom in 2003 under the United Kingdom's Department for International Development (DFID) as a trust fund for various donors and it was to be managed by the World Bank (Niez, 2010). Since its inception, there are four more donors who came on board: The Australian Department for Foreign Affairs, the International Finance Corporation (IFC), Trade (DFAT), the Dutch Directorate General for International Cooperation (DGIS), and the Swedish International Development Agency (SIDA). The functions of GPOBA's includes to fund, demonstrate, design, and document OBA methods that would enhance basic service delivery in the developing nations (Harun, 2012).

A pact between Kenya Power Company and Global Partnership Output Based Aid (GPOBA) programme was made in 2014 which led to receipt of Shs.1.2 billion grant which was aimed at subsidizing electricity connections especially in the informal settlements. KPLC is now proud for the continued electrification in Kibera slum. Since the onset of the program, electricity connectivity has been on the rise. The project envisioned minimizing cases of illegal and unmetered power that had taken toll in Kibera slums. KPLC's target was to connect approximately 120,000 households to electricity. By the end of 2017, about 108,000 customers across the 14 villages in Kibera had been connected to the national grid. KPLC has improved its infrastructure in Kibera courtesy of the program. Approximately 30% of the customers in Kibera usually vend their tokens via the approved company's agents and through the mobile phone money transfers. (Harun, 2012).

The program aims at helping the residents get legal power at a lower cost. At the end of the program, the connected residents will have prepaid meters and they will pay only Shs.1, 160 for the connection. The amount would be recovered through the buying of tokens for a period of one year which means they would pay about Kshs 100 each month. Moreover, the GPOBA contributes around US$ 225 (Kshs.19, 350), and the KPLC contribute Kshs.11, 970 and in total that would amount to Kshs.32, 480 for every connection. The aim of this was to make sure that the legal connection was provided to the slum dwellers at a very low cost (KPLC, 2015).

The project implementation took place through a concerted effort between the Kenya Power employees and the locals residing in Kibera. The strategy which incorporated the locals largely contributed to the triumph of the project. Presently, the project looks at the sustainability approaches to make sure that the investment made is beneficial in the long-run. The aspect of engaging the locals during the project implementation is important in ensuring sustainability of the gains made by the project. This work evaluates the social and economic impact of GPOBA project on the livelihoods of Kibera residents. The focus will be on small and medium enterprises within Kibera.

1.2. Problem Statement

Power connectivity in Kenya has been on the rise. The government and developing partners have continuously designed projects that would focus on connecting power to off grid areas. Over the years, rural and slum electrification has become a major focus. The logic behind introduction of rural electrification was to enhance sustainable development and local access to this vital service. If there is no long-term sustainability, the benefits accrued from rural electrification might not be actualized. For a long time, the informal settlements were excluded from power access owing to high connectivity charges. This led to a situation whereby most slum residents resorted to illegal connections that led to loss of lives, properties and exacerbated poverty. In a bid to eliminate the negative effects of illegal connections, the GPOBA project was implemented. Nevertheless, the project has not been analyzed critically to assess the socio-economic benefits of crossover to legal electricity in Kenya. This study intends to fill the gap through a case study of Kibera slum focusing on micro, small and medium-sized enterprises.

1.3 Research Questions

The study will be guided by the following questions:

i. To what extent has the GPOBA project led to legal electricity connections in Kibera?

ii. What is the effect of electricity connections on MSMEs growth in Kibera?

iii. What is the employment and growth in the emergent MSMEs in Kibera within the GPOBA period?

1.4 Objectives of the Study

1.4.1 General Objective

The main objective of the study is to determine the effect of GPOBA project's electricity connection on MSME's growth in Kibera.

1.4.2 Specific Objectives:

i. To establish the extent to which GPOBA project led to electricity connections in Kibera.
ii. To determine the effect of GPOBA project's electricity connections on MSMEs growth in Kibera.
iii. To assess the employment growth in the emergent MSMEs in Kibera within the GPOBA period.

1.5 Significance of the Study

This study will be a great asset to the Kenyans at large. First, the paper will bring out the economic and social impact of legal electricity by Kenya Power through GPOBA project to small and medium enterprises in Kibera slum. With this information, the government of Kenya will have a ground to review the milestones achieved through this project. This will inform the decision makers and the policy makers on the necessary adjustments needed in formulation rural electrification programs.

The study will be imperative to the donors and developing partners such as the World Bank. After evaluating the impact, the donors will find it appropriate to collaborate with the government agencies in programs that target the scaling up of such project. Eventually, Kenya will achieve its objectives especially on energy sector as stipulated in the Kenya Vision 2030. The donor community will also assess whether the concept of output-based aid is indeed impacting on people's lives in the provision of clean and safe electricity for domestic and commercial use.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing theories on the topic, and empirical evidence. Moreover, the chapter focuses on the existing literature to illuminate the gap that it proposes to fill. Additionally, the chapter outlines the conceptual framework. The chapter is divided into theoretical and empirical review and an overview that brings out the literature gap.

2.2 Theoretical literature

2.2.1 Rational Choice Theory

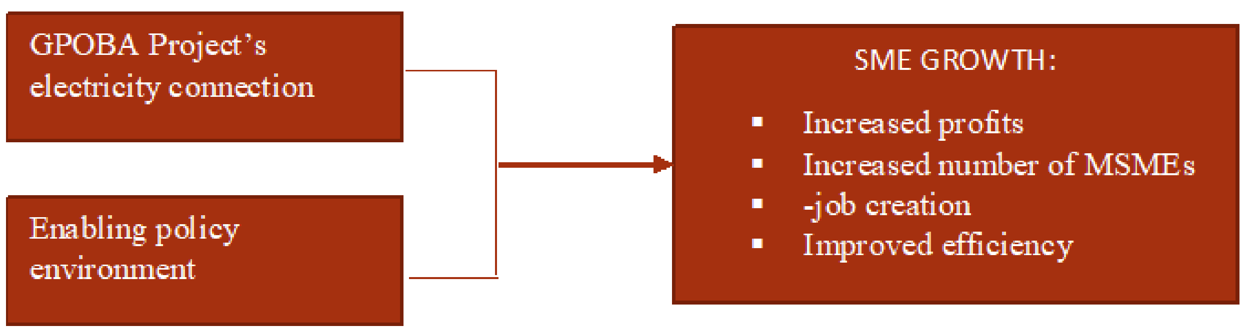
Rational Choice theory is considered an economic approach that posits that people are prudent and they make rational decision which makes them derive satisfaction or benefits which are in the best of their interest. Various mainstream economics approaches focus on the rational choice theory. Most rational Choice theorists contend that people's decisions are based on benefit maximization and minimization of what would be termed as hurtful to their well-being. The theory can be adopted by the business owners in their business model since it helps in predicting the decisions made by their customers on spending (Harun, 2012).

The theory provides a good framework for comprehending and modeling economic and social behavior of the humans. The model is vehement in the school of macroeconomics and rationality has been widely acknowledged in analyzing and modeling macroeconomic models in all areas dealing with the decision making. The rationality that is the point of reference in the rational choice theory is not the same as that used in colloquial word. Majority of the people often interchange rationality with saneness. This hypothesis utilizes an explicit and condensed definition of rationality construing that people's actions are aimed at balancing between the costs and benefits as they seek to maximize self-benefits. In this theory, the costs are only extrinsic to persons instead of taking the intrinsic direction.

2.2.2 Rural Electrification Adoption and Benefits

The rural electrification programs generate an exceptional increase in electricity connection especially in the rural areas (Ying, 2006). Enrique (2010) posits that the grid extension is an inexpensive model that would put new customers in the grid and enhance electricity access in the rural communities Nevertheless, in places where electricity is not available; there is fluctuating uptake for the connection. Emmanuel and Raymond (2011) postulated that household electrification in most cases rely on the characteristics of the households. In areas that have access to electricity, the connection usually takes between one and three years. Nevertheless, there are households that do not get connected to electricity at all even if it is available (Bhattacharyya, 2013; Emmanuel and Masaru, 2005). Adoption and constant utilization of electricity by households improves the standards of living in the rural areas and it stimulates economy at the community level. To build on Bhattacharyya's formulation, this study has formulated a conceptual framework for electricity adoption in the slum areas as indicated in Figure 1.

Figure 1: Slum Electrification and Benefits



Source: Author, 2019

Generally, the slum areas are characterized by high rate of illegal connections a low connection of electricity (Harun, 2012). Most slum dwellers illegally connect power to their houses and premises where they do businesses. This has both legal and economic implications. Illegal connection lead to higher risk of fire outbreaks in the slums, a situation that often lead to destruction of properties.

The government comes up with policies to mitigate illegal power connection practices. The policies also set to increase power connectivity targeting the low-end users under affordable programs. Through the power lighting company for instance, Kenya engaged donors who sponsored GPOBA program to enhance electricity connection in slum areas such as Kibera. Such programs have numerous benefits especially to the SMEs operating in such slum areas. For instance, new connections significantly improve business environment; new entrants in the businesses, expansion of the existing businesses, increased sales turnover, job creation, and improved operations' efficiency.

2.2.3 Illegal electricity connections

There are few studies that have looked at the social aspect of the non-technical losses. The common one evaluates aspects of corruption (Jamil andAhmad,2013; Bo and Rossi,2007), others evaluated some elements of those who take bribes and the ones paying bribe in Eastern Europe and Asia (Clarke andXu,2004). There are those that look at the political aspect surrounding the electric utilities leading to power theft as a major strategy to spearhead political agenda during election times (Golden and Min,2012) and others focus on the general rent-seeking (Hasnain and Matsuda, 2011). These studies reveal that corruption issues and political power concern significantly influences people's perceptions on electricity sector and attitudes regarding power theft.

Electricity theft is usually defined as the utilization of electricity from utility firms without legal agreement or lawful obligation to modify. (Smith, 2003). Electricity theft has been an intricate phenomenon that requires evaluation of numerous parameters prior to implementation of methods that would control or detect it. Such parameters entails aspects such as social, safety, economic literacy rate, regional, administrative, political, uncertainty, infrastructural, criminal, clique, corruption, effect on genuine customers, and power quality, during that period when the action happens. Other than the demonstrated approaches, billing anomalies is another form illegal electricity connection in various developing nations. Lack of dedication and corruption by the utility firm's staffs escalate the behavior of illegal electricity connection and in most cases employees of utility companies to control the illegal consumption are the reasons for billing irregularities occurs. In some cases, employees do not read the meter correctly, therefore they can intentionally lower or inflate the units consumed (Tasdoven, Fielder and Garayev, 2012). In addition, there are those households and factories that fail to pay the correct utility bills.

Undesirable effects emanating from electricity theft are usually dire and hazardous. Predominantly, electricity theft implicates both the customers and the utility firms. Electricity theft often burdens the generation division. Moreover, it undesirably affects the supply of electricity since the utility firm has no effective estimates regarding the quantity supplied to the illegal customers. This often overloads the voltage, distresses the performance and in various occasions damages customers' appliances. This huge amount electricity, trips the generation unit and this in turn disturbs power supply to the customers (Sullivan, 2002). This erratic amount of extra load leads to blackouts in the peak load period. To preserve noble power factor as well as flat voltage silhouette along the feeders, adequate combative power needs to be supplied. Load detaching should need to be done to compensate the voltage breakdown throughout the ultimate load period (Begovic et al., 2000).

The study by Harun (2012) revealed that in cases where the illegal connections outstrip lawful connection holders, the legally connected households tend to join free riders. Illegal connection is often linked to the rising electricity demand. The increasing tariffs actually aggravate the issue. Collusion and tolerance by the utility staffs significantly encourage illegal connection in the early stages. The general socio-political situations that encourage increased misuse of the public goods by a several minority offers the social and political validity to accentuate the behavior (Harun, 2012).

Tasdoven, Fielder and Garayev (2012) research determined methods of electricity efficiency improvement in Turkey. Their findings indicated that illegitimate connections unreasonably increase the prices of electricity to the legally connected customers since the utility firms have to pass extra cost of energy to them. This is due to the added cost of distribution and maintenance. Moreover, electricity theft has an effect on the quality for power supplied due to system overload. Ultimately, this led to power interruptions for all the customers, output loss and damages to the customers' appliances. Power theft significantly affects the amount reinvested and creation of employment in the energy sector since revenue is lost through power theft. Apparently, the funds to extend development and generation capacity is limited, as a result, in case demand is more than the supply, power outages cannot be avoided. As a result, firms raise their power tariff rates so that they can effectively supply electricity.

2.3 Empirical Review

Various studies have focused on the illegal connections in the slum areas with a view to highlight important issues such as the socio-economic impact of electricity connection. Most economists have conventionally elaborated the supply side of the violence and crime as dependent on the expected outcome of the illegal actions. Consequently, the empirical studies undertaken in most cases generally assume that unlawful behavior is meant to maximize the people's expected utility. With such structure, the final benefit is construed as the anticipated benefit less the anticipated cost of the criminal activities (including penalties), considering a person's risk preference and the moral values they uphold. Therefore, projecting the likelihood of unlawful actions requires profound assumptions and variability as a result of people's perception and contexts. The expected slums resident's utility is due to economic reasons and the cost of their actions emanate from safety risks and poor quality of service. Looking at the predicted punishment or penalty, it cannot be referred to as the predication in an informal setting (Wamukonya & Davis, 2014).

A number of the accessible empirical literature looks at the general crime; therefore, they do not get adequate data on important structural parameters especially the energy-linked crimes undertaken by slum residents. Nevertheless, the theoretical underpinning of in most papers emanate from the lessons learnt from comparable projects that deal with slum electrification so that certain circumstances can be understood and also the challenges facing such projects. Araujo (2007) makes an enriched analysis of how energy is lost and non-payment of the electricity in Brazil during the distribution and this validates the choice of various independent variables. To be specific, analyzing the country-wide perspectives, the author some vital variables explaining loss of energy and non-payment in various macro-categories related to factors such as those related to income, development, regulation and urban disorganization.

Khandker et al. (2008) scrutinized the effects of welfare related to rural electrification. The panel surveys took place between 2002 and 2005 and about 1,100 households were engaged in remote areas of Vietnam. The result of this study revealed that connection to the grid is both intensive and extensive and about 80 % of the household were connected by 2005.the uniqueness of Vietnam is that, whenever electricity is made available in an area, both the poor and the rich benefit equally. Estimations using econometrics indicate that connection to the grid positively impacts the households' income, education and expenditure. Nevertheless, after a long period, saturation point is reached due to exposure to electricity. The study recommends that long-term benefits of rural electrification should be assessed. Other studies indicate that homes with electricity roughly consume 4% of their budgets of electricity whereas those households that are not electrified spend approximately 15% of their budget on other forms of energy (MRC 1998). There are studies that show that other than the use of wood, electricity is also cost effective especially for cooking. That relative cost of using electricity together with rural electrification programs have resulted to a situation where most South African households use electricity more compared to the rest of Africa (Graham and Dutkiewicz 1998)

Pachauri (2007) came up with an energy economic model for the rural regions in one of the Indian state through the use of cross-sectional data. The study evaluated the link between electricity accessibility and progress of socio-economic contexts in the rural region, focusing in the reduction of poverty. The study determined that the literacy rate above six years could be clarified by road density per 1000km sq. household electrification rate, and sex ratio, accentuating the manner in which electricity access improves education. Even though it offers a good evaluation of the link between consumption of electricity and various socio-economic aspects; for instance the gross domestic state product as well as the rate of literacy. The study focused more on the household level and consumption of electricity, specifically on lighting appliances.

Yang (2003) examined the effect of rural electrification on decrease in poverty levels and economic development in the rural areas. The study utilized a panel data collected in six Chinese provinces for a period of twenty years. The aim was to offer effective recommendations on maximizing the scares capital on rural electrification spending. Those provinces were paired into three; the well-developed provinces, medium-developed and those that were least developed. Yang conclude that the greatest effect of rural electrification on economic growth is felt in those rural provinces that were well-developed and whereas in the ones that were least developed, electrification was not felt much. In regard to reduction of poverty, the greatest impact was felt in the provinces that were medium-developed whereas in the well-developed as well as least developed provinces, little reduction in poverty was experienced. The study offers a good guideline during policy formulation especially on the rural electrification depending on the objectives that a project aims to achieve.

Fishbein (2016) utilized Ilskog's methodology to assess the link between rural electrification projects and sustainable development. The methodology utilized thirty-nine indicators covering five sustainability factors; technical, environmental, economic, social, and institutional. The study conducted field work was conducted in seven East and Southern African rural areas to evaluate whether the input of rural electrification programs by the NGOs and the private sectors were effective in connection to sustainable development than in situations where the government take responsibility of rural electrification. The study therefore concluded came into conclusions that the government utilities were much better in terms of social views whereas the private firms managed customer relationships better than the government. Nevertheless, it was not possible to generalize the conclusions of the research due to challenges of the sample size and conditions under which the research was undertaken. Rural electrification is an agenda for development, thus the suggested methodology that would consider various sustainability factors to effectively assess the project in comparison with the financial evaluation.

Wamukonya & Davis (2014) undertook a survey to uncover the most suitable models for energy demand for development nations. The study scrutinizes diverse energy demand modeling methods; econometric, input-output methods, scenario end-use method, and hybrid. This study establishes that even if those mentioned models are appropriate for the developed nations, they may not be appropriate for the developing nations since aspects such as poor information quality and its common that the past and the future do not have similar trajectory as a result of economic transformation and structural adjustments. Wamukonya and Davis contemplated on end-use models as a more suitable model for developing nations. According to them, the model should consider aspects such as structural economic adjustments, rural energy, technological varieties, informal economics, Investment decisions and inequities. The study focused more on the energy demand modeling. Nevertheless, the work by Whitfield and Darby (2006) offers a more insightful view on the complexities linked to energy modelling in the developing nations.

The formation of novel, and usually informal businesses generated through electricity accessibility has been assessed in various nations through undertaking household surveys. Some researches fail to find a link between the increase in MSMEs and electrification. Nevertheless, the interpretations require keenness since giving priority to dynamic areas might lead to biasness in the survey. For instance, an ESMAP study undertook a study across four Philippines provinces and uncovered that about, 25 % of those households found in the electrified regions were having home-run businesses (such as the small retail shops) in comparison to 15 % of households found the less electrified areas (ESMAP 2002). Nevertheless, as indicated by Kooijman-van Dijk (2008), the study does not indicate whether the outcomes were associated with electrification or whether the selection of the areas was due to interest in the socio-economic features of the targeted area.

A study concentrating on the impact of electrification in Nigerian Abuja state by Abegio and Okefe (2009) uncovered that the development of SMEs is certainly linked to the availability of elementary infrastructure including the roads, energy infrastructure and telecommunication. Infrastructure has an effect on economic growth through a number of direct and indirect channels. One of the direct associations is the productivity impact whereby a rise in the quality of the infrastructure significantly increases productivity of several aspects. On the other hand, the gradualness in electrifying rural areas in several developing nations either off-grid or via grid expansion lead to sluggish business growth.

2.4 Overview of the Literature Review

From the reviewed studies, there exists a knowledge gap in understanding how electricity is used in domestic and commercial entities in urban slums in Kenya. Having the GPOBA program in place, a number of the Kibera residents and various small and medium enterprises significantly benefited from the legal connections. Nevertheless, literature has not evaluated the impact of the legal connections on the socio-economic conditions of the urban slum dwellers. This study investigated the socio-economic impact of the GPOBA project in Kibera villages in an attempt to fill the gap.

CHAPTER THREE

METHODOLOGY

3.1 Theoretical Framework

This recognizes the socio economic benefit of electricity connection. Therefore, the study adopts social cost benefit analysis methodology to help unravel the benefits of GPOBA connection project to the business growth in the informal settlements. Tasdoven, Fielder, Garayev, (2012) outlines three main stakeholders in a community, private producers (equated to business people), consumers, and the government which provides a structure of operations. Social cost benefit model looks at the aspect of economic efficiency. This model supports the rational choice concept that had been outlined in the literature. Whenever a program such as rural electricity or slum electrification program is designed, there must be an aspect of evaluating the benefits that will accrue to the consumers and also the choice they make based on availability of a product or a service.

3.2 Model Specification

The econometric model employed in this study to investigate the socio-economic effect of electrification on small and medium scale enterprises (MSMEs) in the slums of Kibera is the standard growth model of Fishbein, (2016) and Khandker et al., (2008) expressed as:

SG= f {LCU, NMSMES, SW} …………………………… (i)

The relationship above can explicitly be expressed as

$$SG = \alpha + \beta_1 LCU + \beta_2 NSMEs + \beta_3 SW + e \quad \text{…………….} \quad (ii)$$

Where:

SG is the MSME growth

LCU is the legally connected units in period t

NMSMEs is the number of MSME businesses in period t

SW is the MSME workforce in period t

e is the error term

α is a constant, and

$\beta 1$, $\beta 2$, $\beta 3$ and $\beta 4$, are the Beta coefficients

3.3 Variable Definition and Measurement

Table 1: Variables Definition and Measurement

Variables	Measurement	source
SG	MSME growth is the enhanced capacity of the MSMEs in an area of operation. It is measured through changes in size, output, number of employees, profits, inventories and technology adoption.	(Fishbein, 2016)
LCU	This is the legally connected units in the slums and it will be measured by enumerating the number of MSMEs that have followed the laid out procedures of obtaining electricity from the KPLC	(Ogalo, 2011)
NMSMEs	This is the number of MSMEs business operating in Kibera	(Khandker et al., 2008)
SW	It means the workforce employed by the MSMEs located in a certain area. It is measured by the number of employees working in the MSMEs	(Pachauri, 2007)

3.4 Data

The study utilized time series data from 2000 to 2016 to estimate the socio-economic impact of rural electrification. The data on connected units in slums was obtained from Kenya Power and Lighting Company; data on the number of MSMEs and workforce in the legally connected units was obtained from KPLC, MSEA and KNBS.

CHAPTER FOUR: EMPIRICAL RESULTS

4.1 Introduction

This section presents the findings of the study and result discussions. Presentation is done using tables and figures.

4.2 Descriptive Statistics

Descriptive statistics gives important information on the element of data used in a research. This study descriptive data include the variables' mean, standard deviation, minimum and maximum values, skewness and kurtosis values as shown in table 2.

Table 2: Descriptive Statistics

Variable	**Mean**	**Std Dev**	**Min**	**Max**
MSME Growth	5.810525	1.178375	4	7.61
Number of Connections	816.65	393.4901	319	1545
Number of Businesses	14085.05	393.4901	13240	16923
Number of Employees	18318.1	2524.467	13822	31702

The maximum growth in MSMEs was 7.67% and the minimum was 4%. Similarly, maximum connection was 1545 and the minimum were 319 connections in a quarter year. The average growth was 5.8% and the deviation from the mean was 1.18. On average, there were 817 connections, 14085 businesses and 18318 employees. From the result, it was noted that there was no major variation from the mean of MSME growth. This means that there would be no much difference between MSMEs growth in the period prior and after the implementation of GPOBA project.

4.3 Time Series Properties

4.3.1 Unit Roots Test

Time series data is usually stationary at first difference. As a result of non-stationarity, there was likelihood of obtaining spurious results. In order to check for stationarity of data, the study employed Augmented Dickey Fuller and the results were displayed in table 3. Each variable was tested for the unit root. The First difference was computed for non-stationary data series in case there was a combination of stationary and non-stationary data series (Aaker, Kumar, & Day, 2008). ADF is helpful in testing the null hypothesis of non-stationary of data series against the alternative hypothesis of stationary data series.

The following were the hypothesis assumed by ADF test

H_0: The variable was non-stationary (variable had unit root)

H_1: The variable was stationary (variable had no unit root)

Table 3: Augmented Dickey Fuller Test

	t statistics	**pvalue 5%**	**Unit roots**
MSME Growth	-2.174	-3.000	Presence of unit root
Number of Connections	-1.901	-3.000	Presence of unit root
Number of Businesses	3.423	-3.000	No unit root
Number of employees	-3.188	-3.000	No unit root

Source: *STATA computation*

From Table 7, the data from for MSME growth and the number of connections were non-stationary. This called for an additional step of conducting a stationarity test at first deference. Table 4 indicates the result from the second round of test at 5 percent level.

Table 4: Stationarity Test at First Difference

Variable	t statistics	P value at 5%	Unit roots
MSME Growth	-4.001	-3.000	No unit roots
Number of Connections	-3.480	-3.000	No unit roots

Source: STATA computation

After the second difference, the variables data became stationary, necessitating further statistical analysis to determine the link between variables.

4.3.2 Cointegration

It was necessary to carry out cointegration test using Johannsen cointegration test to determine the direction of the variable link before testing for short term relationship through VECM. The results were displayed in table 5. The study tested for the incidence of co-integrating connection amid variables after the unit root test establishes that the series data is stationary. Cointegration tests assist in determining the long run relationships.

Table 5*: Cointegration Results*

Maximum Rank	**Trace Statistics**	**5% critical Value**
0	49.4304	47.21
1	19.0961*	29.69

Source: STATA *computation*

There result indicates that there is one cointegrating equation between MSME growth and the number of connections.

On maximum rank 1, the hypothesis is as follows:

H0: there is cointegration between MSME Growth and number of connection

H1: there is no cointegration between MSME Growth and number of connection '

At maximum rank one, the values for trace statistics (19.0961) is less than the critical values (29.69). Therefore, we do not reject the null hypothesis. This means that, on the basis of the maximum rank two, MSME growth and electricity connections are cointegrated of one equation.

4.4 Lag Order Selection

To guide the analysis, it was important to select the lags and the results are as indicated in table 6.

Table 6: Lag Order Selection

Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-850.229				1.9e+16*	48.8131*	48.8744*	48.9908*
1	-840.325	19.807	16	0.229	2.7e+16	49.1614	49.4682	50.0502
2	-826.946	26.759	16	0.044	3.2e+16	49.3112	49.8634	50.911
3	-811.093	31.705	16	0.011	3.6e+16	49.3196	50.1173	51.6304
4	-793.384	35.419*	16	0.003	4.0e+16	49.2219	50.2651	52.2437

Lag selection is often based on four major parameters; FPE, AIC, HQIC, and SBIC. Three parameters which are FPE, AIC, HQIC and SBIC gave 0 lags. LR gave 4 lag. Following the rule of using the majority of the parameters, 0 lags were selected.

4.5 Post Estimation Diagnostic Tests

4.5.1 Multicollinearity

After carrying out a regression, a post diagnostic test was carried out to establish whether there was multicollinearity among variables through Variance Inflation Factors (VIF) as displayed in table 7.

Table 7: Multicollinearity Test

Variable	VIF	1/VIF
No of Businesses	17.44	0.057333
No of Employees	14.02	0.071346
Number of connections	2.32	0.431948
Mean VIF	11.26	

The mean vif was 11.26. Generally, if the value of vif is less than 10, there is absence of multicollenearity. Tolerance (1/vif) shows the extent of collinearity. Vif maximum acceptance level is 10. From the results, there is multicolenearity based on the vif. Both number of businesses and number of employees indicate a multicolenearity with vif of 17.44 and 14.02 respectively. This meant that one variable had to be withdrawn from the model. The number of employees was withdrawn from the model and the results were as shown in table 8

Table 8: Multicollinearity test without the number of Employees

Variable	VIF	1/VIF
No of Businesses	2.12	0.471010
Number of connections	2.12	0.471010
Mean VIF	2.12	

After the removal of the number of employees from the model, vif was 2.12 which is less than 10. The study also tested for multicolenearity after removing the number of businesses from the mode as shown in table 9. The results indicated a lower mean vif of 1.71. With the two models, there was no multicolenearity.

Table 9: Multicollinearity test without the number of businesses

Variable	VIF	1/VIF
No of Employees	1.71	0.586131
Number of connections	1.71	0.586131
Mean VIF	1.71	

4.5.2 Normality Test

It was essential to conduct a test for normality to check on the distribution of the data as indicated in table 9. This basically involved carrying out skewness and kurtosis tests, and the jargue bera normality test. Decision to convert data into log form or not was made at this step.

Table 10: Normality test

Variable	**Kurtosis**	**Skewness**
MSME Growth	3.236303	0.7618514
Number of Connections	3.046177	1.177136
Number of Businesses	2.242998	-0.1423968
Number of Employees	3.580507	-1.014415

The dataset for MSME Growth, number of connections and number of employees has heavier tails than normal distribution since its kurtosis is greater than 3 whereas the dataset for the number of businesses is assumed normal distribution since their kurtosis is close to 0 and it has light tails. The results indicate that the data for number of connections is positively skewed whereas that of number of employees is negatively skewed. Data for MSME growth and the number of businesses is fairly symmetrical.

4.5.3 Serial Correlation

To test for serial correlation, pairwise correlation was used and the results are represented in Table 11.

Table 11: Autocorrelation results

	MSME Growth	Electricity Connections	Number of Businesses	Number of Employees
MSME Growth	1.0000			
Electricity Connections	0.8840*	1.0000		
	0.0000			
Number of Businesses	0.3323*	-0.0540	1.0000	
	0.0362	0.7406		
Number of Employees	0.2525	0.1643	-0.0539	1.0000
	0.1160	0.3111	0.7413	

Source: STATA computation

MSME growth has a positive correlation coefficient of 0.8844 with electricity connections. Similarly, number of businesses is positively correlated with both MSME growths.

4.5.5 Vector Error Correction (VEC)

The study had established that MSME growth and electricity connection were cointegrated and this necessitated using VECM to determine the short run link between variables and the results are displayed in table 12.

Table 12: Vector Error Correction Results

Equation	chi2	P>chi2
MSME Growth	59.07444	0.0000
Number of Connections	29.87139	0.0017
Number of Businesses	37.97215	0.0001
Number of Employees	77.00064	0.0000

Source: *STATA Computation*

The results indicate that there is a short run relationship between SME growth and the number of number of businesses, as well as number employees at 1% percent level of significance. Similarly, there is a short run relationship between MSME growth and the number of electricity connection at 5 percent level of significance.

4.7 Regression Analysis

To capture the effect of GPOBA project on the growth of MSMEs in Kibera, two OLS regression models were used. The study captured the effect prior to introduction of the project and during the implementation of the project. The results are displayed in table 13;

Table 13: OLS Regression Results

	Prior to GPOBA Project		***During GPOBA Project***	
Equation	**Coefficients**	**P>chi2**	**Coefficients**	**P>chi2**
Number of Connections	0.0028034	0.000	0.0041243	0.000
Number of Businesses	0.0019356	0.055	0.0010655	0.016
Number of Employees	0.0000408	0.000	0.0054455	0.002
	Prob > F =0.0000		Prob > F =0.0000	
	R-squared = 0.9940		R-squared = 0.7037	
	Adj R-squared = 0.9928		Adj R-squared = 0.6481	
	Constant = 23.1888		Constant = 78.65733	

Source: STATA Computation

Before the GPOBA project, an increase in number of electricity connections by one unit could lead to 0.0028034 increase in MSME growth in Kibera. Similarly, a one-unit increase in the number of businesses led to a growth of MSMEs by 0.0019356. Increasing the number of employees by one unit would also lead to a growth of MSMEs by 0.0000408.

After the introduction of GPOBA project, there was a slight change. A one-unit increase in number of electricity connections, lead to an increase in MSME growth by 0.0041243. Similarly, a unit increase in the number of employees led to a growth in MSMEs in Kibera by 0.0054455. However, even though an increase in the number of businesses lead to a growth in MSME by 0.0010655, the increase is less than that witnessed prior to the implementation of GPOBA project.

It was important to carry out a multinomial regression analysis to establish whether the results shed some lights on the difference between the two periods (before and after GPOBA). The results are as indicated in table 14.

Table 14: Multinomial logit Model results for comparison between two periods (before and after GPOBA)

	Parameter estimates		**Marginal Effects**	
	coefficient	**Std. Error**	**dy/dx**	**Std. Error**
MSMEs growth	9.393699	6.332867	0.3809834*	0.2264216
Number of Connections	0.0271251	0.0174785	0.0011001*	0.0006185
Number of Businesses	0.0227948**	0.0112518	0.0000117**	0.0000195
Number of Employees	0.0002882	0.0004899	0.0009245	0.0003722
Model parameters				
Constant	281.0114**	142.9099		
Prob > chi2	0.0000			
Pseudo R2	0.7918			
Observations	40			

Note: *, ** and *** Denotes significance at 10%, 5% and 1% significant levels respectively

Source: STATA Computation

The results show during the GPOBA period, the probability of MSME growth increased by 38 percentage point compared to the period before the GPOBA project. Similarly, compared to the period prior to GPOBA projects, probability of increasing electricity went up by 0.11 percentage point. In the same manner, the probability of experiencing a rise in the number of businesses during the GPOBA project increased by 0.0012 percentage point. However, even though the probability of having increased number of employees during GPOBA project was high, there was no significant difference between the two periods. The results confirmed the outcomes of the OLS regression in that GPOBA project has led to improvement in the growth of MSMEs.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter will provide the study's summary, conclusion and policy recommendations. Discuss the rest as follows;

5.2 Summary

Electricity connection has been a major challenge especially in the informal settlement area. Kibera, which is the largest slum in Africa, has been facing challenges especially due to illegal electricity connection. GPOBA was conceptualized to remedy these challenges. It was imperative to evaluate the progress of the project in terms of the effect it has on the business activities around the slums and specifically to the MSMEs.

The study sought to establish the nexus between electricity connection and MSMEs growth. The independent variables chosen for the study include electricity connection, number of MSMEs businesses, and the number of employees. They were regressed against the dependent variable which was MSMEs growth.

Preliminary descriptive statistics indicated that the maximum MSMEs growth experienced within the study period was 7.67% and a minimum of 4%. In addition, the maximum number of connection in a quarter year was 1545. On average, MSME growth within that period was 5.8%.

Cointegration test indicated that there was a long run relationship between the variables under consideration. A test for short-run relationship also established that there was a short run relationship between MSME growth and the number of number of businesses, as well as number employees at 1% percent level of significance. In addition, there was a short run relationship between MSME growth and the number of electricity connection at 5 percent level of significance.

Regression was carried out using the data collected prior GPOBA project and that which was collected during the implementation of the project. The results indicated that in both periods, there was a relationship between electricity connection and the growth of MSMEs. The result from OLS were in line with the findings using Multinormial logistic regression. The two indicated that the implementation of GPOBA project led to increased MSME growth.

5.3 Conclusions

Whereas it is the dream of every country to improve the welfare of the citizen, informal settlements have had significant challenges of electricity connection. This led to conceptualization of GPOBA; a project that was instrumental in increasing legal connectivity in Kibera and other informal settlement. With this in mind, it is important to examine the effect of this noble project to find out whether it has socio-economic benefits. With an aim of informing the policy, this study established that there is a significant effect of electricity connection on the growth of MSMEs in the slum areas. This would form the basis of intensification of the connection to make sure that many slum dwellers are connected to electricity. It is important to note that in the informal settlement, some individuals do businesses in the premises where they live.

5.4 Policy Implications

The study findings do have imperative policy implications. This includes coming up with policies that would enhance effective legal connection in the informal settlement. Policies seeking to create an enabling environment for small scale businesses are necessary to ensure that businesses are given the necessary conditions to enhance their operations. It is also worth noting that there are policies seeking to heighten employment rates specially to boost youth employment. As a result, electricity connection has a ripple effect since it would trigger growth of businesses and ultimately create more employments.

5.5 Recommendations for policy making

Similar to some study on legal electricity connections, this study finds a noteworthy positive link between electricity connection and growth of small businesses. The following are the policy recommendations;

i) Kenyan government should negotiate with the World Bank to lengthen the period to which GPOBA project covers to ensure that more slum dwellers are connected to electricity.

ii) The government should consider implementing similar electricity connection project to other slams to enhance growth of MSMEs in the informal settlements.

iii) The policy makers should come up with strategies that encourage development partners who are interested in boosting energy sector especially in intensifying electricity connection.

iv) There is need to encourage business growth in Kibera and other slums since they create employment to a huge working population

5.6 Limitation of the study

The study faced various several limitations which are largely due to source of data. Initially it was difficult obtaining data from KPLC on the number of connection. The researcher had to follow a tedious process of authorization to access the official data.

5.7 Recommendations for further research

As Kenya look forward to enhancing electricity connection, it is important to find out the uptake of the uses in utilizing power after connection. This is important especially when reviewing electricity tariffs to ensure that small businesses are incentivized by charging them a rate they would be comfortable to pay.

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