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Effects of Rural Electrification Program on MSEs Owners Sustainable Livelihoods: A Quantitative Survey of LMCP Kiharu Constituency, Murang'a Kenya

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Abstract:

Electricity Connectivity is the backbone of social and economic development in a country as it enhances the quality of life. The success of rural electricity programs should be determined by their effects on the sustainable livelihoods of their beneficiaries rather than the number of people they serve. This study investigates the effects of rural electrification on the sustainable livelihoods of MSEs owners through the elimination of health risks caused by fossil fuels, an increase in working hours, an increase in income, and increased employment. The results should assist developing countries to improve their country's HDI by making sure that their rural electrification programs improve the lives of their beneficiaries. A survey of bisexual respondents of different educational backgrounds aged (below 18 and above 35) agreed that clean energy, street lighting, reduction in the cost of energy and increased access to electricity due to the project improves the livelihoods of the MSEs owners. A weak relationship was found between access to clean energy and reduction of health risks posed by fossil fuels, street lighting and increase in working hours at night, reduction in the cost of energy and increased income and access to electricity and increased employment among MSEs owners. From the results, it's evident that rural electrification is not enough to improve the sustainable livelihood of MSEs owners as seen by the weak relationship between the variables. It should be combined with other developmental infrastructures to bring about the desired rural development which is the responsibility of the government and its development partners.

Keywords: Sustainable livelihood, rural electrification, clean energy, employment, the cost of energy, income, street lighting, Murang'a Kenya

1. Introduction

The world has witnessed a substantial increase in electricity connection in rural areas. Most of the governments have considered electricity connectivity as a tool to bring development in those areas. For a nation to develop, social-economic development is very crucial. This can be brought about by developing small and medium enterprises through availing supportive infrastructure to them. Some of these structures include rural electrification through projects such as the Last Mile Connectivity Project (LMCP) in Kiharu Constituency, Murang'a Kenya. The success of rural electrification programs has been looked at in terms of the number of individuals connected to the electricity rather than how the connectivity has changed the living standards of the locals. This article suggests that among other benefits a rural electrification program should reduce health risks associated with prolonged usage of fossil fuels, increase working hours through the installation of street lights, increase the income of MSEs owners through reduction of the cost of energy and increase employment.

Although extensive academic research has explored the advantages of electricity in both household and business setups, (Fan et al. 2005; Lipscomb et al 2013; Khandker et al 2014; Dinkelman 2011; Raul Jimenez, 2017; Kembo 2013; Yadoo A. 2012) and others factors affecting connectivity to rural electrification, (Bose et al 2013; World Bank 2015; Heltberg 2003; Tasciotti, 2012; Kebede 2006) much less research has investigated the effects of rural electrification programs on business owners. Those that do investigate the effects of rural electrification on businesses rather than the business owners (Ouma 2013; Akpan, 2013; Harrison et al, 2014). Due to the huge amount of capital invested in rural electrification programs, it's important to determine whether they change the lives of their beneficiaries or not. In Kenya, the government invested huge funds on development expenditure, 26% (657.3 bn) of the 2018/19 budget. It is vital to make sure these funds are invested wisely and they achieve their intended objectives.

Electricity is one of the factors that may have a direct and indirect impact on the performance of MSEs. These MSEs have been accepted globally as the means which accelerate economic growth and rapid industrialization. (Harris & Gibson, 2016) In Kenya, according to the Economic Survey (2006), the sector contributed over 50% of new jobs created in 2005. In addition, some expensive rural electrification programs have proved to be useless. Lim (1984) found poor economic returns of rural electrification in Malaysia and Fluitman (1983) argues that the benefits of rural electrification tend to be overestimated and the costs underestimated. It is important to understand how rural electrification programs affect the livelihood of their beneficiaries as it can help to increase their viability.

Previous research has addressed several aspects of the effects of rural electrification programs on their beneficiaries. Some covered the effect of rural electrification on the community at large (Khandker et al. 2014; SNV Netherlands Development Organization 2014; Dasso and Fernandez 2015; Raul Jimenez, 2017) while others narrowed the effects to businesses (Ouma 2013; Akpan, 2013; Harrison et al, 2014) Rural electrification leads to a significant reduction in poverty rates of the community, (Khandker et al. 2014), leads to different opportunities for self-employment at the local level and support installation of street lights (SNV Netherlands Development Organization, 2014), increases employment especially among women (Dasso and Fernandez, 2015) and leads to cleaner living environment (Raul Jimenez, 2017). At the business level, previous studies found out that rural electrification leads to the growth of SMEs (Ouma 2013), enterprises connected to electricity are more profitable (Akpan, 2013) and lack of electricity connectivity is a major constraint of enterprise performance in Africa (Harrison et al, 2014). Despite these works, little is known about the effect of rural electrification programs on the livelihood of those who own small and medium enterprises. E.g how it affects their health, level of income, increase in working hours, and whether it increases employment opportunities among them. These studies researched the effects of rural electrification programs on the community in general and businesses but are more silent on the effects of the programs on the livelihood of the MSEs owners. They fail to answer the question; do the programs improve the livelihood of small and medium business owners? And if so how?

1.1. The General Objective of the Study

Against this background, the main purpose of this research was to investigate the effects of rural electrification programs on the sustainable livelihood of MSEs owners. This was done by studying those whose businesses were connected to the Last Mile Connectivity Project in Kiharu constituency Murang'a Kenya. The effects of the project on these owners were studied in terms of increased working hours, income, employment, and elimination of health hazards caused by fossil fuels. This study attempted to answer the following question;

What are the effects of the rural electrification program (LMCP) on the sustainable livelihood of MSEs owners?

1.2. The Specific Objective of the Study

- To investigate whether clean energy due to rural electrification eliminate health risks posed by fossil fuels to MSEs owners
- To investigate whether rural electrification programs street lights prolong MSEs owners working hours.
- To assess whether rural electrification programs influence the cost of energy and its effect on the income of MSEs owners
- To establish whether access to electricity has created employment among MSEs owners in Kiharu constituency.

1.3. Definition of Terms

1.3.1. Sustainable Livelihoods

Livelihood that comprises of the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living (Chambers and Conway, 1992). In the context of this study, sustainable livelihood is that livelihood that can survive, cope, and recover from social-economic shocks and stress. A livelihood that can be able to provide means of survival for current and future generations, in the short run and long run.

The remainder of this article is structured as follows: the literature review containing past research related to the study. Next, the procedures used to test the hypothesis are described. The findings of the study are then presented. The article concludes with a summary of the study's research contributions and limitations directions for further research.

2. Literature Review

2.1. An Overview of the Effects of Rural Electrification Programs

Electricity Connectivity can be termed as the backbone of social and economic development in a country as it enhances the quality of life. Most of the governments globally have considered electricity connectivity in rural areas as a tool to bring rural development. In Kenya, there have been different rural electricity programs that have been financed by the Kenyan government as well as its development partners. These programs include the Last Mile Connectivity Project (LMCP) and Rural Electrification Projects through Rural Electrification Authority. (REA) Social-economic development is an important factor in national development. To achieve this, governments are incorporating rural development in their development agendas by providing the necessary infrastructure to support small and medium enterprises in the rural areas (Fan et al., 2005; Lipscomb et al., 2013; Khandker et al., 2014).

Most of the developing countries in Africa have provided for rural electrification in their developmental budgets. In South Africa, electricity cost is subsidized with the aim of satisfying the consumer needs by taking into consideration the impact of rural electrification on various sectors in rural areas. In Uganda, private electricity providers are hired to install and manage electricity. This leads to the increased cost of electricity and decreased income of rural businesses as compared to developing countries like Costa Rica which have attained 100% rural electrification and Tunisia with 95% rural electrification coverage. In these countries, the cost of doing business in rural areas is very low which motivates the locals to start electricity-powered small businesses.

In Kenya, before the Rural Electrification Authority was formed in 2007, energy and poverty had been a major problem in rural areas. Prior to the program, rural communities relied heavily on traditional fuels like kerosene, charcoal,

LPG, and firewood for their lighting, cooking, and heating. Wood fuel provides 70% of the energy for all sectors in the country, including micro and small enterprises. This leads to adverse health effects, poor lighting, and environmental degradation as well as the high costs of these fuels. According to the World Bank, there has been a great increase in electricity connectivity in Kenya where 56% of the population is connected to electricity. This has enabled mechanization of farming operations such as threshing, milking, and hoisting grain for storage in these areas which in turn leads to an increase in income. To conclude, rural electrification programs have been implemented by governments globally. Their effects are felt by nearly every sector in the economy as discussed above. The next section aims to narrow down the effects of rural electrification programs on the sustainable livelihoods in four main areas;

- Elimination of health risks posed by fossil fuels through clean energy provided by rural electrification programs
- Rural electrification programs street lights and prolonged working hours of MSEs owners
- The influence of rural electrification programs on the cost of energy and its effects on the income of MSEs owners
- Effect of access to electricity on the creation of employment among MSEs owners.

2.2. Elimination of Health Risks Posed by Fossil Fuels to MSEs Owners through Clean Energy Provided by Rural Electrification Programs

Approximately 2.8 billion people in the world use solid fuel for their daily energy requirements like lighting and heating (WHO, 2016). These fuels burn inefficiently leading to indoor air pollution in their households (Barron and Torero (2014). Various researchers have researched the effects of continual use of these fuels. They mainly affect the lungs by causing inflammation, reduced ciliary clearance, and impaired immune response (Bruce et al, 2000). These fuels especially coal adversely affect human life through air pollution-related ailments (Spalding Fetcher and Matibe (2003). Solid fuels were estimated to account for 1.6 million excess deaths annually and 2.7% of disability-adjusted life years (WHO, 2002). These findings show that the use of unclean sources of energy in either business or at home is a great risk to the health of the people involved.

Some researchers discussed the effect of rural electrification on the health of the beneficiaries from a different perspective. They pointed to the fact that through rural electrification, rural health facilities are able to afford better diagnosis and storage equipment increasing the chances of patients surviving various ailments. (Kagawa and Nakata (2008) Kitchens and Fishback (2013) found that the infant mortality rate decreased sustainably in the United States between 1930 and 1940 following electrification. Electricity improves the social-economic welfare of a community by positively influencing the health sector of the community.

Both two perspectives agree that rural electrification improves the health of the rural community. After electrification, there was a decrease in cough and respiratory diseases in Bhutan households (ADB, 2010). There was also a decrease in the infant mortality rate in the United States following electrification as mentioned above. Evident from the above literature, rural electrification has helped reduce health hazards associated with fossil fuels by providing an alternative to cleaner energy. However, the previous studies have discussed the effect of rural electrification in reducing solid fuel pollution in a household context rather than a business context (Barron and Torero, 2014; Raul Jimenez, 2017; ADB 2010). The other studies discussed the health benefit of rural electrification in health facilities context. (Kagawa and Nakata, 2008; Kitchens and Fishback, 2013) This study adopted a narrower perspective and investigated the health benefit of rural electrification on MSEs owners through the elimination of health hazards caused by fossil fuels used in these enterprises.

2.3. Rural Electrification Programs Street Lights and Prolonged MSEs Owners Working Hours

The section above discussed the elimination of health risks due to fossil fuels as one of the ways rural electrification programs affect the sustainable livelihoods of their beneficiaries. In this section, the extension of working hours at night as a result of street lights installed after rural electrification is discussed. Through government public service programs such as street lighting, electricity can enhance the security not only of the community but also of the various business owners. Security is one of the indicators of a socially developed community. Rural electrification results in increased security in the community due to the installation of street lights. (Hirmer and Guthrie, 2017; Yadoo A. 2012). In Kenya, street lighting installed through rural electrification allowed small and medium entrepreneurs to extend their selling hours and generate more due to the feeling of security from the street lights (Ouma, 2013). The researcher, however, looked at the national grid rather than a specific rural electrification program. In Kenya still, there was increased security as a social effect of electricity (Kembo, 2013). The context was the community as a whole rather than a specific sector of the community like businesses.

Rural electrification programs sometimes do not bring about increased security of either business or the community in general. In, Brazil's murder rate rose concurrently with its rural electrification program. (Geoff Carr, 2014). To put more emphasis on this, rural electrification had long been claimed to have diverse benefits for health, nutrition, education, and security. There has been little rigorous evidence regarding these benefits and no attempt to quantify them at all (Saunier (1992). Based on the research gaps identified in the aforementioned discussion and to provide more evidence that rural electrification leads to increased security and extension of working hours at night, that's why this study was carried out.

2.4. The Influence of Rural Electrification Programs on the Cost of Energy and Its Effects on the Income of Mses Owners

The section above discussed the extension of MSEs owners working hours through street lighting as one of the ways rural electrification programs affect sustainable livelihoods of their beneficiaries. In this section, the effect of

electrification programs on the cost of energy and the income of MSEs owners is discussed. Empirical studies point to the fact that energy has a very crucial role to play in economic development. Over 2 billion people all over the world live with no electricity and continue to exist below the poverty line (UNDP cited in Hayika, 2006). The government should implement physical infrastructure such as rural electrification in its public policy reforms to achieve the desired level of rural development among its citizens. Rural electrification facilitates more efficient machines that use cheaper energy thus increasing productivity and income of MSEs. (Bernard and Torero, 2011) As compared to other sources of energy like diesel generators, electricity is cheaper. It reduces the cost of energy hence maximizing profits (Fan et al. 2005; Lipscomb et al. 2013; Khandker et al. 2014; Chaurey, et al 2004). However, unreliable electricity is however expensive and it raises operation costs due to loss of customers and income.

Few researchers however differed with the above opinion. They found that there is an insignificant relationship between electricity and an increase in the income of individuals as seen from the poor economic return of electrification in Malawi (Lim, 1984). The benefits of rural electrification tend to be overestimated and the costs understated (Fluitman, 1983). These researchers argued that the high cost associated with installation and the initial amount of connection makes rural electrification have an insignificant positive impact on businesses.

Contrary to these studies, this study will be focussed more on the effect of rural electricity on the income of business owners rather than the businesses. The study also aims to provide more evidence that rural electrification programs reduce the cost of energy hence increasing the income of their owners and by so doing improving their sustainable livelihoods.

2.5. Effect of Rural Electrification Programs on Electricity Accessibility and Creation of Employment among MSEs Owners

While the previous section discussed the effect of rural electrification street light on the extension of MSEs owners working hours, this section will explore past literature on the effect of rural electrification on employment. Rural electrification increases the rates of investments in rural areas thus creating employment. When the rural areas are connected to electricity, different types of MSEs are established as a result of people getting services nearer to their homes as compared to when they used to go to town for the services. Evidence from past studies shows that rural electrification leads to increase in women employment (Dasso and Fernandez, 2015; Dinkelman), it leads to industrialization due to new production methods (Rud, 2012; Barkat et al., 2002; Chowdhury, 2010) and increases investments (IEG, 2008 and Maleko, 2005) These scholars agree that the most efficient way to deliver effective and long-lasting impact when designing a rural electrification program is to make sure that such a program have a direct positive impact on the livelihoods of its beneficiaries by increasing their revenue generation.

On the contrary, sometimes, rural electrification fails to significantly improve the probability of being employed in either wage or self-employment (Singh and Vermaak, 2005) While some of the studies above were more gender-oriented and others industry-oriented this study will branch from these approaches and narrow down the study to a more specific cross-gender context; the MSEs owners. The study also aims to provide more evidence that rural electrification programs affect electricity accessibility leading to an increase in employment among MSEs owners.

3. Methodology

3.1. Sampling

The main question of this research was: what are the effects of rural electrification programs on the sustainable livelihoods of MSEs owners. The target population of this study was the MSEs owners whose businesses are connected to the Kenya Power's 15 Last Mile Connectivity Project transformers in Kiharu Constituency, Murang'a Kenya. The unit of analysis was the individual MSEs owner. The project covered both households and businesses. This study singled out MSEs owners because most studies have already covered the effects of rural electrification programs on households and businesses and left out business owners.

3.2. Sampling Frame

The sampling frame was a list of the individual MSEs connected to these transformers per every rural ward in the constituency giving a total of 637 newly connected MSEs. This information was obtained from the Kenya Power and Lighting Company (KPLC). A stratified simple random sampling technique was used as the population of interest was not consistent and could be divided into groups to obtain a representative sample. According to Erik and Marko (2011) stratified random sampling yields estimates of the overall population parameters with greater accuracy. This method was chosen as it reduces the chance of bias and all items had an equal opportunity of being selected.

3.3. Sample Size

To obtain the total sample, the total population was divided into strata (ward). Then, a sample was selected from every stratum. Mugenda & Mugenda (2008) suggest that for descriptive survey research designs, at least 10%-20% of the total population is enough for a sample. To obtain the total sample size, a sample was taken from each stratum (ward) by taking 15% of respondents in each stratum. The sample size from each stratum was then added to give the total sample size of 99 MSEs which was 15% of the total population. Then, through purposive sampling, respondents in three markets in three wards with the highest sample size were selected. These markets were selected because they were the only business-oriented facilities installed with Last Mile Connectivity Project sub-stations. All the other substations were

located in primary and secondary schools thus minimizing the number of MSEs owners who benefited from them. The total selected respondents in the three markets were 76 MSEs owners.

3.4. Respondent's Response Rate

76 questionnaires were sent to these respondents and out of these 71 were returned resulting in a response rate of 93.42 % which was satisfactory. According to Mugenda and Mugenda (2003), a response rate of 50% is enough for analysis and reporting, a rate of 60% is good and a response rate of 70% and over is excellent. This response rate, therefore, was satisfactory to make conclusions on the study. All the respondents were able to satisfactorily fill the questionnaires and all were analyzed.

3.5. Respondent's Demographic Profile

The respondents provided a reasonably well-presented profile of the LMCP small and medium-sized enterprises beneficiaries. The researcher tallied three demographic characteristics of the respondents in these markets to give a concrete reference to all data as recommended by statistics scholars including Kothari (2004) and Mugenda and Mugenda (2003). These were age, gender, and academic qualifications. 45 % of the respondents were male and 55% female. The majority of the respondents (66.5%) were in the 18-35 age group, (31.9%) were aged over 35 years and only one case of below 18 years was noted. (1.6 %). 25.3 % of the respondents reached the primary level, 49.2 % of the respondents reached secondary school level, 18.3 % reached diploma/ certificate level, 12.7% reached diploma level with no respondent with masters or Ph.D. level of education. 8.5 % of the respondents had other qualifications

3.6. Data Collection

The initial questionnaire was pre-tested on 8 MSEs owners using the pilot study method to test the validity of the data. According to Ondiek (2008), a pilot study should be performed on at least 10% of the sample size hence the figure is 8 MSEs for this study. To test the reliability of the data, a test and retest method were used according to Kothari (2004). Six questionnaires were given to the same MSEs after a period of one week. The reliability of the questionnaires was estimated by examining the consistency of the responses between the two tests. The data for this study were collected from January to March 2020 through questionnaires that were hand-delivered to each respondent. Questionnaires have been used in studies on the effect of rural electrification (Ouma, 2013; Kembo 2013). No incentives were given to the respondents to complete the questionnaires.

3.7. Measurements

Closed-ended questions require the respondent to choose from among a given set of responses (Mugenda & Mugenda, 2008). A single response selected from various possible responses in the questionnaire was used to gather this information from the respondents. The responses were then analyzed in the form of percentages for easy conclusions. The other four variables; clean energy and MSEs owners health status, street lighting and prolonged working hours at night, cost of energy and income of MSEs owners and access to electricity and employment were quantified into an ordinal and nominal scale where a yes or no, before or after and increase and decrease responses was required. Yes, increase and before were coded 1 and the no, decrease and after were coded 0 during data analysis. The data was then analyzed in the form of the mean and standard deviation to estimate their average implications and through correlation analysis to estimate their relationships.

4. Results

4.1. Descriptive Statistics

4.1.1. Information on MSEs

On the length of time, the MSEs were operational, 53.5% of the MSEs were started less than three years ago 33.8% started between 3-5 years and 12.7% started their businesses over 5 years ago showing that most of them were new. On employment, 52.1% of the MSEs enumerated had one employee. 42.2% had between 2 and 9 employees while 5.6% had over 10 employees. On the source of energy, a cumulative 63.4% of the MSEs owners used kerosene, LPG lamp, and diesel for lighting which is harmful to their health. 22.6% used solar power, 10% used rechargeable D.C lamp and none used biogas. For business processes, 54.9% used labor 21.2% used diesel and 23.9% used clean energy. On MSE's access to electricity, 75% of the MSEs were connected to electricity with just 25% of them operating without electricity. Out of those not connected to electricity, 50% couldn't afford the service, 33% of the MSEs owners suffered from transformer problems while 17% preferred other sources of energy.

4.1.2. Effects of LMCP on the Sustainable Livelihood of MSEs Owners

The mean (M) of the effects of the sustainable livelihood on the lives of MSEs owners is presented in Table 1 below. The highest effect is represented by an increase in the number of customers ($M = 0.96$, $SD = 0.203$) and the lowest effect is shown by the reduction in eye problems. On average, the effects of street lights on MSEs owners working hours and the influence of the project on the cost of energy and its impact on their income are the major effects of the project on the sustainable livelihood of MSEs owners. (Overall $M = 0.916$, $SD = 0.405$ and 0.855 , $SD = 0.338$) respectively. This was followed by the effect of clean energy on the elimination of health risks of fossil fuels. ($M = 0.825$, $SD = 0.371$). The effect of accessibility of electricity due to the project on the employment of MSEs owners was the lowest. ($M = 0.682$, $SD = 0.291$)

Table

	N	Min	Max	Mean	SD
Effects of LMCP clean energy on the elimination of fossil fuel health risks				0.825	0.371
Connection Reduces Breathing Complications	71	0	1	0.77	0.421
Connection Reduces Eye Problems	71	0	1	0.76	0.430
Connection Result To Clean Working Environment	71	0	1	0.87	0.335
Reduces Risk Of Naked Flames	71	0	1	0.90	0.300
Effects of LMCP street light and prolonged MSEs owners working hours				0.916	0.405
The number of street muggings reduced due to electricity connection	71	0	1	0.94	0.232
Street lights increased working hours in the evenings	71	0	1	0.85	0.780
Electricity connection led to an increase in the number of customers	71	0	1	0.96	0.203
Effect of the influence of LMCP on the cost of energy and income of MSEs owners				0.855	0.338
The business was started before electricity was connected	71	0	1	0.73	0.446
The energy cost decreased after electricity connection	52	0	1	0.94	0.235
Business income changed after electricity connection	52	0	1	0.88	0.326
Electricity led to energy affordability	52	0	1	0.87	0.345
Effect of electricity accessibility on the level of employment of MSEs owners.				0.682	0.291
Did electricity motivate you to start the business	19	0	1	0.89	0.315
Connection to electricity led to establishment of businesses	71	0	1	0.90	0.300
Connection to electricity increased the number of employees	71	0	1	0.93	0.258

1:

Effects of LMCP on the Sustainable Livelihood of MSEs Owners

Notes: Scale Values Range from 1 "Yes", "Increase" or "Before" to 0 "No", "Decrease" Or "After" M= Mean, SD= Standard Deviation. The Higher the Mean Score, The Higher the Effect of That Aspect on the Sustainable Livelihood of Mses Owners

These results indicate that governments and their development partners should direct more of their efforts on making sure rural electrification programs leads to more employment opportunities. Efforts in regard to the street light and prolonged working hours and the influence of electricity on the cost of energy and income should be less.

4.2. Inferential Statistics

The study conducted a spearman's correlation analysis to determine the strength of the relationship between each of the variables. This is a non-parametric analysis used to determine the strength and direction of relationships between variables (Green and Salkid, 2005). Each variable in the questionnaire was tested independently.

4.3. Relationship between Clean Energy Due to the Rural Electrification Program (LMCP) and Elimination of Health Risks Caused by Fossil Fuels

The correlation analysis done on this objective focused on establishing if there is a relationship between clean energy due to the rural electrification program studied (LMCP) and the elimination of health risks associated with fossil fuels. Clean energy effects were broken down into a cleaner working environment, reduction of breathing complications, reduction of eye problems, and reduced risks of naked flame.

The results were presented in Table 2 below. There was a weak positive relationship between the elimination of health risks, cleaner working environment, reduction of breathing complications, reduction of eye problems, and reduced risks of naked flame. ($r_s=.154$; $r_s=.35$; $r_s=.103$ and $r_s=.078$ respectively). This indicates that the effects of clean energy mentioned above eliminate the health risks caused by fossil fuels improving the sustainable livelihoods of the MSEs owners. However, as can be seen from the results in Table 2 below, the relationships are very weak. The government, therefore, should come up with policies like creating awareness of the dangers of fossil fuels among MSEs owners and connecting not only their businesses but also their homes to electricity to discourage them from using fossil fuels either at home or at work.

		Elimination of health risks	Cleaner working environment	Reduction of breathing complications	Reduction of eye problems	Reduced risk of naked flame.
Elimination of health risks	Correlation coefficient	1.000	.154	.35	.103	.078
	Sig. (2-tailed)	.	.199	.775	.393	.518
	N	71	71	71	71	71
Cleaner working environment	Correlation coefficient	.154	1.000	.110	.164	.052
	Sig. (2-tailed)	.199	.	.360	.172	.669
	N	71	71	71	71	71
Reduction of breathing complications	Correlation coefficient	.35	.110	1.000	.164	.406 ^{□□}
	Sig. (2-tailed)	.775	.360	.	.172	.000
	N	71	71	71	71	71
Reduction of eye problems	Correlation coefficient	.103	.164	.164	1.000	.157
	Sig. (2-tailed)	.393	.172	.172	.	.192
	N	71	71	71	71	71
Reduced risk of naked flames	Correlation coefficient	.078	.052	.406 ^{□□}	.157	1.000
	Sig. (2-tailed)	.518	.669	.000	.192	.
	N	71	71	71	71	71

*Table 2: Relationship between Clean Energy Due to Rural Electrification Programs and Health Status of MSEs Owners
Correlation Is Significant at the 0.01 Level (2-Tailed)*

4.4. Relationship between Rural Electrification Street Lights and Prolonged Working Hours of MSEs Owners

The correlation analysis on this objective focused on confirming whether the street lights powered by the LMCP led to the extension of business hours among the MSEs owners. Effects of rural electrification street lights were broken down into the availability of street lights, reduction of street muggings, and safety of doing business at night. The results were presented in table 3 below. There was a weak positive relationship between the extension of working hours at night, reduction of street muggings and safety of doing business at night. ($r_s=.06$; and $r_s=.033$ respectively) However, the availability of street lights had a moderate relationship ($r_s=.569$). This shows that rural electrification street lights affect the sustainable livelihood of MSEs owners positively by increasing their working hours. To strengthen this relationship the government and its development partners should supplement the installation of street lights with increased security measures to ensure the MSEs owners are able to work in a safe environment at night.

		Extension of working hours at night	Availability street lights	Reduction of street muggings	Safety of doing business at night
Extension of working hours at night	Correlation coefficient	1.000	.569 ^{□□}	.060	.033
	Sig. (2-tailed)	.	.000	.618	.785
	N	71	71	71	71
Availability of street lights	Correlation coefficient	.569	1.000	.106	.058
	Sig. (2-tailed)	.000	.	.380	.632
	N	71	71	71	71
Reduction of street muggings	Correlation coefficient	0.060	.106	1.000	.455 ^{□□}
	Sig. (2-tailed)	.618	.380	.	.000
	N	71	71	71	71
Safety of doing business at night	Correlation coefficient	.033	.058	.455 ^{□□}	1.000
	Sig. (2-tailed)	.785	.632	.000	.
	N	71	71	71	71

*Table 3: Relationship between the Extension of Working Hours at Night and Rural Electrification Street Lights
Correlation Is Significant at the 0.01 Level (2-Tailed)*

4.5. Relationship between the Influence of Rural Electrification on the Cost of Energy and Its Effect on the Income of Mses Owners

The correlation analysis of this objective focused on confirming whether rural electrification influences the cost of energy and its effect on the income of MSEs owners. The influence of the rural electrification program was subdivided into a decrease in energy cost after connection to electricity and energy affordability. The results were presented in table 4 below. There was a weak positive relationship between increases in the level of income due to a change in energy cost, decrease in energy cost after connection to electricity and energy affordability. ($r_s=.106$; $r_s=.168$ respectively) This relationship confirms that rural electrification leads to an increase in the income of MSEs owners by influencing the cost of energy thus improving their sustainable livelihoods. To strengthen this relationship, the government and its development partners should offer financial aid to MSEs owners, provide markets for their products and reduce taxation in order to cut the cost of operation thus increasing their income

		Increase in the level of income	A decrease in energy cost	Electricity led to energy affordability
Increase in the level of income	Correlation coefficient	1.000	.106	.168
	Sig. (2-tailed)	.	.457	.233
	N	52	52	52
Decrease in energy cost	Correlation coefficient	.106	1.000	.144
	Sig. (2-tailed)	.457	.	.308
	N	52	52	52
Electricity led to energy affordability	Correlation coefficient	.168	.144	1.000
	Sig. (2-tailed)	.233	.308	.
	N	52	52	52

*Table 4: Relationship between the Influence of Rural Electricity on the Cost of Energy and Its Effect on the Income of MSEs Owners
Correlation Is Significant at the 0.01 Level (2-Tailed)*

4.6. Relationship between Access to Rural Electrification and Employment among MSEs Owners

The correlation analysis of this objective focused on whether rural electrification programs lead to an increase in employment among MSEs owners. Access to rural electrification was sub-divided into the motivation of business startup by electricity connection and an increase in employee numbers due to electricity connection. The results were presented in table 5 below. There was a weak positive relationship between establishments of businesses, the motivation of business startups and an increase in the number of employees due to increased access to electricity. ($r_s=.145$ and $r_s=.072$ respectively) This relationship confirmed that access to electricity due to rural electrification has led to the improvement of MSEs' sustainable livelihoods through increasing employment opportunities among them. The government and its development partners should implement other programs to increase the level of employment in order to strengthen this relationship.

		Connection to electricity led to the establishment of businesses	Electricity connection and motivation to start the business	Increase numbers of employees due to an electricity connection
Connection to electricity led to establishment of businesses	Correlation coefficient	1.000	.145	.072
	Sig. (2-tailed)	.	.541	.549
	N	71	19	71
Electricity connection and motivation to start the business	Correlation coefficient	.145	1.000	.076
	Sig. (2-tailed)	.541	.	.749
	N	19	19	19
Increase numbers of employees due to an electricity connection	Correlation coefficient	.072	.076	1.000
	Sig. (2-tailed)	.549	.749	.
	N	71	19	71

*Table 5: Relationship between Access to Rural Electrification and Employment among MSEs Owners
Correlation Is Significant at the 0.01 Level (2-Tailed)*

5. Discussion

This study investigated the effects of rural electrification programs (LMCP) on the sustainable livelihood of MSEs owners. The study conceptualized the effects of the program on the provision of clean energy, the installation of street

lights, and the influence of the program on the cost of energy and electricity accessibility. The sustainable livelihood of MSEs owners was conceptualized into the elimination of health risks caused by fossil fuels, prolonged working hours due to the street lights, increased income and employment. The study contributes to community development literature by demonstrating the effects of rural electrification programs on the community's sustainable livelihood, specifically MSEs owners. Most previous research studied the effects in the community in general (Khandker et al. 2014; Dasso and Fernandez 2015; Raul Jimenez, 2017) while others narrowed the effects to businesses (Ouma 2013; Akpan, 2013; Harrison et al, 2014). However, despite these works, little is known about the effect of rural electrification programs on the livelihood of those who own small and medium enterprises.

6. Summary of Findings

The results in the sample indicate that the major effects of rural electrification programs is the prolonged working hours and increased income of MSEs owners due to the influence the programs have on the cost of energy. Their effect on the elimination of health risks associated with fossil fuels is moderate. The lowest effect of the programs is an increase in employment due to electricity accessibility. The study also found that there was a positive correlation between the rural electrification program and the sustainable livelihood of MSEs owners. This means that through the provision of clean energy, installation of street lights, influencing the cost of energy and accessing electricity to MSEs owners, the programs are able to eliminate health risks posed by fossil fuels, extend the working hours of the MSEs owners especially at night, increase their income and lead to increased employment among them. Despite this fact, the study found that these relationships were very weak mainly because of other factors at play.

Consistency with recent research concerning the effects of rural electrification was observed. Street lights due to rural electrification result in increased security in businesses thus enabling the locals to extend their business operations at night (Kembo, 2013; Hirmer and Guthrie, 2017). Also, access to clean energy like electricity reduces the consumption of low quality, dirty fuels for lighting thereby reducing intra-house emissions of polluting gasses reducing respiratory diseases (Raul Jimenez, 2017 and ADB, 2010). Despite complaints of high costs in terms of electricity bills, electricity has led to rising entrepreneurs with SMEs (Ouma, 2013). Electricity also reduces the cost of energy and maximizes profits (Lipscomb et al. 2013; Khandker et al. 2014). Finally, rural electrification leads to an increase in women's employment (Dasso and Fernandez, 2015; Dinkelman), it leads to industrialization due to new production methods (Rud, 2012; Chowdhury, 2010). These findings are in line with the findings of this study on the effects of rural electrification on the sustainable livelihood of MSEs owners.

The weak relationships also are in line with past studies. Despite a big proportion of the shopping centers being under the grid, not all individual enterprises are connected to electricity in the constituency where the study was done. 40% of the residents, therefore, have resulted in using other sources of energy for cooking and lighting like firewood, biogas, Liquefied Petroleum Gas, Paraffin, and solar lamps (Kenya power, 2016). As seen earlier, Brazil's murder rate rose concurrently with its rural electrification program which explains the weak relationship between rural electrification street lights and prolonged business hours at night. There is an insignificant relationship between electricity and an increase in the income of individuals as the benefits of rural electrification tend to be overestimated and the costs understated (Fluitman, 1983; Lim, 1984). These researchers argued that the high cost associated with installation and the initial amount of connection makes rural electrification have an insignificant positive impact on businesses. Finally, rural electrification fails to significantly improve the probability of being employed in either wage or self-employment (Singh and Vermaak, 2005). These past studies explain why this study found weak relationships between rural electrification program and their effect on the sustainable livelihood of MSEs owners.

According to the results, the lowest effect of rural electrification is increased employment due to increased access to electricity. This is mainly because only 19% of the population in the area under study was connected to electricity according to a report by the Kenya National Bureau of Statistics, (KNBS, 2013). There was a weak relationship between the LMCP and its effect on the sustainable livelihood of the MSEs owners because, despite the Kenyan government investing huge funds on development expenditure, 26% (657.3 bn) of the 2018/19 budget, very little has been done to ascertain the effects of these development projects on the livelihoods of their beneficiaries. The Human Development Index for Murang' a County stands at 0.56 (Murang' a County CIDP 2017-2022). This means that the residents are only living to 56% potential for development which is behind Kenya's population potential for development which stands at 59%. This is evidence that, regardless of the huge amounts of money spent on rural electrification programs like Last Mile Connectivity Project, the livelihoods of the beneficiaries especially those who own the MSEs doesn't improve much. Security is poor, a cumulative 63.4% of the MSEs owners studied used kerosene, LPG lamp, and diesel for lighting, out of those who were not connected to electricity, 50% couldn't afford the service and 33% of the MSEs owners suffered from transformer problems. On employment, 52.1% of the MSEs enumerated had one employee while only 5.6% had 10 and above employees. This shows that the government have a long long way to go to ensure rural electrification programs meet their set objectives

7. Managerial Implications

Today, academicians, government and their development partner need to understand the effect rural electrification programs have on their beneficiaries. The weak relationships seen between the rural electrification programs studied and the effect it has on its beneficiary's livelihood is evidence that more is yet to be done in accessing the benefits of development projects by both the government and its partners.

The study recommended that the government should co-operate with other donors like the African Development Bank or the World Bank whose studies stress the need to inject new funds to support rural electrification projects (ADB, 2013; World Bank, 2015). The government should give incentives to ensure a 100% connection rate. For development to take place one motivator is not enough. (Kagawa and Nakata, 2008) Due to the weak relationships between the rural electrification program studied and its effect on the sustainable livelihood of MSEs owner, the government should fund and implement other development-based projects In order to create an all-rounded conducive environment for MSEs to thrive.

Electrification companies should cut electricity connection costs as well as giving the MSEs owners more grace period in terms of the repayment period. (Bose et al., 2013; World Bank, 2015; Heltberg, 2003) By so doing, more MSEs will be connected to rural electrification programs and reap their benefits. For this to happen, rural electrification authorities and companies, national and county governments, and other partners in these programs should carry out a project awareness program that should be aimed at educating the local MSEs owners on the benefits of connecting their businesses to electricity. Some beneficiaries of these programs fail to connect with rural electrification due to a lack of knowledge of the benefit of electricity connection. (Kirubi, 2006)

Finally, the local authorities where these programs are implemented should conduct business incubation programs for MSEs owners with the aim of equipping them with the skills and expertise of doing business. This will boost the MSEs performance and will have a positive influence on electricity adoption since well-performing businesses are likely to adopt electricity from the national grid or rural electrification programs such as the Last Mile Connectivity project.

8. Limitations and Directions of Further Research

Design issues presented one of the main limitations of this study. The study tested the relationship between the variables but did not test their significant differences. The conclusions are therefore based on the strength or weakness of the relationship between the variables studied but didn't test whether the relationships were significant or not. Testing the significance of relationships is important as it helps to understand whether they happened by chance or by evidence. (Green and Salkid, 2005) The study may have been affected by the common method bias. The information was gathered using one single questionnaire to measure all the variables and so perhaps the strength of the relationships was biased. A single rural electrification program was studied (LMCP) and the results cannot be generalized to represent the effects of national grid rural electrification.

The study covered a single constituency. A larger scaled comparative study should be done to compare and contrast findings between various counties or countries as far as the effect of rural electrification programs is concerned. Other studies can be carried out to access the impact of other government development projects on the sustainable livelihood of business owners.

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