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Rural Electrification and Maize Value Addition in Mpumudde Sub-County, Lyantonde District

Sulaiman Ssegilinya*, Rebecca Kalibwani, Gershom Nuwemuhwezi

Agriculture and Agribusiness, Bishop Stuart University, Mbarara, Uganda

Email address:

ssegisulai@gmail.com (Sulaiman Ssegilinya)

*Corresponding author

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Abstract: The study was about rural electrification on maize value addition in Mpumunde Sub-County, Lyantonde District. The study specific objectives were to; characterize maize value addition actors benefiting from rural electrification, identify factors limiting farmers from participating in maize value addition other than electrification, assess the contribution of rural electrification towards adding value to maize. The study employed a descriptive cross-sectional research design and primary data was collected from 200 respondents. The data was analysed using SPSS version 22.0. The study concluded that maize value addition actors who benefited from rural electrification were characterized by low level of education that is average number of years in school being six; limited size of land with average of 4 acres and majority had productive age with an average of aged 38. The study also concluded that there were factors limiting farmers from participating in maize value addition other than electrification which were; limited training on value addition was significant at (p=.027). Skills and experience at (p=.021), Credit services/financing at (p=.003). Market availability at (p=.026). Materials and equipments to use at p= (.029). Level of education and storage facilities were seen non-significant at 5% level of significance with p-values (p=.312; p=.261). The final conclusion was that maize value adders agreed that the rural electrification connection to maize milling centers mostly were more efficient in their operations than the non-connected milling centers. They had improved quality value added products, efficiency in processing activities, operated for long hours and had faster processes. The study recommends that, there is a need for the government to link with the donors like World Bank who have already acknowledged through their own studies that there should be a need for massive injection of funds to support the rural electrification programme. There should be more grace period for the rural people in terms of repayment period since they are not used to the urban living style where deadlines on payment attract severe action like total disconnection. Maize value adders should be subsidized with value addition equipments at a fair price to help them sustain production of better quality value added products. The study recommends that village saving cooperative societies limited render soft and affordable loans at low interest rate to help farmers finance their value addition activities and ensure sustainability of quality value added products.

Keywords: Rural Electrification, Maize Value Addition, Mpumudde, Lyantonde District

1. Introduction

Globally, over 1.4 billion people worldwide lack access to electricity and those who have access are supplied with intermittent and unreliable electric power [1]. In some studies, electrification in some rural communities is considered a driver of sustainable economic development and improvement of value addition performance in developed world [11]. Access to electricity allows rural households sufficient time to work on their farms as household chores can be shifted to the evening [15], and the day does not have to end at sundown. In Norway, China, Belgium, most of the agricultural activities take place in the rural communities and it continues to be the major source of livelihood in such communities [3].

A systematic review by [10] found that electrification stimulates agricultural output and has the tendency of

increasing employment. As the level of employment increases, this will, in turn reduce the poverty levels. In most developed countries, maize is "an engine for economic growth" [19], employs a large proportion of labour and in some cases contributes a higher share to the country's employment and Gross Domestic Product (GDP).

The study uses utility maximization theory. This theory is anchored on the assumption that the decision of maize processors to add value to their products is influenced by expected utility and return, which ought to be higher if the processors add value to the products [14]. The utility is compensated by the consumers through patronage. Thus, maize processors will add value to their products if and only when they perceive the net benefits as a result of value addition will be greater than is the case without it [12]. Although utility cannot be observed directly, however, the choices made by economic agents like the consumers can help in determining it.

In Africa, the number of people living in rural communities is about 60% and majority of these rural dwellers are engaged in maize [19]. According to the [20] there are about 789 million people who do not have access to electricity and about 72% of these people are in the rural areas of Sub-Saharan Africa. The rate at which rural communities get access to electricity is slower than rural population growth [12], hence having the lowest electricity connection rates [26]. With the growing demand for energy, the United Nations Sustainable Development Goal 7 has set a target to have universal access to energy by 2030.

Other initiatives include the USAID Power Africa initiative whose aim is to increase electricity by 60 million households across Africa. Roughly 85% of these people live in rural areas and a large proportion are in Africa [17]. Until today, many production and supply utilities have failed to sustain the electricity demand of many rural areas communities, little electricity that is produced has been focused to supply only highly populated and major industrialized cities [5].

In Uganda, limited access to electricity continues to affect the delivery of social services, constrain the development of small-scale industrial and commercial enterprises and adversely affect large scale industrial and commercial investment [8]. To alleviate this situation, the Government of Uganda (GoU) has initiated several interventions to achieve its electricity access targets: (i) the Uganda Vision 2040 - access of 80 % by 2040, (ii) the National Development Plan II, access from 14% to 30% by 2020; and (iii) the 2013-22, Rural Electrification Strategy and Plan target to increase access to electricity in rural areas from 7% to 26%. Before 2003, less than 9.7% of the total population in Uganda had access to electricity. The level of access for the urban population was 55% compared to a mere 3.3% for the rural population. To reduce the inequality, Government of Uganda developed and adopted the Rural Electrification Strategy and Plan (RESP) 1 & 2 to be implemented by the Rural Electrification Agency (REA) [17]. REA is a statutory body formed in 2003 with the responsibility of undertaking rural electrification on behalf of Government with policy guidance from the Rural Electrification Board. Since its inception, REA has extended over 10,000km of medium voltage electricity lines and 7,000 km of low voltage distribution electricity lines. Rural electricity access has increased from 3.3% in 2003 to 12% in 2016 [13].

Despite the extension of electricity lines to rural areas, the application process for connection is complicated since consumers have to visit the offices of the service providers which may be distant, it is expensive for the rural population to wire their houses using the standards stipulated by the Electricity Regulatory Authority (ERA), due to the discrepancy in the connection costs across different service territories.

1.1. Problem Statement

Rural areas of poor countries are often at a disadvantage in terms of access to electricity. The high cost of providing this service in low populated, remote places with difficult terrain and low consumption result in rural electricity schemes that are usually more costly to implement than urban schemes. In addition, low rural incomes can lead to problems of affordability and the long distances mean greater electricity losses and more expensive customer support and equipment maintenance [21]. Despite this, rural electrification has been claimed to have substantial benefits, promoting production through maize processing, better health and education for households. Rural areas continue to be the home to majority of the population in Uganda and also the hub of different maize production activities [18]. Lack of electricity supply affects close to ninety (90) percent of the population particularly those who are involved in value addition because they need electricity mostly all the time [1]. Despite, the impressive gains the government has made in providing electricity to populations living in rural areas, Mpumudde Sub-county has not yet achieved the universal electricity coverage and even in areas where the rural electrification program have been rolled out fully, a section of the population has not shifted to value addition. It is projected that well planned, carefully targeted and effectively implemented rural electrification programs have the potential of opening up opportunities for low income rural people to increase their income through maize value addition activities and thereby accelerating rural development [8]. However, there is limited data on the impacts of rural electrification on the growth of maize value addition activities in Uganda and Mpumudde sub-county in particular. The study therefore sought to bridge the knowledge gap by assessing the effect of rural electrification on maize value addition in Mpumunde Sub-County, Lyantonde District.

1.2. Research Objectives

The general objective of the study was to assess the effect of rural electrification on maize value addition in Mpumunde Sub-County, Lyantonde District. The specific objectives

were to; characterize maize value addition actors benefiting from rural electrification, identify factors limiting farmers from participating in maize value addition other than electrification and assess the contribution of rural electrification towards adding value to maize in Mpumunde Sub-County, Lyantonde District.

1.3. Significance of the Study

This study will help decision makers and donors to improve the implementation of rural electrification program as it might have impact to developing countries especially Uganda. The existing evidence linking rural electrification to growth and expansion of agro-processing firms/businesses will be enhanced. This study can therefore shed more light on the productive role of rural electrification and thereafter providing the foundation for future policy making during rural planning and development initiatives. A detailed evaluation of the impacts of rural electrification program in Mpumunde Sub-County will therefore play integral role in the provision of reliable data and trends in maize value addition enterprise electricity use. Since Mpumunde Sub-county is a beneficiary of the rural electrification program, the study will assess the impact that the scheme for rural electrification has had on maize value addition development and income generating activities. The study results will help the researcher to acquire his Master's degree in Agriculture and Rural innovations at Bishop Stuart University.

1.4. Conceptual Frame Work

According to [16], a conceptual framework is defined as a coherent set of concepts, beliefs, values, propositions, assumptions, hypotheses, and principles. A conceptual framework is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas. The conceptual framework below will be based on a three factor model independent variable, dependent variable and intervening variable as mentioned below.

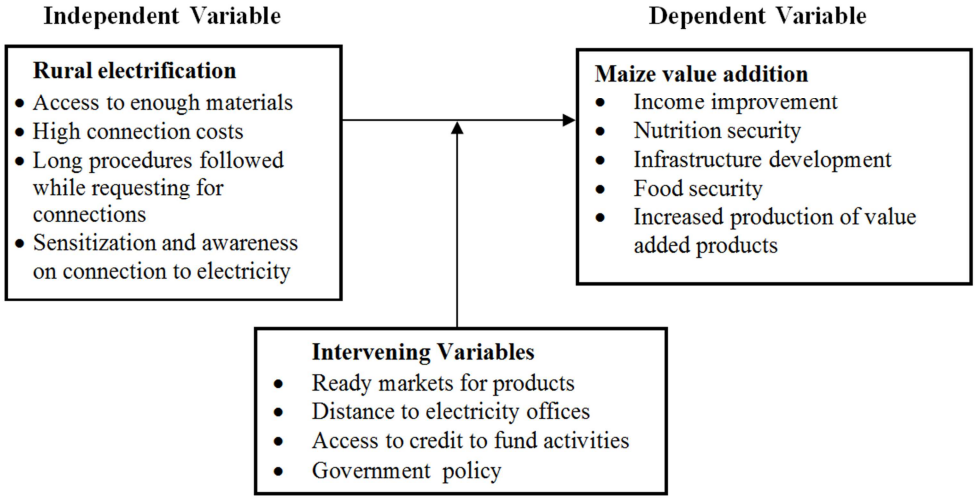

Figure 1. *Conceptual framework.*

2. Methodology

The study was conducted in Mpumudde Sub county, Lyantonde district in Uganda. Lyantonde is located in the South-western region of Uganda lying between latitude 0^0 S and 0.5^0S Longitude of 31.1^0 E and 31.3^0 E. Lyantonde borders Rakai District in the South, Masaka in the East, Kiruhura in the West and Sembabule in the Northeast. The District headquarter is in Lyantonde Town Council. The distance from Kampala, the National capital city is of 193 Kilometres. The District had a total households 0f 20,839, total population of 94,841 people according to the 2014 population census of whom 46,906 and 47,936 were males and females respectively. Lyantonde has an area of about 864.62 square Kilometres.

The study adopted a descriptive cross-sectional survey to assess relationship between rural electrification and maize value addition. The design adopted both quantitative (statistical) and qualitative (attitudes and opinions) approaches for data collection. These approaches made it possible to investigate the phenomenon in the area.

The study targeted farmers who do maize value addition, agricultural service providers and community stake holders. Agricultural service providers were considered for their technical knowledge, advisory services, and community stakeholders were considered because they took part in policy implementation.

The study was conducted on representative sample of 200 respondents. The researcher drew the sample size using the standard statistical formula by Kish and Leslie, (1965) at 95% confidence interval and 5% error term as follows:

$$n = Z_{\alpha/2}Pq/d^2$$

The study employed purposive sampling and stratified random sampling criteria in the selection of respondents across the district. Purposive technique was used on farmers and while stratified sampling involved the division of a

population into stratum or groups. In this case, value chain actors were divided into groups based on shared characteristics. The formed groups included farmers and processors. It was from each group that a target sample was drawn using a systematic probability sampling technique. Random numbers were used to attain the required number of respondents from each group. Non-probability (simple) random method was used to select key informants like agricultural service providers.

The study used self-administered questionnaires with (closed and open-ended questions), interview guide to collect primary data. The questionnaires were administered by the researcher himself. Primary data was captured on; Socio-demographic characteristics like sex, age, education level, income status, source of income, landholdings and among others, factors limiting farmers from participating in value addition other than rural electrification, and T contribution of rural electrification on adding value to maize. Oral personal interviews that involved a face to face contact or conversation using an interview guide were used to capture opinions and views from key informants.

Data collected was coded, entered and cleaned using the excel computer program which was later exported to Statistical Package for Social scientists (SPSS), Version 21.0 for analysis. Both descriptive and inferential statistics were generated and used in interpreting results. Continuous variables were analyzed using mean and standard deviation while frequencies and percentages were applied on categorical variables. Multivariate analysis using correlations and regression statistics were performed to assess the possible associations between variables and significant relations with the dependent variables.

3. Results

Respondents during survey were asked their gender, responses were captured and presented in figure 2 below;

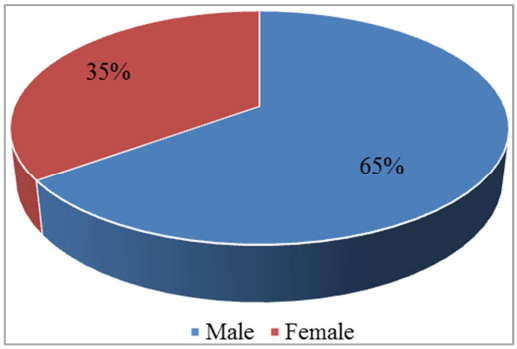

Figure 2. *Gender of respondents.*

As shown in figure 2 above, 65% of the respondents were males and 35% were female. The dominance of males in the study meant that electrification and maize value addition had hectic work which could not be done by females. However, the results implied that the study did not suffer from gender bias.

Table 1. *Descriptive Statistics on age, education level and size of land under maize production.*

	Minimum	Maximum	Mean	Std. Deviation
Age in years	18	75	38.54	13.313
Educational in years	0	19	6.40	4.638
Size of your farm	1.0	17	4.234	3.7723

Source; field data, 2023

According to the findings in table 1 above, Average age distribution among respondents was 38 years with the youngest respondent aged 18 and the oldest 75 years. Average number of years in school was 6 with a minimum of 0 and a maximum of 19. Majority of the respondents had spent between 1 – 6 years in school. Respondents had an average landholding of 4.234 acres with minimum holdings of an acre and a maximum of 17 acres.

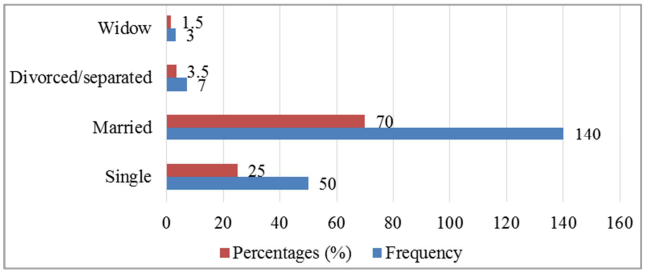

Figure 3. *Marital status.*

According to the findings in figure 3 above, it was revealed that 70% of respondents were married, 25% were single, 3.5% had separated/divorced and 1.5% were widowed. The dominance of married couples implied that value addition was done to improve on their income to help them to fund their children school fees as well as enhancing shelf life of their food to avoid starvation during food insecurity situations.

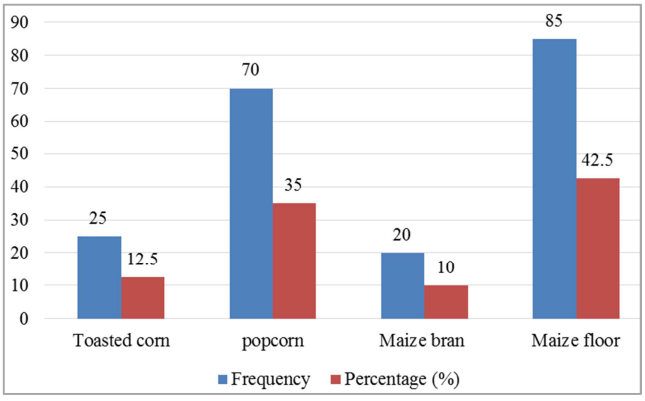

Figure 4. *Products got out of maize after value addition.*

According to the figure 4 above, it was revealed that majority of respondents 42.5% produce maize flour out of maize grains, 35% revealed popcorn, 10% revealed maze bran and the least number of respondents 12.5% revealed toasted corn.

Table 2. *Regression output for factors limiting farmers from participating in maize value addition other than electrification.*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	18.812	1.763		9.905	.000
	Limited training on value addition	2.027	1.033	.138	1.772	.027
	Skills and experience	2.011	1.002	.149	2.678	.021
	Level of education	-.068	.051	-.114	-.741	.312
	Credit services/financing	3.045	1.164	.200	-2.128	.003
	Storage facilities	-.183	.221	-.114	-.710	.261
	Market availability	3.102	1.048	.177	1.896	.026
	Materials and equipments to use	2.228	1.187	.146	1.092	.029

Regression results for factors limiting farmers from participating in maize value addition other than electrification were presented in Table 2 above. Some of the factors were found to be statistically significant and others were non-significant. The significant factors included; limited training on value addition was significant at (p=.027). This factor had a significant influence on limiting farmer's participation by 2 limited chances. Skills and experience was seen as significant factor in limiting farmer's participation in maize value addition at (p=.021), with 2 limited chances. Credit services/financing was seen significant in limiting farmer's participation in maize value addition at (p=.003), with 3.045 limited chances. Market availability was seen significant in limiting farmer's participation at (p=.026) by 3 limited chances. Materials and equipments to use were seen significant in limiting farmers from participating in maize value addition at p= (.029) by 2 limited chances. Level of education and storage facilities were seen non-significant at 5% level of significance with p-values (p=.312; p=.261). This meant that even farmers who had no formal education were able to use electricity to add value to the maize as well as those without enough storage facilities.

Respondents/farmers were asked how they were helped to participate in maize value addition; responses were captured and indicated in table 3;

Table 3. *How government tried to help farmers to participate in maize value addition.*

		Frequency	Percent	Cumulative Percent
Valid	Extension training	60	30	30
	Rural market establishment centres	45	22.5	52.5
	Provision of drought resistant seeds	25	12.5	65
	Rehabilitation of rural feeder roads	50	25	90
	Subsidization of equipments at fair price	20	10	100
	Total	200	100.0	

Table 3 above shows that majority 30% of the respondents revealed that the government had helped them with constant training services on how best they can add value to their maize harvests, 22.5% revealed rural market establishment centres, 25% revealed rehabilitation of rural feeder roads, 12.5% provision of drought resistant seeds to maize farmers while 10% revealed subsidization of equipments at fair price.

Table 4. *Other roles of rural electrification other than using it during maize value addition.*

Roles of rural electrification	N	Minimum	Maximum	Mean	Std. Deviation
Used for lighting in homes	200	8	120	46.42	27.202
Used in salons during shaving	200	5	370	77.65	60.018
Refrigeration	200	2	45	15.62	8.230
Used for welding	200	5	48	17.34	9.113
Used for cooking	200	2	12	4.45	0.988

Results in table 4 presented a highest mean of 77.65, which showed that electricity is strongly used in salons during shaving in Mpumudde sub-county, Lyantonde district, followed by a mean of 46.42 that implied that electricity in Mpumudde sub-county is mostly used for lighting in homes. This was closely followed by mean of 17.34 which showed that electricity is used welding, another strong role had a mean of 15.62 which showed that electricity is for refrigeration in different small scale medium enterprises like bars/pub, restaurants, retail shops and among others. Electricity has played pivotal role in helping rural households to cook and boil their water and milk and this presented a mean of 4.45.

Respondents were further asked on how rural electrification contributed towards adding value to maize; responses were captured, analaysed and presented in table 5.

Table 5. *Contribution of rural electrification towards adding value to maize in Mpumudde sub-county, Lyantonde district.*

Contribution of rural electrification	Chi-square (x^2)	Df	Asymp. Sig. (p=0.05)
Growth of various milling centres	3.114	2	0.011
Sustainability of quality value added products	2.881	3	0.001
Efficiency in processing activities	0.891	2	0.010
Electricity has enabled milling enterprises to operate for more hours	3.012	4	0.001
Production of more value added products	2.004	2	0.004

A test of chi-square was established to ascertain that the increase in maize value addition was because of rural electrification and not mere chance. Using Pearson's chi-square test with a 95% confidence level, the results with Asymptotic significance less than 0.05 are the ones to indicate a strong relationship while those equal to or greater than 0.05 are rejected as being not related.

Results as indicated in table 5 show that all the rural electrification had low asymptotic significance values close to zero and hence an indication that the value addition was not due to chance but strongly related to a level of 95% confidence on the connection to the electricity in rural areas. The chi-square results are given below;

Growth of various milling centres (x^2 = 3.114, p=0.011), Sustainability of quality value added products (x^2 = 2.881, p=0.001), efficiency in processing activities (x^2 = 0.891, p= 0.010), enabled milling enterprises to operate for more hours (x^2 = 3.012, p=0.001) and production of more value added products (x^2 = 2.004, p=0.004).

4. Discussion

The study findings revealed that majority 65% of the respondents were males and 35% were females. The dominance of males in the study meant that electrification and maize value addition had hectic activities which could not be done by females. It is further reported that females are more constrained to access agricultural credit to buy value addition equipments, like milling machines and machines to produce popcorn. This finding is in agreement with [9] who reported that males have easy access to credit due to having access and control over productive resources which act as collateral unlike female counterparts. Therefore, it is hypothesized that female maize farmers are more constrained to access agricultural credit than their male counterparts.

The study results established that majority of respondents were married unlike other statuses. This was reported by 70% of the respondents. The dominance of married couples implied that value addition was done to improve on their income to help them to fund their children school fees as well as enhancing shelf life of their food to avoid starvation during food insecurity times. This finding concurs with [23] who in her study reported that married persons are more likely to have engaged in production than their unmarried counterparts because married people need to meet food security for its household members.

The study findings indicated that respondents had an average landholding of 4.234 acres with minimum holdings of an acre and a maximum of 17 acres. It is expected that the more sufficient land size maize farmer accumulates, the more access to agricultural credit from financial institution. This finding concurs with [4] who in their study reported that big land enables maize farmers to meet the collateral requirements of the bank as well as supporting engaging in multiple enterprises through diversification. Therefore, it is hypothesized that farmers with sufficient valuable land have more access to agricultural credit from financial institution to finance production activities than counterparts with few acres of land.

The study results further indicated that average number of years in school were 6 with a minimum of 0 and a maximum of 19. Majority of the respondents had spent between 1 – 6 years in school. The results meant that majority of the maize value adders were not highly educated and this limited the number of participants in value addition since high level of education helps some people to make better decisions and handling value addition activities perfectly. This finding can be compared with [14] who in their study reported that education is very vital for boosting the productivity of the human factor and making people more aware of opportunities for earning a living.

The study also discovered that there were factors limiting farmers from participating in maize value addition other than electrification; The study results established that market availability was seen significant in limiting farmer's participation at (p=.026) by 3 limited chances. Rural producers, and especially maize farmers, have little information about the market demand, which is costly to obtain and also limited accessibility of markets to absorb value added products at local levels. Maize value adders may gather information through contact with other actors in the commodity chain, but the accuracy of this information is not certified since those actors might be exhibiting "opportunities behavior" [12]. Maize farmers lack information about product prices at the local level, about quality requirements, about the best places and times to sell their products, and about potential buyers. This finding is consistent with [24] who in their study explained that market information allows farmers to make informed marketing decisions that are related to supplying necessary goods, searching for potential buyers, negotiating, enforcing contracts and monitoring.

The study findings revealed that limited training on value addition was significant at (p=.027). This factor had a significant influence on limiting farmer's participation by 2 limited chances. Respondents further explained that training services on value addition are limited due to limited number of extension agents in the district compared to large number of farmers who need training and therefore agents would not

reach all the rural areas to offer training services. This finding can be compared with [22] who in their study reported that farmers in groups exchange ideas/information, achieve economies of scale, incur less costs and ensures collective production, marketing and training thus increasing probability of practicing value addition.

The study results also established that storage facilities was seen as non-significant at 5% level of significance with p-value =.261. Respondents further explained that their storage facilities are so limited and of poorly setup which are susceptible to rodents which feed on their products. This has affected their quality of their products. This finding is in line with [2] who in their study reported that the quality of stores renders all sorts of vermin exist that tend to partake of the produce.

The study also revealed that there were contributions of rural electrification towards adding value to maize in Mpumudde Sub-county, Lyantonde district; the study findings revealed that rural electrification has enhanced efficiency in processing activities and was therefore significant at (p= 0.010). Respondents further explained that activities have been run smoothly due to stable power supply to the processing centres. This finding can be compared with [6] whose study in South Africa, revealed that rural electrification played a vital role in stimulating the economic growth in rural areas by creating and increasing agro-processing activities both at the household level and at the community level. The same author revealed that rural electrification improved women participation in income generating activities particularly value added activities whereby women started working outside their homes and joined the formal labor force.

The study results revealed that rural electrification leads to growth of various milling centres. This was seen significant at p=0.011). The study finding can be compared with [7] who revealed that in getting the correct trend of businesses rising due to connection, his study sought to establish the products that have resulted into value addition due to electricity uptake or power connection in rural settings and examples were milk packaging and refrigeration where previously only hawked milk was available, maize milling and packaging of flour where initially, the diesel grinders only produced a few bags of flour for immediate use than previously before rural electricity connection.

The study results revealed that sustainability of quality value added products as a result of rural electrification has improved people's household income in Mpumudde sub-county, Lyantonde district. Sustainability of quality products meant that value adders sell at high prices and fetch more profits which at times increase their income at their household levels. This finding can be compared with [24] who in their study in Bolivia resulted into significant improvements and growth of various income generating activities in rural areas such as cottage factories, maize milling houses which sell maize flour. The same authors reported that revenue producing services increased family income and enhanced the rural livelihood. In their study on rural electrification expansion played a pivotal role in shaping maize and food security at household level.

The study results revealed that rural electrification enabled milling enterprises to operate for more hours. Respondents explained that this is because there stability of power in rural setting and the unit costs are so friendly. This finding is in line with [21] who reported that access to an electrical grid and better electricity services could also lead to household time savings and allow them to work more hours by increasing their access to markets. However, there is also a need for evaluation of such programs' impacts to determine whether or not interventions are relevant and cost effective.

5. Study Conclusion

The study came to the first conclusion that maize value addition actors who benefited from rural electrification were characterized in Mpumunde Sub-County, Lyantonde District as follows; majority had low level of education that is average number of years in school being six, limited size of land with average of 4 acres and majority had productive age with an average of aged 38.

The study also concluded that there were factors limiting farmers from participating in maize value addition other than electrification in Mpumudde Sub-county, Lyantonde district. Such as; limited training on value addition was significant at (p=.027). Skills and experience at (p=.021), Credit services/financing at (p=.003). Market availability at (p=.026). Materials and equipments to use at p= (.029). Level of education and storage facilities were seen non-significant at 5% level of significance with p-values (p=.312; p=.261).

The final conclusion was that maize value adders agreed that the rural electrification connection led to the growth of maize milling centers mostly which were more efficient in their operations than the non-connected milling centers. They had improved quality value added products, efficiency in processing activities, operated for long hours and had faster processes.

6. Study Recommendations

A major recommendation of the study is that the government should link with the donors like World Bank who have already acknowledged through their own studies the need for massive injection of funds to support the rural electrification programme. In other words, the government needs to be able to give incentives of any kind that will encourage the people to get connected.

There should be more grace period for the rural people in terms of repayment period since they are not used to the urban living style where deadlines on payment attract severe action like total disconnection.

Maize value adders should be subsidized with value addition equipments at a fair price to help them sustain production of better quality value added products.

The study recommends that village saving cooperative societies limited render soft and affordable loans at low

interest rate to help farmers finance their value addition activities and ensure sustainability of quality value added products.

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Conflicts of Interest

The authors declare no conflict of interest.

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