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DETERMINANTS OF RURAL ELECTRIFICATION ADOPTION AND SOCIO-ECONOMIC BENEFITS AMONG HOUSEHOLDS: A CASE OF MERU-SOUTH SUB-COUNTY, KENYA

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ABSTRACT
Electricity is a critical asset for both human well-being and country's socio-economic development. However, low adoption and general lack of optimal utilization of electricity continue to undermine maximum socio-economic productivity in most Sub-Saharan African countries. The rural areas are the hardest hit through low economic development and empowerment. There is little information on socio-economic dynamics that preside over the low adoption and potentials of rural electricity in this region. This study evaluated determinants of electricity adoption and explored socio-economic potentials and benefits of electricity in Meru South Sub-County. Interviews were conducted among stakeholders from the energy sector and also 150 randomly selected households using closed and open ended questionnaires. Data analyses used SPSS Vr 19. Results showed that 36% households had electricity compared to 64% non-adopters. Predictor factors that influenced adoption were distance from transformers (p=0.000), education level (p=0.020), gender (p=0.045), household size (p=0.009), and income (p=0.011). Electricity benefits and potentials including improved quality of life through lighting (100%) and business opportunities (38.8%) were cited. Household characteristics influenced electricity adoption but utilization had not been geared towards income generating activities. There is need to continue and increase popularization of electricity potentials among households and communities, and to review existing policies on distribution via grid extension to accommodate household characteristics to increase adoption and optimal utilization.
Key words: *Non-adoption, Electricity accessibility, Potentials, Grid extension*

1. INTRODUCTION
Electrical energy is a critical facet to a country's and its populaces' socio-economic development and well-being. However, the Sub-Saharan Africa (SSA) region emerges as the least electrified region globally, with over over half a billion households having no access to electricity (IEA, 2012). Generally, electrification levels in SSA region stands at less than 30.5% (59.9% urban; 14.3% rural) with the bulk of un-electrified areas stretching into rural areas (IEA, 2010). It has been projected further that households without connectivity to electrical energy in SSA will increase by 11% to 655 million by the year 2030 (IEA, 2012).

Without robust interventions aimed at expanding the growth of the power sector, these trends are anticipated to persist and worsen (IEA, 2012). Like most other SSA countries, Kenya's electrical energy accessibility and eventual adoption is quite low (World Bank, 2010). There have been efforts to expand electrical energy accessibility in Kenya, nonetheless, its adoption is still quite low (19.2%); much lower than the average adoption of SSA (30.5%) region (GoK, 2014). Conversely, disparities in the electrical energy distribution in Kenya are quite high. For instance,

electricity connectivity estimated at 51.3% and 5 % in urban and rural areas, respectively. (IEA, 2010). The low electrification and energy growth status in Kenya, occasioned initiatives to establish and increase revenue allocation to an autonomous authority (Rural electrification Authority: REA), whose prime mandate was to accelerate the pace of electrification in rural areas (REA, 2013). This was envisaged to increase accessibility to electrical energy among all households as enshrined in the Vision 2030.

The government's intentions are that all Kenyans have access to electricity by the year 2030 is envisaged in the country's long term blueprint for development, the vision 2030 of the Rural Electrification Authority (REA) under section 66 of Energy Act 2006 (No. 12 of 2006). REA has initiated programmes to accelerate rural electrification via national grid extension in the rural areas. Electricity accessibility has been reported to have increased over years (REA, 2013). Despite the efforts of increasing electricity distribution networks in various parts of the country low levels of electricity adoption among households continue to exhibit among households. Owing to electricity's critical role in rural and household socio-economic development, understanding factors that translate to this low adoption coupled with understanding the potential benefits of electricity during the early stages of the implementation of a rural electrification programme among households helps in clarifying and framing of policies and options for developing countries (Barrios, 2008). There is an enormous consensus that electrification enhances quality of life at the household level and stimulates economy at a broader level (Khandker *et al.,* 2009). Electricity is a critical tool for use at micro level (household). Studies have showed that energy services are a crucial input to the primary challenge of providing basic needs among households. For instance, household access to electricity facilitates timely cooking of food, provides a comfortable living temperature, lighting, and enables the use of communication appliances, which all contribute to the individual and family quality of life (Mvondo, 2010). This study therefore seeks to fulfill the objective of examining the determinants of electricity adoption and socio-economic potential benefits among rural households in Meru South Sub County, Kenya.

2. METHODOLOGY

2.1 Study area

The study was carried out in Meru South Sub County, of Tharaka - Nithi County. The area lies between longitudes 37 18'37"and 37 28'33"East and Latitude 00 07'23" and 00 26'19"South. Meru-South lies in the Upper zones-LH1, UM1, UM2, Middle zones-UM3 and Lower zones-LM3, LM4, LM5 (Jaetzold *et al*., 2006) on the eastern slopes of Mount Kenya. The altitude ranges from 830 meters in the lower areas to 1850 meters above sea level at the base of Mt. Kenya. Population density is of 205 persons per Km^2. The topography of the Sub-County is influenced by the volcanic activity of Mt. Kenya with numerous rivers originating from Mt. Kenya forest (Figure 1).

The major economic activities which are the livelihood systems engaged by the local community include; agriculture and livestock production. Coffee and tea are major cash crops, while maize, beans, potatoes, cassava and bananas are grown for subsistence and cash sale. Livestock keeping is also practiced where households keep dairy cattle goats and sheep and poultry.

2.2. Data Collection and Sampling Technique

The study utilized a survey design approach together with mixed methodologies combining both qualitative and quantitative research methods to enable an in-depth investigation into the subject matter studied. Structured and unstructured questionnaire was the main instrument used to collect primary data. A Multi stage random sampling procedure was employed in selection of divisions, and locations and sub-locations where households were to be interviewed. Simple random sampling was used to obtain the households from each of the selected sub-locations. A total of 150 households were selected from the sub-county for the study.

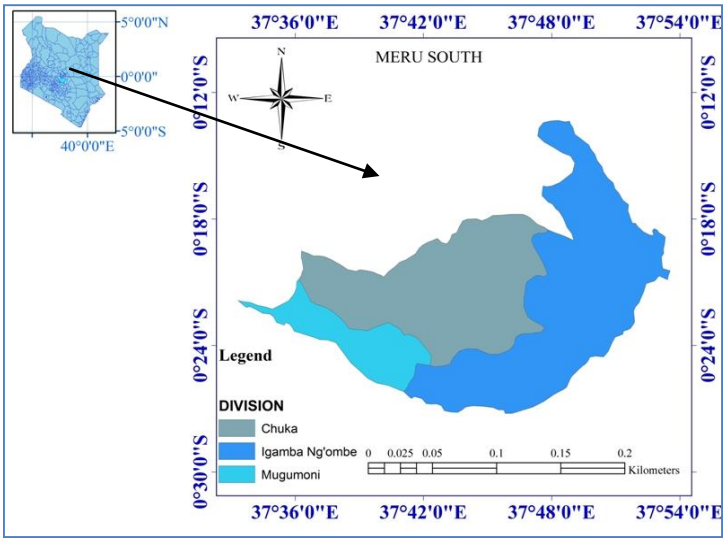

Figure 1. Map of Meru-South Sub County Kenya showing the Study Area

2.3. Analytical Procedure

Analysis of the general characteristics of the respondents, socio-economic profiles of adopters and non-adopters was done using descriptive statistics such as frequencies, means, standard deviation, percentages. This analysis was performed using SPSS and Microsoft Excel. Binary logistic regression mode was used in analyzing possible predictor factors influencing electricity adoption. This regression method was chosen because binary logistic regression is primarily used when the dependent variable is a dummy categorical variable (usually dichotomous) and has two outcomes such as 0 and 1. More so, logistic regression is often chosen when the predictor variables are a mix of continuous and categorical variables or if they are not nicely distributed (logistic regression makes no assumptions about the distributions of the predictor variables) (Peng, 2002). In this study, the dependent variable is adoption of electricity by households, which is a dichotomous variable therefore a value of 0 was assigned if the household was of a non- adopter and 1 if household consisted of an adopter giving a regression of a non-linear form. This was done following a guide line provided by Hilbe (2009) for analysis of the kind. The estimated model can be generally stated as:

$\ln (p/1-p) = a + b_1x_1+b_2x_2+\ldots+b_nx_n$----------

The logit transformation of the probability of adoption is represented as follows:

Logit $(p) = a + b_1x_1+b_2x_2+\ldots+b_nx_n$----------

Where p: is the probability of a case belonging to category 1, p/1-p: the odds of electricity adoption, a:constant, n: number of predictors and b_1-b_n represents regression coefficients associated with each explanatory variable and x_1-x_n represents explanatory variables.

3 RESULTS AND DISCUSSION

3.1. Socio-economic Characteristics of the Respondents

The findings revealed that about 94% of the respondents were male headed households while 6% constituted of females headed households. Marital status of household head indicated that 91.3% were married, 4.7% were widowed and 4% were single parents. In levels of education attainment of the household heads was, 5.3%, 40%, 41.3%, and 13.3% for non-formal education, primary level, secondary level and tertiary level respectively. As per the household's heads occupation, 18.7%, 73.3%, 2.7%, and 5.3% were employed, self-employed daily laborer and unemployed respectively (Table 3.1).

Total monthly income among household heads which was 30.7%, 39.3%, 17.3% 6.0% and 6.7% for less than 5000, 5001to 10000, 10001 to 20000, and 20001 to 30000 and more than 30001 respectively. The study results indicate a distribution of ages of the heads of households interviewed ranging between 25 to 83 years, and the average age of the household head being 48.74 years. The study further revealed that 36.7% were aged between 25 and 45 years,

56.7% between 46 and 65, giving a cumulative figure of about 93.3% of household heads interviewed aged between 25 and 65 years. The average age of household heads was 48.74, median 48.50 and the mode 48 years. Majority of the household had wooden houses (52%) followed by 24% of those who owned stone made houses and 12.7% owned mud houses and 10% had bricked houses.

Table 2.1: Description of variables in the empirical binary logistic model

Acronym	Description	Type of measure
Dependent variables		
ADOP	Whether a household has adopted or not	Dummy (1 if yes, 0 if no)
Explanatory variables		
GENDER	Gender of the household head.	1, male; 2, female
MASTAT	Status of marriage.	1, Married; 2, widowed; 3, Single parents; 4, Single
EDULEV	Educational background of the household head	1, No formal; 2, Primary; 3, Secondary; 4, Tertiary
OCCUP	Work done by household head	1, employed; 2, self employed; 3, Dairy laborer; 4, unemployed
MSI	Sources of income by household head	1, salary; 2, farming; 3, wages; 4, business
MINC	Monthly income of the household head	1, ≤ 5000; 2, 5001-10000; 3, 10001-20000; 4, 20001-30000; 5, >30000
HWM	House type by wall material	1,wood; 2, stone; 3,mud; 4,brick; 5,iron sheet
AGE	Household head's age	Years
HHS	Household in number of people	Numbers
DST	Walking distance of the transformer from the dwelling	1, ≤600metres; 2, >600metres

Table 3.1: Distribution of the respondents' socio-economic characteristics

N=150	Variables	Percentage
Gender	Male	94.0
	Female	6.0
Marital status	Married	91.3
	widowed	4.7
	Single parents	2.0
	Single	2.0
Education	No formal education	5.3
	Primary	40.0
	Secondary	41.3
	Tertiary	13.3
Occupation	Employed	18.7
	Self employed	73.3
	Dairy laborer	2.7
	Unemployed	5.3
Source of income	Salary	19.3
	Farming	68.0
	Wages	4.0
	Business	8.7
Income (Kshs.)	5000 and below	30.7
	5001-10000	39.3
	10001-20000	17.3
	20001-30000	6.0
	Above 30001	6.7
Walling material	Wood	52.0
	Stone	24.0
	Mud	12.7
	Brick	10.0
	Iron sheet	7.0
Age (years)	25-35	12.7
	36-45	28.0
	46-55	33.3
	56-65	19.3
	Above 65	6.7
	≤ 600 metres	40.0
Distance from the transformer	>600 metres	60.0

3.2 Determinants of Electricity Adoption using Binary Logistic Regression Model

The binary logistic regression function in SPSS was used to conduct the simultaneous logistic regression analysis. The model was significant ($\chi 2$=92.432, *df*=10, p<0.05) and the overall percentage of correct predictions is 88.7%.

Table 3.2: Statistics of variables used in the binary regression model

Variable	Minimum	Maximum	Mean	Std. Deviation
GENDER	1	2	1.06	0.238
AGE	1	5	2.79	1.101
MASTAT	1	4	2.09	0.468
EDULEV	1	4	2.61	0.784
OCCUP	1	4	1.93	0.631
HWM	1	5	3.11	1.1
MSI	1	4	2.13	0.8
DST	0	1	0.6	0.492
MINC	1	5	2.18	1.136
ADOPT	0	1	0.36	0.482
HHSIZ	2	6	4.49	1.214

3.2.1 The validity of the model

The p-value 0.93 uses the Hosmer and Lemeshow Goodness-of-Fit Test, which is computed from the Chi-square distribution with 8 d.f. We fail to reject the null hypothesis that there is no difference between the observed and predicted values of the dependent, implying that the model's estimates very well fit the data at an acceptable level. Sidibe´(2005) also mentioned that a p-value less than 0.05 indicates a poor fit for a binary logistic regression model. The results of the analysis as shown in Table 3.3 revealed that gender, household size, household head monthly income, distance from the transformer and educational level are the major determinants of electricity adoption in the study area. The analyses show that distance of the transformer from the household was statistically significant p=0.000 at <0.005. A negative sign of beta (β=-3.167) indicates that adoption of electricity is negatively influenced by the distance of the household to the transformer. The results imply that increase in the distance from the transformer to the households the less likely that the households will adopt electricity. According to Mapako *et al*. (2007) households near grid electrified growth points usually benefit from the proximity of the grid hence get easily connected. According to the results education level is significant (p=0.020) and positively (β=1.001) influence electricity adoption.

Table 3.3 Parameter estimates of binary logistic regression model for socio-economic factors influencing electricity adoption in Meru- South Sub County

Variables	B	S.E.	Wald	Sig	Exp(B)
Gender	-2.774	1.386	4.004	0.045*	0.062
Age	0.036	0.254	0.020	0.887	1.037
Marital status	1.086	0.575	3.561	0.059	2.963
Education level	1.001	0.429	5.439	0.020*	2.720
Occupation	0.612	0.499	1.506	0.220	1.844
Household size	-0.589	0.226	6.789	0.009*	0.555
House type	0.240	0.240	0.999	0.318	1.271
Main source of income	-0.293	0.309	0.898	0.343	0.746
Household income	0.824	0.324	6.458	0.011*	2.281
Distance from the transformer	-3.167	0.569	31.013	0.000*	0.042

N=150, *Significant at 5% probability level *B*, Parameter estimate;
SE, Standard error. -2log likelihood is 77.37; Chi square statistic is 92.432*;
Overall correct prediction is 88.7.

This implies that households with household heads with higher levels of education are likely to be electricity adopters. These results points out that the higher the level of education the higher the likelihood of electricity adoption. With formal education households have a better understanding of the importance of electricity in their households. This study concurs with findings by Olufemi *et al.* (2012) who stated that electricity adoption and use are positively associated with higher level of education.

The result indicate that household income was found to be significant at (p=0.011 at <0.05) in electricity adoption. A positive sign of beta (β=0.824) indicates that electricity adoption is positively influenced by the household monthly income. This could be because higher income earners have finances to facilitate electricity connection to the households. This signifies that increase in household income increases the likelihood of adopting electricity. The results agree with those of Heltberg (2003) that low income households are less likely to adopt electricity due to the high initial cost of connecting from the grid which includes the infrastructure, cost (obtaining connection to the grid). According to Mills and Schleich (2010) richer households are less likely to face income or credit constraints for investments in modern energy sources such as electricity. Results are in consensus with findings by Barnes (2007) that initial connection charges still remains a challenge when it comes to electricity adoption among low income earners households. According to Mills and Schleich (2010) richer households are less likely to face income or credit constraints for investments in modern energy sources such as electricity.

Gender was statistically significant p=0.045 with a predicted coefficients of -2.774 indicating a negative relationship that implied that male headed households are likely to be electricity adopters as compared to female counterparts. This result is consistent with a study by that of Dreze and Srinivasan (1997), which found out that more male-headed household had electricity connected to their household compared to the female headed households. A study carried out in South Africa found out that female-headed households were consistently less likely to be connected to the main source of electricity than those headed by males; monitored for a period of eight years (StatsSA, 2010) According to Nishimwe *et al.* (2014) female-headed households appear to be less likely to secure electricity for their homes compared to those headed by males. Dungumaro (2008) revealed that households headed by females are relatively underprivileged in terms of assets and income or are significantly over-represented among the poor.

3.3 Socio-economic benefits of electricity adoption among households

The results revealed that households had been connected to grid electricity for periods ranging from one to ten years. The average was 3.7 years, and a median of four years. Evidently earlier years have presented low connection rate with recent years having a higher number of households getting connected to the electricity. According to the results a cumulative of 87.0% of households connected to grid electricity between 2009 and 2013(Table 4.2). This result can be possibly due to accelerated accessibility to electricity in the last five years where rural electrification saw unprecedented increase in electrifying public facilities and increased connection among households. Prior to 2009 when the rural electrification programme was newly initiated only a few households (9.3%) had access to the grid hence fewer existing connections among households

Table 3.4: Years households had connected to grid electricity

	Years	Frequency	Percentage (%)
	1	8	14.8
	2	10	18.5
	3	7	13
	4	18	33.3
	5	4	7.4
	6	2	3.7
	7	1	1.9
	8	1	1.9
	10	3	5.6
Total	**54**	**54**	**100**

4.1 Electrical appliance ownership

Lighting devices were the dominant devices in all households the electrified households at 100%, and consequently households used electricity for space illumination as the prime use of electricity. The second most owned electric appliances were radios at 96.3% and television sets at 94.4%. Other electric appliances that eased domestic labour included electric iron and refrigerator, whose ownership was at 27.8%, and 9.3% respectively. This concurs with a study by Wamukonya *et al*. (2001) who noted that refrigerator is a luxury item owned by a few especially in rural areas and its ownership which is heavily dependent on households' income. Electric appliances used in increasing productivity in agriculture were not prevalent among the households where only 27.8% owned chaff cutters used in cutting fodder. Majority adopters of the households did not have equipment necessary for agricultural productivity, a paradox for an area that is a highly productive agricultural region.

Table 4.2: Electric appliance ownership

Appliances	Frequency	Percent of Cases
Radio	52	96.3
Television set	51	94.4
Refrigerator	5	9.3
Electric iron	15	27.8
Electric heater	6	11.1
Mobile phone	53	98.1
Computer	2	3.7
Lighting devices	54	100.0
Chaff cutter	15	27.8
Total	**253**	**468.6%**

Source: computed from field survey data, 2013.

Mobile phones were also owned by majority of households at 98.1% indicating ease of charging the mobile phones. This finding differs with the scenario in India where agricultural productive areas had been supplied with appropriate equipment in order to enhance productivity (Badiani, 2011). Electric heater ownership among the households stood at 11.1% and computer ownership at 3.7% as many of the households could not afford to buy or did not use mini-gargets in their homes. Electricity is never in demand for itself, but for the outputs derived from the use of various electric appliances. Once electricity has been produced and distributed hence producing its final output, it is expected that output becomes useful only when consumed by an appliance and produces the derived output. Respondents who owned various electric appliances were asked to state various electricity driven output from the appliances as represented in (Table 4.3).

The findings showed that all connected households owned lighting devices which included fluorescent tubes, incandescent light bulbs and energy saving compact fluorescent light bulbs which were used in lighting spaces. Lighting was the first priority for being connected to the grid electricity. This finding concur with that of Chaurey *et al.* (2004) whose study found out that the initial use of electricity in rural areas is household lighting because electric light is much brighter than that provided by kerosene lamps and the price per unit of light can be hundreds of times cheaper. Apart from indoor illumination about 27.8% of the households used electricity for security lighting at various points in the homestead especially at the main entrance (gate) to the residence.

Table 4.3: Direct Electricity Benefits Driven from Appliances used in households

Appliances	Use	Frequency	Percent %
Radio[1]	Access to information	48	88.9
Radio[2]	Entertainment	4	7.4
Television[1]	Entertainment	44	81.5
Television[2]	Access to information	43	79.6
Refrigerator	Preservation of food and beverages	5	9.3
Electric iron	Convenience	15	27.8
Mobile phone benefit	Improved communication	53	98.1
Computer	Access to information	2	3.7
Lighting device [1]	Improved lighting of spaces	54	100
Lighting device [2]	Improved security	15	27.8
Chaff cutter	Increased productivity	15	27.8

[1]first priority use [2]second priority use

About 96.3% of the adopters owned radios and the majority (88.9%) mainly used them in accessing information. This can be explained by reasons such as radios are cheaper to purchase, the availability of local stations that broadcast in vernacular languages; availability of local news and educational programmes especially for farmers. Moreover 7.4% mainly used radios for entertainment purposes, listening to entertainment programs such as music jams storytelling and audio dramas.

Mobile phones were owned by 98.1% of adopters who reported that with electricity it became more convenient for them to use the device. This improved communication in their households with family member in distant places, money transfers, social media and internet. Availability of power for charging the cell phones had made it very convenient to households. Television sets were also a common electric appliance among households whose major output was for entertainment as reported by 81.5% of households and access to information at 79.6%. This finding is almost similar to a study by Barnes *et al.* (2005) that the next most common use of electricity is television and on average, close to half of all electrified homes in rural India have a television and use it for entertainment. It was noteworthy that prices of television sets have fallen thus making them available to many households.

quantities of spoiled food. Computers were used by only 3.7% of the households who mainly used it to access information. Chaff cutter agricultural equipment was owned by 27.8% of the households and was reported to having increased agricultural productivity among the users. Chaff cutters were used by farmers especially those who kept livestock and majority who practiced zero grazing. Electric iron use was reported to be at 27.8% of the respondents and was used as a convenient device for ironing clothes although, ironing clothes was not regarded as a priority and the majority did not use it frequent

Several other electrical appliances were owned by a smaller proportion of households, in particular, the refrigerator, that households used by only 9.3% in preservation of food and beverages. Residents with refrigerators reported that they did not have to worry about wasting perishable food though at times long periods of unplanned power outages resulted in large

The study sought to establish the benefits that households connected to electricity gained from the use of electricity with a focus on home business opportunities and general appreciation of the quality of life. According to the findings, only 18.0% (27) of the respondents run a business from the home. Out of this small number 77.8% (21) were adopters and 22.2% (6) were non- adopters. Findings revealed that 61.1% of households did not carry out any business requiring electricity, whereas 14.8% had at least one business activity at home. Amongst those that declared having a business activity, 38.1% confirmed only one small business activity; 42.9% reported having two business activities and 19% reported having three businesses. This concurs with finding by Maleko (2005) that with availability of electricity there is diversification of business activities within the same household. Multiple studies have shown that microenterprise development is stimulated by electrification, even though other elements (such as availability of microfinance and organized local markets) are necessary to ensure that the RE has the desired impact (Kooijman *et al.*, 2010; Bose *et al.*, 2013; Maleko, 2005).

Household members were involved in several conventional small businesses that used electricity which included mobile phone charging at 44.74% as the most prevalent. Mobile phone charging was especially for those households that had not been connected with electricity and household members charged Kshs. 20. Other home businesses done were hair dressing and barber shops at 10.53%, and general shop business at 34.21% selling electronics, food and hardware (Figure 3.1).

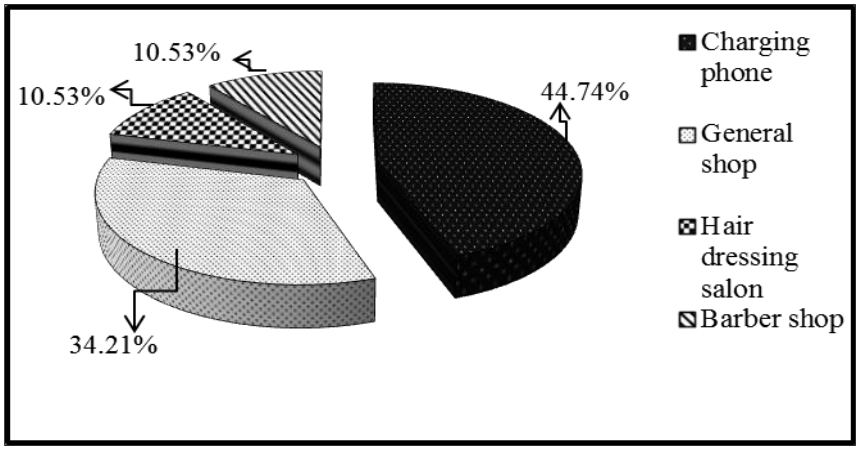

Figure 3.1: Distribution of business activities in households

Rural electrification was beyond comfort and convenience as home-based businesses provided income for the households. The households were asked to state average income on a monthly basis from the small businesses carried out. Households with salon business reported an average monthly total income of Kshs. 6,000. The barber businesses reported a mean monthly income of Kshs. 5,250, mobile phone charging with a mean monthly income of Kshs. 8,500, while general shop business reported a monthly income of Kshs. 14,769, hence having the highest mean monthly income among all small businesses conducted by households.

The study sought to understand the utilization of income from the small business activities by listing their expenditure lines. Based on results three precedence expenditure items were noted; paying school fees for the children was the primary expenditure item at 86%, as indication that children education is an important aspect of these households. Paying electricity bills was reported by 19%. As people, who depended wholly on electricity services paying electricity bill meant ensuring the sustainability of the small business and consequently the continuous improvement of the welfare of the family. Domestic use was at 38% which included purchasing electrical appliances transport costs, household furniture, health matters and leisure for all the family members.

4 CONCLUSION AND IMPLICATIONS

This study was undertaken to unveil the socio economics dynamics of rural electrification adoption in rural areas. Several useful conclusions that provide insight on pathways to increase the electricity adoption in Meru South emerge from this research. First, the results from this paper indicate that the RE project should incorporate consideration of household head income, educational attainment, gender, household size, income and distance from the transformer. Many of the earlier efforts to increase electricity accessibility and adoption are not based on any viable institutional frameworks. The lesson from this paper is that non-consideration of household socioeconomic aspects can lead to inappropriate planning for rural electrification in rural areas. Second, rural electrification planning process should involve assessment of the potential for productive uses of electricity for households and social services and include measures for their promotion. In addition, it has been suggested that there is need for policy support to enable households adopt electricity and make productive use of it.

REFERENCES

Badiani, R. and Jessoe, K.K. 2011. Electricity subsidies for agriculture: Evaluating the impact and persistence of these subsidies in India DRAFT.

Barnes, D. 2005. Transformative Power: Meeting the Challenge of Rural Electrification. ESMAP Knowledge Exchange Series No. 2. The World Bank. Washington, DC.

Bose, T. K., Uddin, M.R. and Mondal, A. 2013. Impacts of Electricity Access to Rural SMEs. International Journal of Managing Value and Supply Chains, 44.

Chaurey, A., Ranganathan, M. and Mohanty, P. 2004. Electricity access for geographically disadvantaged rural communities—technology and policy insights. Energy policy, 321(5):1693-1705.

Dungumaro, E.W. 2008. Gender differentials in household structure and socioeconomic characteristics in South Africa. Journal of Comparative Family Studies, 394:429-451.

Dreze, J. and P.V. Srinivasan 1997. Widowhood and Poverty in Rural India: Some Inferences from Household Survey Data. Journal of Development Economics, 542:217-234.

GoK, Government of Kenya, 2014. Economic Survey 2013, Government of Kenya, Nairobi.

Hilbe, J.M. 2009. Logistic regression models. Boca Raton: CRC Press.

International Energy Agency. 2010. Electricity Access in 2009 Regional Aggregates. Retrieved from IEA: http://www.iea.org/weo/electricity.asp. Accessed 14July 2013.

International Energy Agency. 2012. World Energy Outlook 2012 – Measuring progress towards energy for all: power to the people, International Energy Agency,

Jaetzold, R., Schmidt, H., Hornet, Z. and Shisanya, C. 2006. Farm management handbook of Kenya. Natural Conditions and Farm Information, Vol. 11/C, 2nd edn. Ministry of Agric./GTZ, Nairobi, Eastern Province.

Khandker, S.R., Barnes, D.F., Minh, N.H. and Samad, H. 2009. Welfare impacts of rural electrification: Evidence from Vietnam. World Bank.

Kooijman-van Dijk, A.L. and Clancy, J. 2010. Impacts of electricity access to rural enterprises in Bolivia, Tanzania and Vietnam. Energy for Sustainable Development, 141:14-21.

Maleko, G.C. 2005. Impact of electricity services on microenterprise in rural areas in Tanzania. M.A Thesis: University of Twente, Enschede

Mvondo, J.M. 2010. Impact of access to free basic electricity on household's poverty in Buffalo City Municipality in the Eastern Cape Doctoral dissertation, University of Fort Hare.

Nishimwe-N., R., Sekhampu, T.J. and Paul-Francois, M. 2014. A Gender Comparison of Access to Basic Necessities in a South African Township: Application of the Lived Poverty Index. Mediterranean. Journal of Social Sciences, 58:94.

Ogunleye, A.I., Desalu, O.O., Ojo, O.O., Ariyibi, E.K. and Kolawole, T.F. 2012. A community survey of the pattern and determinants of household sources of energy for cooking in rural and urban south western, Nigeria. Pan African Medical Journal, 121.

Peng, C.Y. J., Lee, K.L. and Ingersoll, G.M. 2002. An introduction to logistic regression analysis and reporting. Journal of Educational Research, 961:3-14.

Rural Electrification Authority. 2013. Retrieved on 22 February 2013 from http://www.rea.com/.

Sidibe´ , M. 2005. Farm-level adoption of soil and water conservation techniques in northern Burkina Faso. Agricultural Water Management 71:211–224.

StatSA. 2010. Social profile of South Africa, 2002–2009. Pretoria: Government Printer.

Wamukonya, N. and Davis, M. 2001. Socio-economic impacts of rural electrification in Namibia: Comparisons between grid, solar and un-electrified households. Energy for Sustainable Development, 53:5-13.

World Bank. 2010.Trading Economics: Access to electricity in Kenya. WB Aid for Energy Sector.