FACTORS THAT INFLUENCE THE ACCESS AND COST OF VARIOUS ENERGY OPTIONS IN THE INFORMAL SETTLEMENTS OF KISUMU COUNTY, KENYA.

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STUDENT NAME: OJWANG ATIENO CONCEPTA

REGISTRATION NUMBER: 220000141

A DISSERTATION SUBMITTED TO AFRICA CENTER OF EXCELLENCE IN ENERGY FOR SUSTAINABLE DEVELOPMENT COLLEGE OF SCIENCE AND TECHNOLOGY UNIVERSITY OF RWANDA IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTERS IN ENERGY ECONOMICS.

Supervisor's name: Dr. JOHNSON BOSCO RUKUNDO

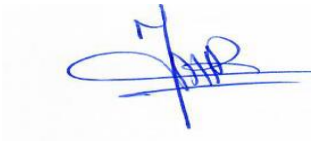
Month and year of submission: NOVEMBER 2021

DECLARATION.

I, CONCEPTA ATIENO OJWANG, hereby declare that the work presented in this dissertation is my original work, and has not been presented for a degree in University of Rwanda or any other University. All sources of materials that will be used for the dissertation work will have been fully acknowledged.

Signature: Date: 16TH NOVEMBER 2021.

Supervisor: Dr. JOHNSON BOSCO RUKUNDO

Signature: 

Date:19th -November 2021

DEDICATION

I dedicate to my daughter ALORA OWAGA for giving me easy time when I left her behind to go for studies and to all my family members who have stood by my side throughout my studies.

ACKNOWLEDGEMENT.

First of all, I want to thank the Almighty God for the grace and strength to complete my studies.

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ABSTRACT.

Accessibility to energy is one of the major economic drivers in every economy. Many households in informal settlements in Kisumu County rely on non-clean energy sources despite many efforts to promote modern fuel technologies. This research demonstrates choice of cooking and lighting fuel in the informal settlement of Kisumu county. The major choices considered are charcoal, firewood, liquefied petroleum gas, electricity, tin lamp and biogas. Using the data collected by Kenya National Bureau of Statistics for census 2019 we concentrate on Seme constituency with approximately 22506 households, the study identifies key driving forces for energy choices in the informal settlements in the county. The findings of the research study shows that home appliances, household size, gender of the household head, education of the household head, age of the household head and the years of working experience the household head has play key role in explaining why different households would settle for different cooking and lighting energy options. In addition, the results clearly show that it is not that the informal settlements of Kisumu county do not have knowledge about clean energy but some socio-economic factors deter them from depending on the clean energy sources for both cooking and lighting. Conclusions and recommendations were drawn from the results based on the objectives of the research. The findings shows that greater percentage of households in the informal settlements settle on non-clean energy options while cooking or lighting and major reason being the household head being aged, the household head being female and the household having many siblings. The years of working experience the household head has is actually found not to affect so much, the choice of the type of energy used.

Keywords: Energy options, Informal settlements, Kisumu county.

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ABBREVIATIONS

UR: University of Rwanda.

CST: College of Science and Technology.

ACEESD: Africa Center of Excellence in Energy for Sustainable Development.

KNBS: Kenya National Bureau of Statistics.

PV: Photo Voltaic

GW: Giga watt

WHO: World Health Organization.

GHG: Green House Gas

SDG: Sustainable Development Goal

KWH: Kilo Watt Hour

KES: Kenya Shilling

OLS: Ordinary Least Square.

LPG: Liquefied Petroleum Gas.

KPLC: Kenya Power and Lighting Company.

FIGURES.

TABLES.

CHAPTER ONE: GENERAL INTRODUCTION.

1.1. **Background**

The availability and accessibility of energy in any country has a strong relationship with its economic and social stability. In developing countries, a bigger percentage still lack electricity. The International Energy agency estimates that 1.6 billion people across the world have no access to electricity [1] and fewer than 10% of rural households have access to electricity. Energy access today in Africa is 700 terawatt-hours [1].According to [2], most of these unelectrified households are found in the informal settlements. Africa has the richest solar resources in the world but has only installed 5 gigawatts of solar photovoltaic which actually if its measured, it is just 1% of the global installed capacity and this is according to [1].With the exception of South Africa, grid electricity in Africa is almost non-existing [2].There are various energy options available in the market today [3] but the main challenges being accessibility and the cost. The accessibility of renewable option at affordable prices would actually, not only reduce women workload but also create opportunities that would lead to economic growth as well as making them economically independent.

Most of the households in the developing countries still find traditional biomass fuels as better option for cooking and heating. This traditional biogas have negative impacts to the environment, affect climate change through the emissions of greenhouse gasses and forest degradation and causing chronic diseases to human beings. According to World Health Organization, up to 15 million people die each 2 years from acute respiratory infections as a result of pollution. Global GHG emissions has continued to grow for the third consecutive year in 2019, reaching to a high record of 52.4GICO2e [4].Though in 2020 there seemed to be a reduction in the GHG emissions but this was because of covid-19 pandemic where bigger changes were noted in transport industry when covid-19 restrictions were targeted to hinder mobility but this was still not sufficient, negative environmental impacts continued to grow in other sectors like residential.

In Kenya, energy accessibility and usability is linked to the welfare of the people. Most poor people tend to make energy choices that is related to their income levels. Poverty levels are directly linked to the type of energy that a household will use [5]. The socio-economic and environmental impacts encountered within Kisumu county informal settlements that depend on various energy options are well presented. In Kenya, the pie chart below shows the energy consumption of the whole country:

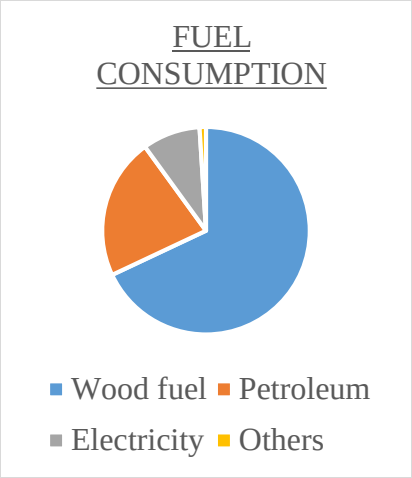

Figure 1: Fuel consumption in Kenya.

Source: Kenya National Bureau of Statistics [6]

Electricity consumption in Kenya is extremely low at 121 Kilowatt-hour per capita and national access rate at about 15%which is below the average of 32% for developing economies. The most consumed fuel at household level is wood fuel as shown above. In Kisumu county, there is a population of 1,144,777 with 300,745 households with an average household size of 3.8 according to [6].

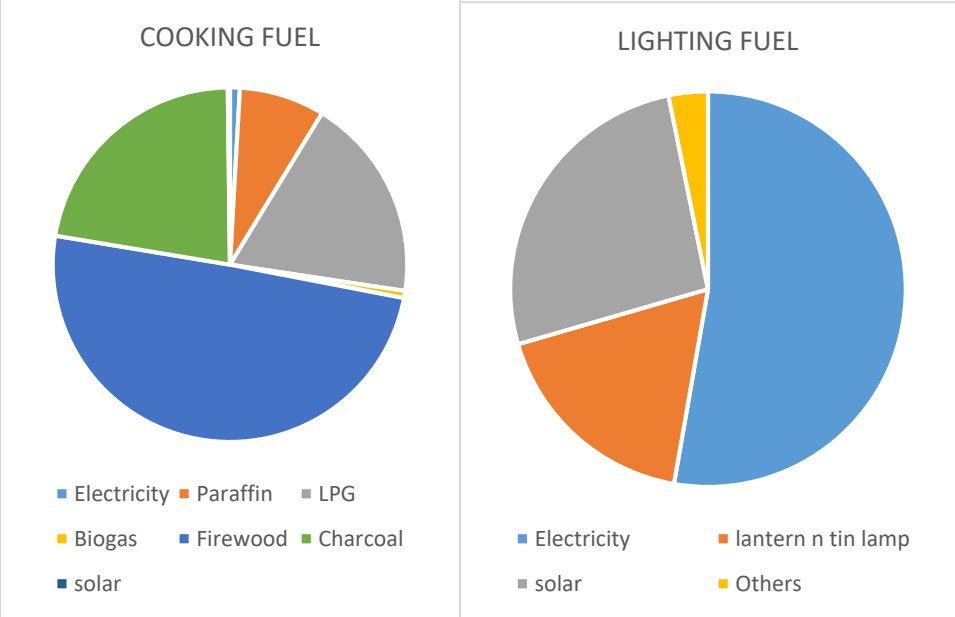

Figure 2: cooking and lighting fuel in Kisumu county

Source: Kenya National Bureau of Statistics [6]

From figure 2 above, it clearly shows that majority of households in Kisumu county rely on non-clean energy for cooking and still not all households depend on clean energy for lighting hence the need to carry out this study on the factors that have led to the choice of opting for non-clean energy and what is the cost of the said clean energy. Kisumu County is also trying to work with the national government to ensure the goal is attained on the Sustainable Development Goals 1 and 7 according to United Nation Development Programme which is poverty eradication and access to clean energy respectively. In the research study [7], on lighting and cooking fuel choices of households in Kisumu County, energy poverty was the major determinant of energy choice. The study focuses on analyzing the factors that makes access of clean energy be possible and what determines the cost of energy chosen.

1.2. **Statement of the problem.**

Conservation of the environment is key in the economy since the forests has essential role it plays in the environment such as acting as water catchment areas, habitat for various animals among others. According to [6], a third of Kenya households still use non-clean sources of energy both for cooking and lighting. The access to electricity from main grid is much lower in rural areas where only 4% have grid connection [8].Many of the rural households use traditional stoves which are not energy efficient leading to more forest destruction, increased indoor air pollution from GHG emissions [9] and also putting a lot of pressure to the biomass sources [7].This research study investigates the reason why informal settlements of Kisumu county still rely so much on the traditional fuels. This research also tries to answer the question why different households will choose specific type of fuel, its cost and why not settle on clean energy. It further gives recommendation that could be implemented to ensure there is zero emission of GHG from the non-clean energy sources.

1.3. **Objectives**

The main purpose for this study is to find out what determines access to various energy sources for households and the cost implications in informal settlements of Kisumu county in Kenya.

1.3.1. **Specific objectives**

The study is guided by the following objectives:

i. To find out the various energy sources used in informal settlements in Kisumu.

ii. To determine the cost of energy options available in the informal settlements.

iii. To assess the factors that influence household choice of energy options.

The rest of the research study is organized as follows: chapter 2 presents reviews of the various literature on the modern cooking and lighting fuels, chapter 3 explains the methods used in carrying out the study, chapter 4 shows the findings while chapter 5 presents the conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW.

A lot of studies have been carried out in different parts of the world since ancient days about the choices households make for settling on certain type of cooking and lighting fuel. This chapter will review the available literature findings from the empirical studies to enable this study be placed in the right context of other past researchers both in Kenya and the rest of the world.

The world rely on fossil fuel to meet its energy requirements [3] . Fossils fuels example, gas, oil and coal provide close to 80% of the world energy demand [3]. Fossil fuel and nuclear energy have a lot of negative impacts on the environment which tend to threaten human health and quality of life and also the ecological balance. In the study [3], the Pakistan's primary energy supply mix mainly consisted of fossil fuel which was contributing to more than 60% of the total energy supply and this was found to be very risky. Because of the effects of fossil fuels, renewable energy was introduced as an option. According to [10], the Danish Energy Agency was trying to convert the energy system then to be 100%renwable.The major source of energy then was wind power which was insufficient to meet the demand of energy in Denmark. Renewable energy sources have the potential to provide energy services with almost zero emissions of both air pollutants and greenhouse gases. This made a great turn for the nation and various renewable energy options got explored. Increasing energy cost has been having an adverse impact on the economic conditions of the country at micro and macro levels. The high cost of electricity really affected the income at their disposal lowering their living standards and forcing them to exploit other options. Most of the options exploited were non-clean sources.

In [11], population growth and the growth of living standards draws the conclusion that the consumption of goods and energy is rising leading to increase in generation of waste. In Europe, it was discovered that the average heating value of municipal solid waste was at 10 mega joules per kilogram hence they found it logical to convert this waste into energy. The burning of the municipal solid waste was having a negative impact to the environment as a lot of gas was released into the atmosphere.Oxy-fuel combustion technology was introduced in burning of wastes as a way of reducing the carbon dioxide emission to the environment. Since some part of the carbon in the municipal solid waste is biogenic, there is still some carbon dioxide emitted in the environment [12].Converting these wastes into energy solved part of the challenges in energy deficit in Europe and also helped save the environment from emission of these poisonous gases. The low cost of

collecting these municipal solid wastes that were being deposited all over made it affordable for the households to get clean energy.

In the study of [13], when you talk about shortage of cooking fuels, that is, shortage of firewood to be precise, you are basically referring to the informal settlements. The lives of women in the informal settlements also are linked to the kind of energy they use. Most women were using firewood, cow dung and crop residue which is very harmful to their health. Their lives were reduced to spending more time in covering long distances to fetch firewood. This time could have been used to engage themselves in activities that would lift their living standards. The quality of these fuel was low, accessibility was easy, and it was really affordable but not efficient for cooking. Many other options were investigated to compare their feasibility in India. The only difficulty that was being experienced was getting the data. Though the researchers realized that other factors other than cost and accessibility affected their choice of energy. This factor was cultural preference. Most of the communities in India did not consider using cow dung to produce biogas for cooking. The Advisory Board of Energy (ABE) tried to find a suitable energy mix so as to curb the scarcity of energy and also improve the lives of women.

Kenya vision 2030 is the national development blueprint, initiated to transform the country into a newly industrializing, middle-income economy by the year 2030 [14].It was noted that about 90% of the global energy supply comes from fuels that are carbon-based. These are the fuels that have negative impact to the environment causing climate change that is being faced today in many countries across the world. In Kenya today, a lot of attention has been shifted towards renewables. Though these renewable energy projects have been found to be capital intensive, the government of Kenya has gotten into partnership with the government of other developed countries for loans, grants and donations to support this initiative. For this growth of renewables to be actualized, it has been advised to begin at the household level before being industrialized with the local available resources. In [5], Kenya has a lot of potential for renewable resources and so civic education on the importance of shifting to renewables using the locally available resources was initiated. Due to the excessive loggings, the government tend to promote kerosene and LPG as an alternative source of fuels to improve the quality of energy used in households and also to reduce the over reliance on wood as it is done in Nigeria [15]. The government has in many occasions banned the production of fuel but this has been unsuccessful since the demand for charcoal is too high leading to illegal production hence the government decided to license its production to encourage

commercial production in a sustainable manner [5].For cooking, kerosene, biomass and LPG are the key energy options in most rural parts of Kenya. Even though most households would go for different options because of some factors as effectiveness in cooking a meal fast or efficiently. Other option preferred in the informal settlements is charcoal being that it is affordable, easily accessible, and easy to use and at least clean compared to the commonly used firewood. Most of these informal households do not consider the carbon monoxide that is emitted by the charcoal which causes suffocation.

In Kisumu County, many households are facing higher levels of energy poverty. This is so according to the household level; census that was carried out by KNBS in 2019 where many households were found to be using more of traditional fuels for both cooking and lighting [7].The major determinants of energy choice in the informal settlements in Kisumu county were affordability and availability. The number of people relying on traditional biomass for cooking is on the rise in Kisumu. Very few houses in Kisumu have access to electricity and this has deprived them the opportunity of also acquiring other household appliances like refrigerators and limit their communication. The county government of Kisumu has encouraged the use of improved cooking stoves to replace the traditional three stones which emits a lot of smoke affecting the health of the people [7].According to the report [16], the objective of the energy sector in the county government of Kisumu is to enhance a 24hour economy driven by industrialization powered by clean energy to drive economic growth and development. The county government distributed 280 ethanol jikos as a pilot in the households so as to show the people in the community that there are other options that needs to be exploited.

In [17] the researchers came out with different reasons as to why households settle on different coking and lighting options. Some other factors which determines the type of energy choices are the income of the household head, age of the household head, education level of the household head and the years of experience of the household head. Children and women are mostly responsible for firewood collection and this also negatively affects the schooling of these children. [17].

CHAPTER THREE: METHODOLOGY

3.1. **Conceptual framework**

A household choice of energy for either cooking or lighting is determined by economic and non-economic factors. The inability of households in the informal settlements to meet its energy needs, has been overlooked [18].The energy insecurity is majorly due to lack of knowledge from the households on the environmental impacts of the said energy choice. Cooking fuels can be commercial like kerosene, LPG and electricity or non-commercial like firewood but still they are scarce [13].The cooking and lighting fuels to be used can be determined by the household size, education level, gender of the household head, age of the household head, general poverty, religion of the population and the number of educated people in the household [7].

3.2. **Data and Variable Description.**

The dataset used is survey data obtained from Kenya National Bureau of Statistics through a census, which is carried out after every decade. The study is largely oriented to the informal settlements of Kisumu county which will actually represent informal settlements in the whole county. The variables in the dataset used in this study are described as follows .First of all, in Kenya, the demand for energy is higher than the supply and this is seen by the rising trend of prices of electricity per Kilowatt hour .The amount of electricity generated is less than the amount of energy demanded. Since there is energy scarcity and also the fact that many households are constrained by their budget, there is need to choose the best and affordable energy to use.

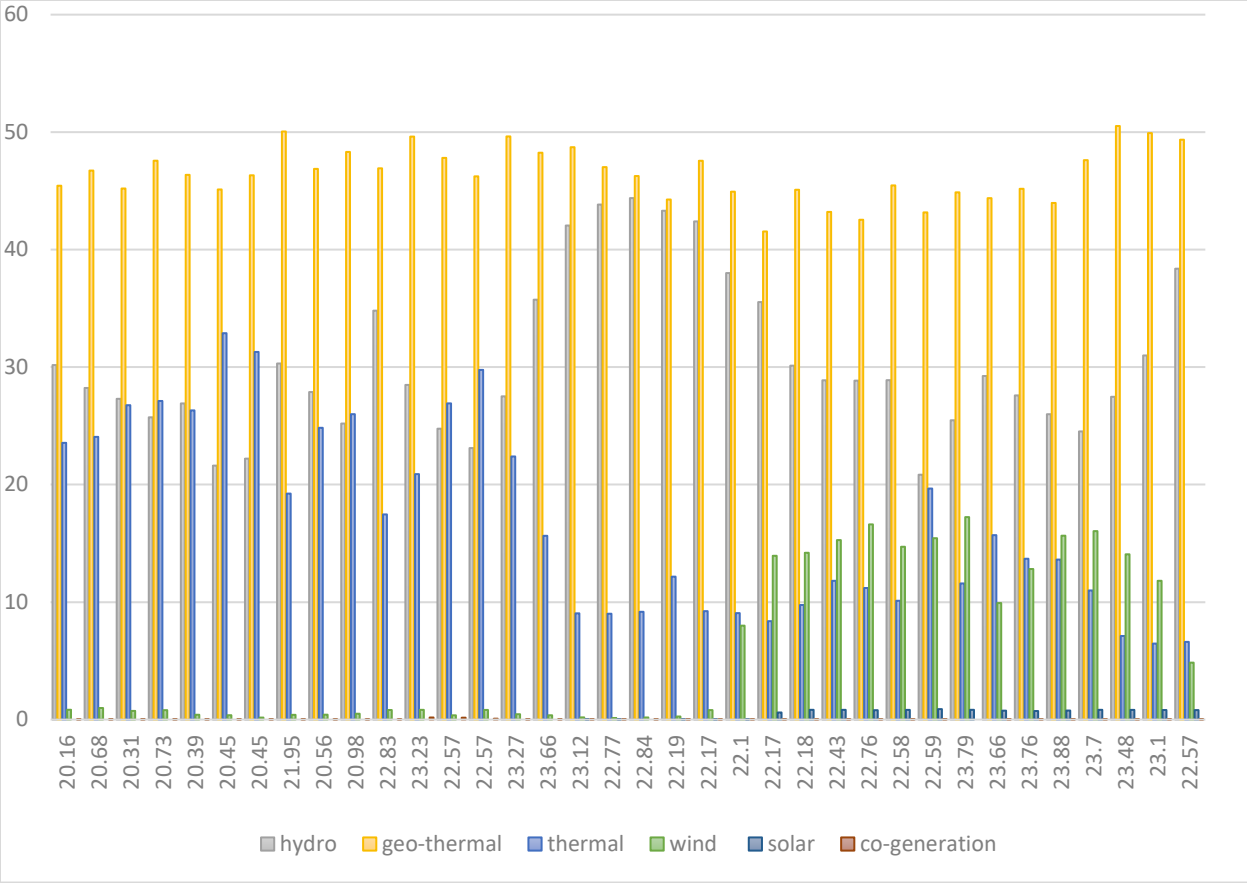

Figure 3: Energy generation and prices per Kwh from 2017-2019.

Source: KNBS leading economic indicators 2017, 2018 and 2019.

The above figure shows the ever increasing cost of electricity which tend to make households settle for non-clean energy. Kenya generates most of its electricity from geothermal as above but still many households depend on non-clean sources of energy. The World Energy Council expects the world primary energy consumption of geothermal to have grown by 50-275% in 2050 depending on different scenarios. Kenya has installed more than 600 megawatts of geothermal power [1].The use of solar via photovoltaic system places no immediate material burden on the environment. Hydropower is the largest renewable source of electricity generation in the world. Wind power in Kenya is also increasing and this has been achieved through the government partnership with the independent power producers. From figure 3, it is observed that the price of electricity has been fluctuating with a small margin and with an increasing trend from 2017 to 2019 with the average being 22.50 Kenya shillings per kilowatt hour.

3.3. **Model**

In this research study, ordinary least square model is used to analyze the data. Ols is used to show the probability of households using clean fuels for cooking and lighting. In this case, we compare households using electricity for cooking and those using firewood for cooking and we also compare households using electricity for lighting and those using tin lamp for lighting.

Let FT be the household fuel choice outcome (choices of fuel for cooking and lighting) CF be the cost the household pays for both cooking and lighting in a given year in Kenya shillings. If cost of fuels for lighting and cooking was stable, we could derive the cost of fuel on household choice by estimating (β_1). The ordinary least square model shown in this study is shown in equation (i) below:

$$FT = \alpha + \beta_1 CF + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(I)}$$

There are some unobserved variables that can influence the choice of fuels a household can use making (**$\beta_{1)\,OLS}$** biased. To deal with such unobserved variables, we introduce controls; Individual controls (**IC**), and household characteristics **HC** and estimate equation (ii)

$$FT = \alpha + \beta_1 CF + IC + HC + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

Where **FT** is the choices of fuel for cooking and lighting. Apart from it explaining the amount of energy consumed by households, it also explains the types of fuel, electricity and firewood, used by household for cooking and electricity and tin lamp, used for lighting. **CF** Is the fuel cost incurred by an household in a year Kenya shillings, **HC** is a set of household controls which includes; includes total number of family members living together under one roof while **IC** are individual controls which includes; gender of the head of the household, age of the household head and years of working of the household head

The constant **β**'s are parameters of the econometric model and they describe the directions and strength of relationship between the variables and **ε** is the error term containing all the unobserved factors that could affect the choices households make on fuel to use for cooking or lighting.

By setting the regression identification conditioning all controls, the regression analysis will be unbiased and does not affect outcome.

CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents the findings and discusses the results of the study. The discussions are a result of the regressions carried out for each type of fuel used in Kisumu. The major variables discussed in this chapter are well presented in tables and graphs.

4.1 **Descriptive analysis.**

Figure 2 below shows that only a population of 20.4% uses clean energy (electricity, LPG, biogas and solar) for cooking and the remaining 79.6% use non-clean energy (firewood, charcoal and paraffin) for cooking. It clearly shows that many households still do not consider getting clean sources of energy because of some reasons as it is discussed here in. Firewood and charcoal are found to dominate among the population of the rural settlements in Kisumu county since they are considered affordable and easily accessible. The rate at which households rely on firewood is too alarming at 49.6%.this percentage shows a significant air pollution contribution to the environment. Since cooking activities takes place in the indoor environment (kitchen), there is a very high risk of respiratory problems caused by indoor air pollution. The smoke from the firewood causes not only respiratory problems but also low birth rate, cancer, eye infection and chronic obstructive pulmonary disease. This type of fuel combustion causes emissions of harmful gases like carbon monoxide which causes suffocation, sulfuric gas and nitrogen gas which blocks the ozone layer causing acid rain and global warming [19]. The use of firewood for cooking should be discouraged since it has low efficiency and high energy intensity apart from the pollution.

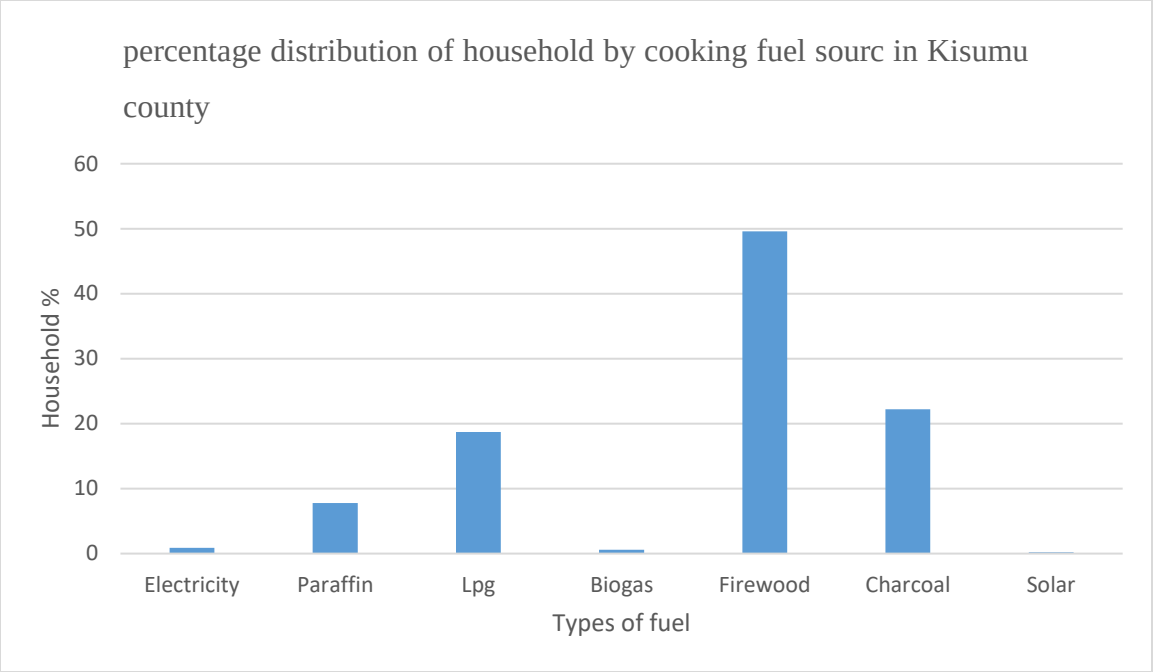

Figure 4: Percentage distribution of household by cooking fuel source in Kisumu county

Source: Kisumu county data

Table 1: Descriptive statistics of explanatory variables for cooking and lighting.

	Mean	Standard Deviation	Minimum	Maximum
Gender of the household head	0.53	0.50	0	1
Age of the household head	30.7	19.5	14	96
number of siblings in the household	4.40	2.57	1	12
Households using electricity for cooking	0.00097	0.031	0	1
Households using firewood for cooking	0.91	0.28	0	1
number of education years of the household head	5.16	3.80	0	12
Years of working experience of the household head.	12.2	9.60	0	515
Amount of money spent monthly on firewood for cooking	416.8	110.3	0	630
Amount of money spent monthly on electricity for cooking	1.85	64.0	0	3320

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Source: Author computed using KNBS census 2019 data.

The table 1 shows the descriptive statistics of the variables used in my study. The studies shows that 53% of the households are headed by women and have influence of the choice of the fuel a family uses. It is observed that the average number of family members is 4 persons per household with the smallest family having 1 person while the largest family having 12 members. It is also noted that most of the household head are averagely aged 31years with maximum being 96 years while minimum being 14 years . This may result into resourceful age getting respiratory diseases as majority are still young. Averagely, the household head has 12 years of working experience and 0.097% of households use electricity for cooking while 91% use firewood for cooking. Firewood is the least expensive type of fuel for cooking in Kenya and also readily available that is why its consumption is high. From many researchers, this has been found to be very dangerous both to the family members and the environment. It was observed that the rate at which households in the informal settlements in Kisumu is increasing and the county government is ensuring there is introduction of improved wood stoves to kick out the open air burning of fuel wood. The household head are averagely found to have 5 years of schooling.

Table 2: Cost of the major sources of energy used in Kisumu county.

VARIABLES	(1) Electricity cost	(2) Firewood cost	T For electricity	P>|t| For electricity	T For firewood	P>|t| For firewood
Gender	0.099	1.193	0.314	0.754	0.870	0.384
	(0.316)	(1.371)				
Household head age	0.003	0.027	0.368	0.713	0.743	0.457
	(0.008)	(0.037)				
Household members	0.011	-0.319	0.182	0.855	-1.198	0.231
	(0.061)	(0.279)				
Electricity used for cooking	1,908.607***	-187.397	371.522	0.000	-8.409	0.000
	(5.075)	(23.108)				
Firewood used for cooking	-0.009	40.365***	-0.016	0.987	15.705	0.000
	(0.568)	(2.588)				
Years of schooling of the household head	0.031	-0.111	0.758	0.449	-0.618	0.538
	(0.042)	(0.189)				
Working experience of the household head	0.001	-0.099	0.084	0.933	-1.351	0.177
	(0.017)	(0.077)				
Constant	-0.365	388.483***	-0.500	0.617	122.239	0.000
	(0.713)	(3.178)				
Observations	22,506	22,505				
R-squared	0.864	0.134				

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Author computed using KNBS census 2019 data.

From the results of the regression above on electricity cost, the R-squared is 0.864 which implies that the about 86.4% of variance in electricity cost is explained by the model with Gender, household head age, household members, years of schooling of the household head, households using electricity for cooking, and households using firewood for cooking as the predictors.

The p-values of the T-statistics was used to find whether a predictor significantly predicts the response variable or not. If the p-value of the test statistic is less than 0.05 level of significance, the predictor significantly explains the response. In this case where electricity cost is response (dependent) variable, only Electricity for cooking p_value is 0.000 which is less than 0.050 level of significance, thus households using electricity for cooking significantly explains the electricity cost. Households that use electricity for cooking are likely to spend 1908 KES more on electricity and reduce the spending on firewood by 187 KES.

From the results of the firewood cost above, the R-squared is 0.134 which implies that the about 13.4% of variance in wood cost is explained by the model with Gender, household head age, household members, years of schooling of the household head, working experience of the household head, households using electricity for cooking, and households using firewood for cooking as the predictors.In this case where firewood cost is response (dependent) variable, only households using electricity for cooking and households using firewood for cooking have p_values less than or equal to 0.05 level of significance, thus households using electricity for cooking and households using firewood for cooking significantly explains the firewood cost where households using firewood for cooking are willing to spend more on firewood by 40.37 KES while those using electricity for cooking are willing to spend less on firewood by 0.01 KES.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION.

5.1. **Conclusion**

In conclusion, we get to understand the socio-economic factors, that leads to a great percentage of households in the informal settlements of Kisumu county, depending on non-clean types of fuel for cooking at 79.6% and why some households still use non clean fuel for lighting too at 81.6%.Three conclusions are drawn. First, the research shows clearly the major sources of energy that informal settlements of Kisumu County depend on for cooking and lighting. Many households depend on firewood for cooking at 91%.It is only a handful number of households that use clean sources of energy electricity at 0.97%.For lighting purpose, 3.1% use electricity while 77% use tin lamp and the remaining percentage use other sources which are also non-clean. From the data, the over reliance on firewood for cooking is because it is readily available and affordable. This is very dangerous because of the forest distraction, air pollution and destroying of water catchment areas because of wood burning.

Secondly, the cost of electricity is high compared to firewood which is most preferred. In a month, an average household spends approximately, 1850 Kenya shillings on electricity [20] and firewood at KES 630 for cooking,

Lastly, the socio-economic factors that leads to over dependency on non-clean sources of fuel for cooking and why the whole community is not lit up are: - the household age the more the age increases the more they move to clean energy, working experience of the household head which is a minor factor, the gender of the household head where households having female as there head rely on non-clean fuel and the size of the family where large families cannot afford clean energy.

Kisumu county needs to put in place strategies as recommended below to curb these negative situations,

5.2. **Recommendation.**

Several observations were made during the study and the following are the recommendations:

-The study shows that there are some few households among the many which depend on clean energy. This shows that the households are aware of health effects of using non-clean energy or they are well off and can afford the cost of using clean energy. The study recommends the government to offer civic education to the informal settlements of Kisumu County so that they can be aware of the health and environmental impacts of using non clean energy and hence mobilize the use of modern fuels for cooking and lighting even through the national media.

-In collaboration with financial institutions and institutions supporting humanity, the government should subsidize the cost of modern types of fuel so as to encourage the low-income earners who are mostly found in the rural areas to afford it and also offer low interest loans for private investors to provide solar or come up with biogas projects.

-The energy centers for research and development together with Kenya ministry of energy should carry out free trainings, seminars and piloted projects on renewable energy and conservation of the environment to the households in the informal settlements and on practicing activities that will raise their living standards.

-There should be the existence of National Centers for Energy Research and Development which are well funded and evenly distributed across the counties like the geothermal center of excellence to carry out renewable energy awareness campaigns. In this study, most of the household head were found to be less educated.

-Violators of energy policy should be sanctioned and punished to inject fear on those causing deforestation which is ecologically, economically and environmentally unfriendly for the whole nation.

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