FACTORS INFLUENCING THE LEVEL OF USE OF ALTERNATIVE SOURCES OF ENERGY AMONG THE MAASAI PASTORAL COMMUNITY IN KAJIADO WEST, KAJIADO COUNTY KENYA

John Wandere Kanini

A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science in Environment and Natural Resource Management in the Department of Environment and Natural Resource Management and the School of Science and Technology of Africa Nazarene University

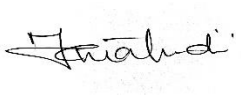
March 2022

DECLARATION

I declare that this document and the research described are my original works and that they have not been presented in any other university for academic work.

John Wandere Kanini

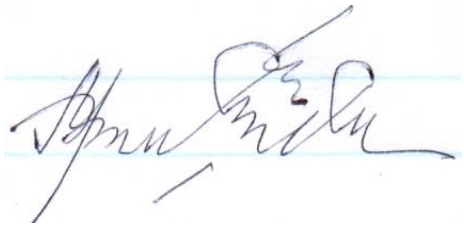
18M01DMEV009



_____

This research was conducted under our supervision and is submitted with our approval as University supervisors.

Dr. Mark Ndunda Mutinda



_____

Dr. Patrick Kisangau Daniel

_____

Africa Nazarene University,

Nairobi, Kenya

DEDICATION

I dedicate this research to my wife Anne Wairimu, My son Ervine Wandere and my daughters Bakhita Thogori, Stephanie Nyambura and Alexis Naisianoi for their understanding, encouragement and patience during my busy work and study schedule. I salute you my lovely family and may God bless you all.

ACKNOWLEDGEMENT

My ultimate acknowledgement goes to Jehovah God for seeing me through the completion of this proposal especially during this period when the COVID-19 pandemic had overtaken numerous activities and disparaged many lives.

I would like to thank my supervisors Dr. Mark Ndunda Mutinda and Dr. Patrick Kisangau Daniel, who have provided superb guidance and have been patient with me throughout the journey of my research. Their constant corrections and insights have made this research and thesis a success.

I would not forget to appreciate my Africa Nazarene University colleagues who hail from various walks of life and have been instrumental in my learning throughout my time of study at the campus.

Finally, I would like to thank and acknowledge my friends and family for being supportive throughout.

TABLE OF CONTENTS

DECLARATION.....**ii**

DEDICATION.....**iii**

ACKNOWLEDGEMENT.....**iv**

TABLE OF CONTENTS.....**v**

LIST OF TABLES.....**x**

LIST OF FIGURES.....**xii**

ABSTRACT.....**xiii**

DEFINITION OF TERMS.....**xiv**

CHAPTER ONE.....**1**

INTRODUCTION.....1

1.1 Introduction.....1

1.2 Background of the Study.....1

1.3 Statement of the Problem.....6

1.4 Purpose of the Study.....8

1.5 Objectives of the Study.....8

1.5.1 Specific Objectives.....8

1.6 Research Questions.....9

1.7 Significance of the Study.....9

1.8 Scope of the Study.....10

1.9 Delimitations of the Study.....11

1.10 Limitations of the Study.....11

1.11 Assumptions.....12

1.12 Theoretical Framework.....12

1.12.1 Technology Acceptance Theory.....12

1.12.2 Stakeholders Theory 14

CHAPTER TWO 18

LITERATURE REVIEW 18

2.1 Introduction 18

2.2. Awareness of Energy Sources 18

2.3 Technology Availability and Maintenance 20

2.4 Affordability of Energy Source 22

2.5 Effectiveness of Energy Source 24

2.6 Summary of Literature Review 26

2.7 Research Gap 28

CHAPTER THREE 29

RESEARCH METHODOLOGY 29

3.1 Introduction 29

3.2 Research Design 29

3.3 Research Site 29

3.4 Target Population 30

3.5 Study Sample 31

3.5.1 Study Sample Size 32

3.5.2 Sampling Procedure 33

3.6 Data Collection Methods 33

3.6.1 Data Collection Instrument 34

3.6.2 Pilot Testing of the Research Instrument 34

3.6.3 Instrument Reliability 34

3.6.4 Instrument Validity 34

3.6.5 Data Collection Procedure 35

3.7 Data Analysis 35

CHAPTER FOUR 38

DATA ANALYSIS AND FINDINGS 38

4.1 Introduction 38

4.2 Response Rate 38

4.3 Characteristics of the Participants 38

4.3.1 Household Leadership 38

4.3.2 Age of Respondents 39

4.3.3 Formal Education Level of the Respondents 40

4.3.4 Household Number 40

4.3.5 Household Livelihood Sources 41

4.4 Energy Sources Used by Maasai Pastoralists 42

4.4.1 Different Sources of Energy Used by Maasai Pastoralists 42

4.4.2 Level of Use of Conventional Energy Sources 44

4.5 Level of Use of Alternative Sources of Energy 45

4.6 Influence of Awareness on the Level of Use of Alternative Sources of Energy 46

4.6.1 Level of Awareness of Alternative Sources of Energy 46

4.6.2: Determination of the Influence of Level of Awareness on the Use of Alternative Sources of Energy 47

4.7 Influence of Technology Availability and Maintenance on the Level of Use of Alternative Sources of Energy 49

4.7.1 Technology Availability for Alternative Energy 49

4.7.2 Influence of Technology Availability on the Level of Use of Alternative Energy 49

4.8 Influence of Affordability of Alternative Energy Sources on their Use by Maasai Pastoral Households 51
4.8.1 Affordability of Alternative Energy Sources 51
4.8.2 Influence of Affordability of alternative Energy Sources on their Use 52
4.9 Influence of Efficiency of Alternative Sources of Energy on the Level of Use 54
4.9.1 Efficiency of Alternative Energy Sources 54
4.9.2 Determining the Influence of Effectiveness of Alternative Energy Sources on the Level of Use by Maasai Pastoral Households 54
CHAPTER FIVE 57
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS 57
5.1 Introduction 57
5.2 Summary of the Study 57
5.3 Discussion 57
5.3.1 Socio-economic Characteristics of Maasai Households 58
5.3.2 Energy Sources Used by the Maasai Households in Kajiado West 59
5.3.3 Influence of Awareness of the Energy Sources on the Level of Use of Alternative Sources of Energy in Kajiado West 62
5.3.4 Influence of Technology Availability on the Level of Use of Alternative Energy Sources in Kajiado West 64
5.3.5 Influence of Affordability of the Alternative Energy Sources on the level of use of the alternative energy by Maasai pastoral Households in Kajiado West .. 65
5.3.6 Influence of Efficiency of Energy Source on the Level of Use of Alternative Sources of Energy by Maasai Pastoral Households in Kajiado West 66
5.4 Conclusions 67

5.5 Recommendations....68

5.6 Recommendations for Further Research....68

REFERENCES....69

APPENDICES....80

Appendix A: Cover Letter....80

Appendix B: Questionnaire....81

Appendix C: Field Photos....88

Appendix D: Approval Letter from ANU....95

Appendix E: NACOSTI Letter....96

LIST OF TABLES

Table 3.1: Proportional Allocation of the Study Samples to the Administrative Wards 33

Table 3.2: Summary of Data Analysis 37

Table 4.2: Gender of the Household Head.....39

Table 4.3: Age of the Respondents 39

Table 4.4: Household Heads' Level of Formal Education 40

Table 4.5: Number of People Living in the Households 41

Table 4.6: Participants Livelihoods Sources (Multiple Response Table).....42

Table 4.7: Percent of Households Using Different Energy Sources.....43

Table 4.8: Level of Use of Different Energy Sources by Maasai Households 44

Table 4.9: Descriptive Statistics and Frequency distribution of the index of Level of Use of Alternative Sources of Energy 45

Table 4.10: Chi-square test for the Equality of Categories for the Index of Level of Use of Alternative Sources of Energy by Maasai Pastoralists.....46

Table 4.11: Level of Awareness of Pastoral Households on Alternative Energy.....47

Table 4.12: Regression Model Summary for Awareness and Level of Energy.....47

Table 4.13: ANOVA Table for the Regression Testing the Fit of the Model 48

Table 4. 14: Regression Coefficients for Awareness and Level of Use of Alternative Energy 48

Table 4.15: Technology Availability for Alternative Energy Sources 49

Table 4.16: Regression Model Summary for Awareness and Level of Energy.....50

Table 4.17: ANOVA Table for the Regression Testing the Fit of the Model 50

Table 4.18: Regression Coefficients for Technology Availability and Level of Use of Alternative Energy 51

Table 4.19: Descriptive Statistics and Frequency Distribution of Affordability 52

Table 4.20: Regression Model Summary for Level of Affordability of Alternative Energy Sources 52

Table 4.21: ANOVA Table for the Regression Testing the Fit of the Model 53

Table 4.22: Regression Coefficients for Affordability and Level of Use of Alternative Energy 53

Table 4.23: Level of Effectiveness of Alternative Sources of Energy 54

Table 4.24: Regression Model Summary for Level of Effectiveness of Alternative Energy Sources 55

Table 4.25: ANOVA Table for the Regression Testing the Fit of the Model 55

Table 4.26: Regression Coefficients for Efficiency and Level of Use of Alternative Energy 56

LIST OF FIGURES

Figure 1.1 Technology Acceptance Model 14

Figure 1.2 Conceptual Framework depicting the factors influencing the level of use of alternative sources of energy among Maasai pastoral households in Kajiado West 17

Figure 3.1: Map of Kajiado County, Showing the Location of Kajiado West 30

Figure 3.2: Map of Kajiado West, showing the Administrative Units 97

ABSTRACT

Conventional sources of energy are normally expensive and have a negative impact on the environment, requiring the use of alternative energy sources that have minimum impact on the environment, which the Maasai pastoral community in Kajiado West have not adopted. There was therefore need to assess the factors influencing the level of use of alternative sources of energy with a view of addressing the issues. The specific objectives of the study were (i) to investigate the influence of level of awareness of alternative sources of energy on the level of their use, (ii) to examine the influence of technology availability and maintenance of alternative sources of energy on the level of their use, (iii) to assess the influence of affordability of alternative sources of energy on the level of their use and (iv) to determine the effectiveness of the sources of energy and the level of their use by the Maasai pastoral community in Kajiado West, Kajiado County. The study adopted the descriptive research design. The study targeted Maasai households in Kajiado West. The sampling frame was made up of the Maasai households that were specifically involved in pastoralism. A stratified random sample of 183 pastoral households were surveyed using a structured questionnaire. The data was analysed using descriptive and inferential statistics in a Statistical Package for the Social Sciences (IBM SPSS version 26). The level of use of alternative energy sources by Maasai pastoral households in Kajiado West was found to be low (M=2.09, SD=1.76) on a scale of 0 to 5, while their use of conventional energy sources was found to be higher (M=3.06, SD= 1.92). The level of use of alternative sources of energy by Maasai pastoral households in Kajiado West was statistically significantly influenced by awareness of the energy sources (β=.633, t=10.99, p<.001), availability of technology (β=.402, t=5.91, p<.001), affordability of the energy source (β=.648, t=11.44, p<.001) and efficiency of the energy source (β=.628, t=10.84, p<.001). The study concluded that Maasai pastoral households in Kajiado West had low level use of alternative sources of energy. The study also concluded that awareness, availability of installation technology, affordability and efficiency had a statistically significant influence on the level of use of alternative sources of energy within the target households. The study recommended that the County Government needs to create awareness of the usefulness of alternative sources of energy, encourage multi-stakeholder networks related to the provision of renewable energy technology. The study findings will be useful to relevant stakeholders in particular enhancing the alternative sources of energy required to improve the community wellbeing and sustain the environmental conditions in the area. The findings will influence policy formulation in the area of energy.

DEFINITION OF TERMS

Alternative sources of energy: Is any other form of energy other than fossil fuel and comprises of both renewable energy and nuclear energy (Bass, 2016)

Fossil fuel: This are fuels formed through natural forces such as gas, coal and oil but considered harmful to the environment because of emission of greenhouse gases (Harvey, 2016)

Households: Are the individuals living in one house (Bass, 2016)

Procurement cost: Is the cost incurred during a purchase of goods (Latour, 2005)

Renewable energy: Is energy produced from sources that do not deplete or replenish (Kuhudzai, 2020)

Sustainable energy: Is the practice of using energy in a way that one is able to meet today needs without compromising the needs of tomorrow (Latour, 2005)

ABBREVIATIONS/ ACRONYMS

CIDP	County Integrated Development Plan
FiT	Feed in Tariff
GHGs	Greenhouse Gasses
GW	Gigawatts
INGOs	International Non-Governmental Organizations
KNBS	Kenya National Bureau of Statistics
NETFUND	National Environment Trust Fund
PACE	Partnering to Accelerate Entrepreneurship
PV	Solar photovoltaic
SDGs	Sustained Development Goals
SPSS	Statistical Package for Social Sciences
TAT	Technology Acceptance Theory
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WEREP	Women Entrepreneurship in Renewable Energy Project

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter presents background information in relation to factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West, Kajiado County. Background of the study was addressed from the global, regional and local perspective. The chapter similarly addresses research problem, objectives, research questions, hypothesis, and significance of the study, scope, delimitations, limitations, assumptions and theoretical background. The study aimed at specifically addressing the following variables; influence of awareness of alternative sources of energy, influence of technology availability and maintenance, influence of affordability of alternative source of energy and effectiveness of sources of energy.

1.2 Background of the Study

Climate change is one of the significant challenges facing the world at large. This effect has been associated with increased human activities such as emission of Greenhouse Gasses (GHGs) to the atmosphere, deforestation, burning of fossil fuels, poor disposal of waste and increased demand for industrialization (Eduado, 2008). The demand for energy in general is expected to increase in the world by 2030 from the initial demand of 11.4 Billion tonnes to 17.7 Billion, a proportionate increase of 55%. However, with the current demand expected to increase, fossil fuels are the most dominant sources of energy in the world accounting to over 60% usage rate despite having alternative sources of energy such as solar power, nuclear power, wind energy, hydroelectric energy, wave energy and biomass energy (Couture & Reynaud, 2012).

Global treaties and policies, instigated during the Kyoto Protocol in 1997-2012 by the United Nations Framework Convention on Climate Change (UNFCCC) were meant to commit parties towards reducing emission of greenhouse gases based on the argument that a major stake of global warming has been fuelled by the human activities in relation to seeking source of energy and production (Ekardt & Hovel, 2009). The Kyoto protocol through its numerous phases of implementation considered a desired need for countries and member states to adopt different measures towards combating global warming where some of the common measures were to implement policies encouraging the use of alternative sources of energy toward contribution to green energy (Longden, Pabari, Majumder, & Hassan, 2012).

The use and adoption of renewable energy across the world contributed to a growth of 32% in the year 2011 (UNEP, 2011). Africa and Asia were among the top continents where growth in adoption of alternative sources of energy oversaw a total investment growth of $3 Billion. This growth in use of alternative sources of energy was attributed to factors such as fast growth of technology in the continents, favourable environment for alternative sources of energy to thrive such as availability of mountains and flat lands for installation of windmills, high temperature resulting from sun rays and increased demand among the developing countries with Kenya and Egypt leading the implementation and usage rate (Keriri, 2013).

Increased cost of fossil fuels, population growth and availability of alternative sources of energy saw the United Kingdom, the champion for adoption of green energy target to increase the adoption of alternative sources of energy especially renewable to a total contribution of the Country's grid by 30% (Harvey, 2016). Through a programme commonly known as Feed in Tarriff (FiT), the UK government in conjunction with private sector has injected 8.7 Gigawatts (GW) into the national grid

with aim of encouraging and supporting growth of small scale businesses, cutting the cost of production of electricity, creating efficiency in the production process and most significantly championing the need for adoption of green energy (Gosden, 2015).

The source of energy in Africa is best understood in three distinct regions. The North Africa is fully dependent on oil and gas, the South Africa is fully dependent on coal while the Sub-Sahara Africa is dependent on biomass (Karekezi, 2013). Due to increased cost of production of energy among the Africa Countries especially the North and the South Africa, there has been a heavy reliance on Biomass even in countries full of oil products such as Nigeria. The cost of production of electricity in Africa is quite high that only a rate of 45% of households fully enjoys the benefits of electricity. Due to this reason, the need and implementation of cheap, reliable and efficient source of energy has grown over time to other alternative sources of energy (Kantai, 2012).

In the year 2017, the Africa Union through the Partnering to Accelerate Entrepreneurship (PACE) and Sustainable Development Goals (SDGs) initiatives recommended the implementation of alternative sources of energy into green energy as means of combating climate change and cost saving on use of electricity. The target of the initiative was entirely based on the need to focus on converting the already current resources to useful energy such as use of solar energy retrieved from the sun, the use of wind energy considering the topographical nature of Africa that supports wind energy, geothermal and wave energy such as in Northern parts of Africa with heavy reliance on Solar energy (Wu, 2015).

The promulgation of the new constitution in Kenya in 2010 brought significant guidelines and changes on aspects of sustainable development through adoption of clean and renewable energy. The government enhanced the move as a means of encouraging economy development and contribution towards the global agenda

implemented during the Kyoto protocol (NETFUND, 2017). Through partnership with the private sector, National Environment Trust Fund (NETFUND) has been in the fore front towards ensuring that Kenya as a nation contributes towards full implementation of alternative sources of energy through resource mobilization, management of available resources, partnership with foreign countries such as Sweden, capacity building, research and development and provision of grants to small groups, households and County Governments (Ganda & Ngwakwe, 2014).

Implementation and use of alternative sources of energy in Kenya is facing enormous challenges just like any other country in Africa. Considering that Kenya is a third world country, over 95% of the population in rural area has heavy reliance on wood fuel which is a major challenge affecting achievement of global goals such as protection of forests, restoration and prevention of forest degradation (NETFUND, 2017). To overcome these challenges, the government of Kenya through main agencies such as National Environment Trust Fund and Kenya Industrial Research and Development Institute publications in partnership with Non-Governmental Organizations (NGOs) and the private sector enhanced implementation of modern energy technologies such as adoption of Solar lighting systems in rural areas, hydropower, wind energy, geothermal energy and bio energy (UNEP, 2017).

The new energy ACT, 2019 provides guidelines on what local governments need to consider towards implementation of alternatives sources of energy. This includes but not limited to development of county energy master plans that should be used by the Cabinet Secretary of the Ministry of Energy and Petroleum to formulate integrated energy master plan towards encouraging use of renewable energy. The ACT still empowers the County Governments to enforce specific regulations meant towards energy conservation, efficient use of energy, inspection and provision of guidelines in

relation to adoption and use of renewable energy (Munyaka, 2019). As much as the ACT has been in place close to one year, little has been witnessed from the County Governments on matters concerning implementation and creating awareness on the importance of renewable energy and in general alternative sources of energy (Johnson & Nyambane, 2016).

Kenya is currently leading in Sub-Sahara Africa on adoption and implementation of use of alternative sources of energy in the Country. Renewable energy in Kenya contributes to 70% of the total energy consumed with major boosts from 310 MW Turkana wind firm, 54.6 MW Garissa solar photovoltaic planet and other non-specified connections such as witnessed in the rural communities (Kuhudzai, 2020). High involvement of the move towards encouraging use of green energy has been witnessed among the key stakeholders such as Kenya Electricity Transmission Company, Kenya Electricity Generation Company, Kenya Power and Lighting Company, M-KOPA Solar, Biopane Energy Company, EOS solar and International Non-Governmental Organizations (INGOs). This growth has been encountered with challenges such as high cost of production and installation of sufficient power grids in relation to maintenance (Gitone, 2017).

Kajiado is among the counties in Kenya leading in adoption of alternative sources of energy. Growth in the population to 51 persons per square kilometre has been the main factor contributing to increased demand for alternative sources of energy. Out of a total of 173,464 households in Kajiado County, only 69,098 are connected to electricity accounting to 38%. However, the main source of energy in Kajiado County is Firewood, Charcoal, solar and petroleum products. Energy plays an important role in driving the economy of a County because of increased demand from both domestic and commercial use. Kajiado County, with some of the best renewable energy sources such

as hydro, wind, solar and geothermal stands in a better position in encouraging adoption of renewable energy and spurring economic growth in general (Kajiado County, 2019).

The Women Entrepreneurship in Renewable Energy Project (WEREP) an initiative by the Green Energy Africa has been the champion of solar power in Kajiado County. The initiative focuses on educating women on the need to focus on efficient energy through provision, marketing and training them on solar installation among other techniques such as maintenance. The initiative that started back in 2014 has so far resulted to over 4000 households being connected with solar lighting. This program has not only resulted to cost saving but has also improved on security from wild animals, access to informal education and access to modern technology in rural areas (Obi, 2018).

Kajiado West Sub-County has the lowest population rate of 21 persons per square kilometres hence becoming quite difficult for individuals, schools and other amenities to be connected with the electricity due to high cost of connection (Kajiado County, 2019). Due to the topography of the County, the County government in conjunction with other stakeholders such as National government through National Environment Trust Fund (NETFUND) and NGOs have been implementing alternative sources of energy such as use of wind energy and solar energy toward creating economy independency among the households and businesses (Sena, 2018).

1.3 Statement of the Problem

According to Wanjiru and Ochieng (2013) adoption of alternative sources of energy is not a new approach in Kenya or any other Country. However, in contrast, electricity remains relatively limited to rural regions. National Government and the County Governments have done little in their power to encourage and ensure full implementation of alternative sources of energy due to assumed high cost of production

and maintenance, lack of local production capacity of solar panels and wind mills, dispersion rate in rural regions resulting to increased cost of home to home connectivity and poor market understanding regarding stakeholders mapping.

Kariuki (2018) conducted a study on barriers to renewable energy technology development in Kenya. The study which focused on descriptive data identified that since the beginning of 21st century, renewable energy has been of interest to researchers, governments and private sector. However, success of implementation of renewable energy technologies has witnessed slow pace due to challenges such as lack of sufficient regulatory framework on implementation of renewable energy, over reliance on fossil fuels, market related barriers, social-cultural barriers, environmental barriers, financial and economic barriers.

Karekezi and Kimani (2014) study identified that lack of connection to the national grid remains the most significant challenge affecting access to energy among Kenyans residing in remote areas. This has been associated with other challenges such as low population density affecting the ability to have shared power sources, lack of sufficient budget towards full implementation of renewable energy from the national and county government's perspective and lack of awareness on efficient use of renewable energy.

Despite significant efforts from National Environment Trust Fund (NETFUND), NGOs and private stakeholders to take part towards full implementation of alternative sources of energy, adoption of alternative sources of energy remains quite low in comparison to the efforts put forth among the pastoral communities. This study therefore aims at addressing why the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West is low using the following five

independent variables: awareness of alternative energy sources, availability of technology, affordability of technology, and the efficiency of alternative energy use.

1.4 Purpose of the Study

The purpose of this study is to address factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West, Kajiado County.

1.5 Objectives of the Study

1.5.1 Specific Objectives

The specific objectives of the study were:-

(i) To investigate the level of awareness of alternative sources of energy (solar, wind, and bioenergy) and their influence on the level of use by the Maasai pastoral community in Kajiado West, Kajiado County.

(ii) To assess the level of technology availability and maintenance needs of alternative sources of energy and its influence on the level of use by the Maasai pastoral community in Kajiado West, Kajiado County.

(iii) To assess affordability of the alternative sources of energy and their influence on level of use by the Maasai pastoral community in Kajiado West, Kajiado County.

(iv) To determine the level of efficiency of alternative sources of energy and its influence on the level of use by the Maasai pastoral community in Kajiado West, Kajiado County.

1.6 Research Questions

The study research questions were:

(i) To what extent does the awareness of alternative sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?

(ii) How does technology availability and maintenance of alternative sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?

(iii) To what extent does affordability of alternative sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?

(iv) How does effectiveness of the alternative energy sources influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?

1.7 Significance of the Study

Cost of producing electricity in Kenya and decreased sources of electricity in the world as a result of global warming has compelled the government of Kenya to consider implementation of strategies which will encourage the use and adoption of alternative sources of energy such as stakeholders participation, public education and cheap outsourcing of other alternative sources of energy such as solar energy. For this reason, this study will be significant to the Government of Kenya through providing reliable literature on factors influencing the level of use of alternative sources of energy among Maasai pastoral community in Kajiado County Kenya.

Cheap access to energy has been part of the development and devolution plans promulgated in the Kenya 2010 constitution. The County governments in this case are supposed to enhance access of services and serve their people through various means

such as provision of convenient means of development through energy infrastructure. For this reason, the current study will be significant to the County governments of Kenya towards renewable energy infrastructure planning and development.

Rural development in Kenya especially among the Pastoral communities has been neglected for long due to lack of permanent structures, resource availability and lack of technical capacity. However, a study published by Bressa (2016) identified that the Maasai women are leading in solar revolution in Africa. This clearly indicates imminent need of renewable and green energy among the pastoral households. Consequently, this study will benefit the County Government of Kajiado as it plans implementation of renewable energy policies in the near future.

The private sector, the people and NGOs in general have been in the fore front towards implementation of alternative sources of energy in Kenya. However, the success of such project is facing serious challenges associated with lack of sufficient information in relation to factors to consider in place prior to implementation of green energy projects. This study will be of benefit to the private sector, the people and NGOs towards addressing challenges associated with implementation of renewable energy in Kenya.

This study will be significant to future researchers because it will contribute to knowledge in relation to factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West, Kajiado County Kenya.

1.8 Scope of the Study

According to Burns and Grove (2013), scope entails all aspects to be covered by the researcher such as purpose, time line and target group. The study on the factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West, Kajiado County aims at contributing to solutions on

energy challenges the community is facing such as lack of connectivity to national grid, scattered communities affecting sharing of energy and discouraging use of fossil fuel which is harmful to the environment. The study was conducted in the month of November 2020 and targeted stakeholders such as the County government of Kajiado, randomly selected groups of households in five wards of Kajiado West and the private sector such as NGOs and private companies engaged in renewable energy.

1.9 Delimitations of the Study

According to Bryson (2015) delimitation is defined as boundaries of the study. The current study on factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West, Kajiado County Kenya will only be limited to addressing four factors only such as awareness of the source, technology availability and maintenance, cost of alternative sources of energy and effectiveness of source. Any other factor that might arise during the study will not be considered. However, it will be featured on recommendations for further studies. The study will similarly address challenges facing the pastoral community. This indicates that the current factors can only be applicable to the Maasai pastoral community and they might not be effective to other communities such as communities with permanent structures and living in urban areas.

1.10 Limitations of the Study

Mugenda and Mugenda (2012) defined limitations as constraints of the study. Cognisant to the fact that the pastoral community keeps on moving from one place to another especially during dry season. The study predicted that this movement will be of negative effect in relation to having direct engagement with community members and community leaders. The study focussed on the available respondents as means of

mitigating the said limitation. The second limitation of the study was language barrier. The pastoral community especially the aged had difficulties in participating in the interview because of limited understanding of English. The study overcome this limitation through seeking support from research assistants who had the capability of understanding language and the operation of the pastoral community. The third limitation of the study was respondent's confidentiality. It was expected that respondents would not be willing to participate for fear of being victimised or because of privacy concerns. This was limitation was dealt with by ensuring that privacy was maintained throughout the study.

1.11 Assumptions

Kothari (2012) defined assumptions as examined beliefs about a study. The researcher assumes that the respondents will be willing to participate in the study without coercion. The researcher similarly assumes that respondents have full understanding of alternative sources of energy and their use. This will enhance the researcher's ability to collect sufficient information to address the study problem.

1.12 Theoretical Framework

This study was grounded under two theories, which are; the technology acceptance theory and the stakeholders' theory.

1.12.1 Technology Acceptance Theory

The principle of the Technology Acceptance theory states that a person's intent to use and usage behaviour of a technology is predicated by the person's perceptions of the specific technology's usefulness and ease of use.

Based on the theory of reasoned action, Davis, Bogozzi & Warshaw in 1989 developed technology acceptance theory (Bass, 2016). Technology acceptance theory

addresses how users of new technology come to accept and use a technology. The theory through a framework or model suggests acceptability of technology or rather an innovation through identification of various modification measures in order to encourage usability. Two main factors form effectiveness of technology acceptance theory. These are; perceived usefulness and ease of use. The two variables are referred to as external variables arising from features and nature of the technology as presented in Figure 1.1.

Belief among users that technology will contribute towards improving performance or success is defined as perceived usefulness. A study conducted by Legris et al., (2013) on why do people use technology and new inventions identified that the capability of the technology to contribute towards success and performance encourages users to adopt the new technology. Positive perceived effectiveness of a certain invention or technology results to creation of positive attitude towards use, creation of behavioural intentions where an individual makes an effort of trying the innovation and lastly actual system use backed by initial purchase of the technology. In reference to this study, the level of use of alternative sources of energy, being new technologies among the pastoral communities is influenced by perceived usefulness in relation to generating electricity a major factor in education for the kids, security and provision of energy for other purposes such as cooking and lighting. Perceived usefulness in relation to technology acceptance theory has positive relationship with actual system or technology use (Hauser & Shugan, 2010).

Perceived ease of use of a technology is determined by the level, which the users believe that the use of the technology will be effortless (Venkatesh, Morris, Davis & Davis, 2013). Self-efficacy and instrumentality have a significance influence on perceived use of technology. The concept of self-efficacy is based on the concept that

the more a system is easy to use, the greater should the user sense efficacy hence the use of the technology while instrumentality addresses the ability of the technology to improve individual performance. Ideally, the use of alternative sources of energy among pastoral communities such as solar power and windmill energy, briquettes and solar Jikos creates positive attitude towards trials because of efficacy and instrumentality. Alternative sources of energy have a sense of ease use and instrumental due to their contribution in the society.

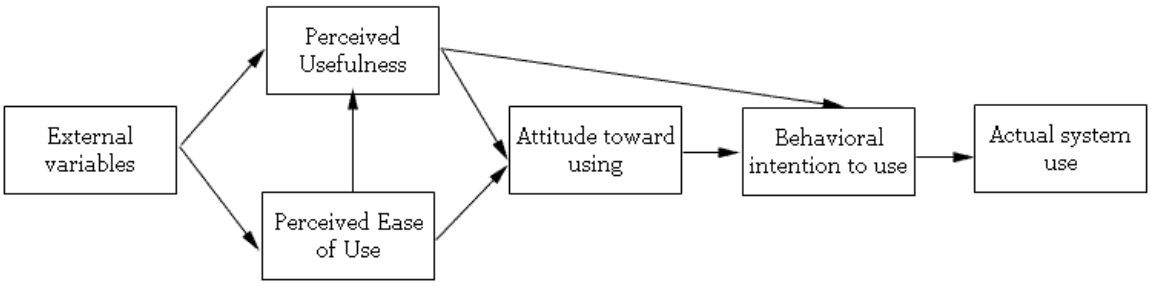


Figure 1.1 Technology Acceptance Model

Technology acceptance model, Version 1 (Davis, Bagozzi & Warshaw, 1989)

1.12.2 Stakeholders Theory

Edward Freeman first developed stakeholders' theory in the year 1984 (Freeman & Moutchnik, 2013). In relation to project management, stakeholder's theory argues that the success and effective implementation of a project solely depends on the ability of a company or individual to engage various stakeholders. There are a number of stakeholders who determine success and implementation of any project. The key main stakeholders identified by Freeman are; the government, suppliers, the society, financiers, well-wishers, creditors and the private sector. Presence of these stakeholders is geared towards ensuring that every group or individual takes part in decision-making and implementation of a project.

The government is one of the major stakeholders in any project because it is fully engaged towards provision of licences and approval of implementation of any project. In relation to the current study, the Kenya government has been in the core front towards supporting and encouraging the private sector to invest in green energy by using cheaper solar systems, wind energy and briquettes, which have minimal emission of carbon dioxide hence becoming safe to human beings and the environment (Laplume et al., 2018). Suppliers, the society and the financiers are similarly key stakeholders in success of any project. Suppliers in this case supply or rather distribute raw materials such as solar panels, wind mills while the financiers such as NGOs, the County government and the private sector purchases them on behalf of the communities who are the major beneficiary. Ideally, every stakeholder in the stakeholders' theory plays key roles towards ensuring effective implementation of a project (Miles, 2012).

In relating stakeholders' theory to the current study, it is clear that availability of stakeholders and the participation of stakeholders towards implementation of alternative sources of energy among the pastoral community affect their use. Critically, availability of the alternative sources of technology influences greatly the availability of the sources because installation of windmills for instance comes with cost, which should be handled from the stakeholders' point of view.

1.14 Conceptual Framework

Conceptual framework is a diagrammatic representation of concepts of the study and their relationship (Mugenda & Mugenda, 2012). In relation to the study, the concepts are represented by independent and dependent variables. The independent variable comprises of awareness of sources, technology availability and maintenance, cost of source of energy and effectiveness of the source while the dependent variable is represented by level of use of alternative source of energy.

The level of awareness of alternative sources of energy ideally determines the use of such a source. Full awareness indicates that an individual if fully acquainted with information about alternative source of energy and has access to information about the alternative source of energy hence resulting to access. Awareness will be determined through usage awareness, and awareness of various alternative sources of energy.

The second factor of the study influencing the level of use of a given energy source of energy is technology availability and maintenance. Availability of the source of energy is a clear indication that there is easy access of the source hence influencing level of use. Availability in this study will be determined through availability of spares, and availability of alternative sources of energy.

The third variable of the study is Affordability, or the initial and maintenance cost of source of energy. Venkatesh, Morris & Davis (2003) determined inverse relationship between cost and usefulness. The higher the cost of a product, the lower the usage rate of that resource. Cost of source of energy will be determined by procurement cost, installation cost and maintenance cost.

Efficiency of the source ideally addresses the quality or fact of alternative source of energy to be useful. Various factors determine the effectiveness of a source of energy such as the source of the energy, if it contributes to income generation and if the technology is renewable. The effectiveness of the sources determines the level of use of alternative sources of energy.

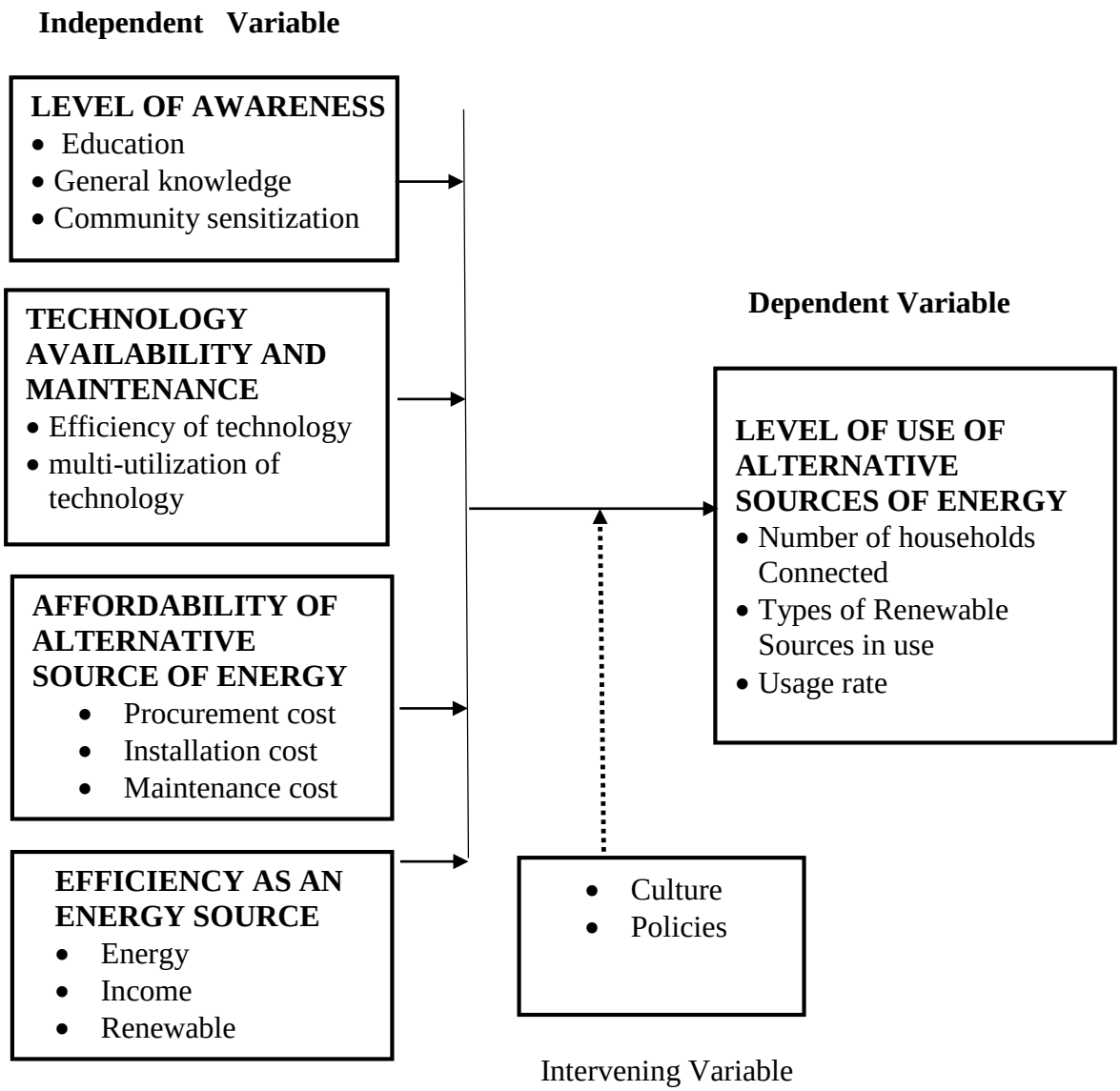


Figure 1.2 Conceptual Framework depicting the factors influencing the level of use of alternative sources of energy among Maasai pastoral households in Kajiado West

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter addressed literature review where the focus was based on factors influencing the level of use of alternative sources of energy. The chapter will also address summary of literature and the research gap.

2.2. Awareness of Energy Sources

A study conducted by Silver (2013) on factors influencing the development of renewable energy strategies; the case of Lolland and Samso Island in Denmark identified that insufficient information and training on various skills, in relation to awareness on effectiveness of alternative sources of energy affected the ability of residents in Denmark to adopt alternative sources of energy. The lack of credible information, inappropriate marketing strategies by the sellers hindered the need of residents in Lolland and Samso to adopt alternative sources of energy. The findings of the study however did not address policy recommendation towards improving access to right information from stakeholders to the public.

A study conducted by Diaz, Alder and Patt (2017) on whether stakeholders perspective on renewable energy infrastructure poses a risk to energy policy implementation, a case of hydropower plant in Switzerland identified that the conflict of interest among various stakeholders in the implementation of hydropower poses various challenges such as in disagreement with various policies aimed at full adoption of hydro power energy. The study similarly addressed that increased claims on the inefficiency of hydropower energy to contribute to the national grid and the cost of

production of such energy affects success of the business in relation to increased cost hence resulting to ineffectiveness.

Everlune et al., (2013) study on socio-economic factors influencing adoption of energy-saving technologies among smallholder farmers in West Pokot County addressed that information in the form of formal education, awareness and community sensitization campaigns affects the use of alternative sources of energy. The study identified that majority of the rural residents have limited access to education on alternatives sources of energy, the use of alternative sources of energy and benefits of alternative sources of energy hence resulting to reliance on wood and charcoal fuel. Due to this reason, utilization of renewal energy in West Pokot remains low among the rural dwellers. The study however failed to provide statistical evidence in relation to adoption and use of renewable energy among residents of West Pokot.

A study conducted by Pundo and Fraser (2006) on multinational logit analysis of household cooking fuel choice in rural Kenya, a case of Kisumu district identified that knowledge on the use of alternative sources of energy through the implementation of rural Solar system and community windmill has resulted to increased use of alternative sources of energy among the residents. The finding of the study addressed that partnership between the community, Non-Governmental Organizations and the public sector has resulted in enhanced adoption of renewable energy through provision of cheap solar systems, capacity building and sponsoring school and churches towards procuring renewable energy products such as solar and its complete setup. The findings of the study however, failed to give specific recommendation on factors to consider towards full implementation of renewable energy in the region with respect to low rate of adoption.

A similar study conducted by Keriri (2013) on factors influencing adoption of solar technology in Laikipia North Constituency, Kenya identified that in respect to the fact that topography and cost of renewable energy are major factors influencing the use of alternative sources of renewable energy, knowledge and awareness affects the rate of use of renewable energy. The findings of the study identified that access to education and knowledge results to enhanced use of renewable energy while lack of awareness knowledge diminishes use of alternative sources of energy. The findings of the study however addressed that in Laikipia North Constituency, the use of wind energy and hydroelectric energy is quite common than solar energy. The study however did not address any recommendations on Public Private Partnership effort towards provision of education and awareness on use of alternative sources of energy.

2.3 Technology Availability and Maintenance

A study conducted by Centre for Climate and Energy Solutions (2018) on effects of availability of technology on adoption of renewable energy identified that growth in technology since 2000 has resulted to enormous changes on access to energy in the world. Due to technology growth and development, the access to renewable energy and alternative sources of energy in America has grown with 100% growth rate since 2000 to 2018. This clearly indicates that the availability of technology to manufacture and implement various renewable energy sources such as solar systems, wind mills, Bio energy, Geothermal and hydroelectric is influenced by access to efficient technology. The findings of the study however failed to address specific reasons that affects the inability of the Americans to adopt alternative sources of energy as main source.

A study conducted by Chen and Arpan (2017) on relationship between technology acceptance model and sustainable energy technology: investigating smart

meter acceptance in the United States identified that there are two perceived attributes affecting adoption of smart meter systems such as usefulness and risk to privacy. The study further addressed that majority of the Americans perceived that smart meter had limited effects on cost saving. On the aspect of risk to privacy, the study further identified that smart meter can be manipulated hence having increased risk to privacy. This clearly identified that perceived usefulness of technology determine the rate of use of such technology.

OECD Report (2019) on factors influencing implementation of alternative sources of energy in the world through a general survey identified that cost of the source of energy, proximity, demand and availability of appropriate technology affects effectiveness of implementation of alternatives sources of technology. The findings of the study similarly identified that technology used in production of alternative sources of energy in third world and developed countries is three times more expensive that in developed countries due to cost of raw materials, taxation and technical knowhow hence affecting full implementation and use of alternative sources of energy. The findings of the study failed to provide sufficient recommendations on how developing countries can enhance technology independency as means of cutting on cost of implementation of alternative sources of energy.

Mutuma and Kimuyu (2015) conducted a study in household energy conservation in Kenya; estimating the drivers and possible savings. Through a survey of 560 respondents in rural Kenya, the study identified that there is relationship between access to alternative sources of energy technology and their usage. According to the study, connection to alternative sources of energy especially in Africa is low because of low technology availability in the region. Solar energy in rural communities contributes to over 80% of alternative sources of energy with only 20% being

represented by other alternatives resources such as wind energy, biomass and hydroelectric. The findings of the study however did not provide recommendations on what the government should focus on towards ensuring availability of technology as means of realizing 2030 renewable energy goals.

Kitheka, et al. (2019) study on factors influencing adoption of biomass energy conservation technologies in selected areas of Kitui County identified that design of the technology material affects their ability to adopt renewable sources. Over 70% of the technologies used in rural areas in Kenya are Chinese made products with limited durability and limited use. Household solar system is only meant for light usage such as lighting. Some technologies similarly associated with imported solar panels are non-reparable and this affects the ability of the householders to consider using products that has questionable durability. The study findings were short of extensive research on areas of improvement towards ensuring quality of imported alternative sources of energy technologies.

2.4 Affordability of Energy Source

A study conducted by Mackenzie (2019) on the cost of shifting US entire energy system to renewable energy identified that 100% shift of the US energy system to renewable energy would cost a total of $4.5 Trillion in replacement of all fossil fuels and nuclear power with hydroelectricity, biomass, geothermal, wind and solar power. The findings of the study identified that the total cost of shifting to renewable energy has affected the ability of various stakeholder to consider the project viable in consideration that the estimates of the cost surpasses the budget US government has spent since 2011. The findings of the study concluded that alternative sources of energy are quite expensive to adopt hence becoming a major factor affecting the use of

alternative sources of energy in the public and private sector at large. The findings of the study however failed to address cost per production of one KWh in comparison to both renewable energy and contemporary methods of production of electricity such as fossil fuels.

Nfah and Ngundama (2012) conducted a study on the identification of stakeholders for sustainable renewable energy applications in Cameroon. Through a focus on descriptive research design, the study identified that effective implementation of renewable energy in Cameroon and any other part of the world depends heavily on availability of stakeholders and willingness of the stakeholders to contribute towards development through various initiatives such as funding, provision of advisory services, manpower, collective management and participation in decision making activities. The study further addressed that availability of micro finance institutions; Non-Governmental Organizations (NGOs) in the implementation of renewable energy enhances the ability to access loans and grants hence resulting to effective implementation of renewable energy in the County.

A study conducted by Dudley (2019) on renewable energy cost over fossil fuel cost, through adoption of descriptive research design identified that the cost of renewable energy has tumbled further in the past one year over the cost of fossil fuel with an average of $0.55 per Kilowatt hour (KWh), cost of solar photovoltaic (PV), geothermal and biomass has dropped to 0.1 KWh while wind energy has dropped to 0.13 KWh. The findings of the study identified that the cost of delivery and production of alternative source of energy was cheaper when compared to cost of production of energy from fossil fuel. Due to this reason, the rate of adoption of renewable energy over fossil fuel has continued to grow especially in Middle East and Asia. The findings

of the study however did not address factors hindering full transformation of fossil fuel energy to renewable energy.

A local study conducted by Sarkodie and Llhan (2020) on investing the environmental Kuznets Curves hypothesis in Kenya; a multivariate analysis identified that Kenya is currently leading in terms of Solar connections per capita. This has been due to ability of various regions in Kenya to tap solar energy. Public private partnership and Non-Governmental Organizations have supported this capability fully hence resulting to effective and efficient installation of solar systems due reduced cost associated with government subsidies and NGOs support. The study findings however failed to address reasons why alternative sources of energy are not yet major source of energy in Kenya.

Kitsao (2018) conducted a study on factors influencing access to renewable energy by rural families, a case of Solar lanterns project in Isiolo County identified that the cost of installation of renewable energy and maintenance affect their ability to install solar power system. In most cases, those who have installed solar systems such as M-Kopa solar although they have benefited through the program, the cost associated with such project has affected them negatively due to hire purchase cost burden, which lasts close to 2 years. The findings of the study however failed to address the cost benefits from those who purchased on cash terms.

2.5 Effectiveness of Energy Source

Adoption and use of alternative sources of energy depends deeply on perceived usefulness and perceived ease of use, which are all factors of Technology Acceptance Theory (TAT). Alternative sources of energy or rather renewable energy has witnessed slow growth rate since introduction due to poor perceived usefulness. Solar energy for

instance is considered by majority as limited to its application on matters concerning commercial use. This perception has indeed resulted to limited adoption of solar energy for commercial purposes. However, the reality remains that solar power and other alternatives sources of energy can be used for commercial purposes as much as full implementation of the technology can be considered (Wojuola & Alant, 2017).

A study conducted by Renewable World Energy (2018) on different uses of energy in our daily lives in rural and urban regions focused on general surveying of how different users have incorporated the use of alternative sources of energy. The study established that there is a relationship between usefulness of the source of energy and usage among the residents. The use of biomass and Solar system for instance was effective towards delivery of sufficient power for homesteads hence resulting to multi usage such as lighting, cooking, farmhouses, and production of food products and even provision of security. Other effective uses of alternative sources of energy mentioned in the study were the commercial uses such as heating water and liquids, cooling, lighting commercial buildings, workstations and copiers. Alternative sources of energy were effective than any other form of energy due to portability nature.

Alternative Protection Energy (2017) study on local renewable energy and resources use in Manhattan identified that adoption of alternative sources of energy such as solar (photovoltaic and solar thermal), wind energy, biogas, geothermal, biomass, low-impact hydroelectric and emerging technologies such as waves and tides have positive usefulness to the environment hence clear relationship between usefulness of the sources and the rate of use. The study identified that alternative sources of energy reduces air pollution because they do not emit greenhouse gases to the air. Similarly, alternative sources of energy results to energy diversification hence

reducing the dependency of imported energy such as imported fuels and similarly they are sources of employment through installation, maintenance and industrial jobs.

Kitheka (2019) conducted a study on factors influencing adoption of biomass energy conservation technologies in selected rural areas of Kitui County. Using survey research design, the study identified that the use of biomass energy in the rural areas of Kitui has been effective source of energy due to numerous uses such as lighting, cooking and heating, which is the basis for activities of rural dwellers. Biomass energy similarly does not require connections with any national grid or any other dependent source hence becoming quite effective and efficient to use to rural homes.

A survey conducted by Kimutai et al. (2019) on factors affecting the number of household energy sources in Kenya: generalized linear model identified that the capability of alternative sources of energy to be utilised among a pool of users affects the ability of Kenyans in rural areas to consider utilization of renewable energy. The main influence in this study was the capability of the alternative sources of energy to be utilised in basic homestead activities such as cooking, lighting and security purposes. In addressing the use of renewable energy among the pastoral communities, the study identified that the portability of the source such as pocket friendly solar system influences their use. The study however did not provide statistical evidence in the rate of usage of renewable energy.

2.6 Summary of Literature Review

Studies meant to address factors influencing the use of alternative sources of energy in the global context identified that usefulness of the source of energy influence the rate at which individuals, the private sector and the public sector adopt alternative sources of energy. According to the findings conducted by (World Energy, 2018;

Alternative Protection Energy, 2017) the use of alternative source of energy is influenced by the capability of the source to provide energy for basic household usage, ability to act as source of income and capability of the source to be renewable for a longer period of time. The use of biomass, solar energy and wind energy as source of energy among the residents in Kenya as identified in the findings is due to the capability that biomass has multi usage such as lighting, heating and similarly it is a renewable energy.

Literature meant to address the influence of cost of source of energy identified that 100% shift from fossil fuel is close to impossible due to hefty cost associated with research and development, mapping, acquisition of raw materials, installation and maintenance cost. Literature clearly identified that alternative sources of energy although beneficial to the environment and human health are quite costly to implement. The use of alternative sources of energy in Kenya and developing countries in general has been influenced by cost of acquisition and production of such source. For instance, installation of windmills and Solar systems require reliance of quality imported materials and manpower hence resulting to increased cost of installation and adoption.

In addressing technology availability, findings of the study identified that the push and the need of adoption and use of alternative sources of energy has been influenced by technology availability and growth in technology. Growth of use of alternative sources of energy has been witnessed in USA with a growth rate of 100% due to influx of technology and technical knowhow. However, technology availability in developing countries has been quite a concern because over 70% of the technologies used in Africa are Chinese made with doubtful quality that affects the ability of individuals to fully integrate alternative use of renewable sources of energy as the main source.

Awareness, access to information, knowledge and education influences the use of alternative sources of energy. Findings meant to address how awareness influences the use of alternative sources of energy identified that misinformation as result of poor marketing; promotion of low standard products has resulted to the ability of households to consider alternative sources of energy less effective in developed countries. In developing countries, there is limited access of information in relation to renewable sources of energy due to lack of community sensitization. However, various studies acknowledged increased creation of awareness and access to renewable energy education as a result of multi stakeholders' partnership and public private partnership in rural areas of Kenya such as in Kajiado, Laikipia, Kiambu and Marsabit Counties.

2.7 Research Gap

Studies conducted by (World Energy, 2018; Mackenzie, 2019; Centre for Climate and Energy Solutions, 2018; Silver, 2013) clearly identified the influence of usefulness of alternative sources of energy, cost of source of energy, technology availability and maintenance and awareness on the rate of use of alternative sources of energy. In respect to the fact that various efforts have been implemented by the international community, the government, private sector and households to implement usage of alternative sources of energy, the rate of implementation remains quite low among households in rural regions especially the pastoral communities. There are limited studies conducted to address why implementation of renewable energy among the pastoral communities is quite low. The findings of this study will contribute towards bridging the existing gap hence contributing to existing body knowledge.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Mugenda and Mugenda (2012) defined research methodology as a scientific process used to identify, select, process and analyse information towards making appropriate decisions. Study methodology entails various steps that include identification of research design, research, target population, sampling procedures, sample size, data collection methods, data processing and analysis, and ethical considerations. This study will focus on the stipulated process towards addressing research methodology.

3.2 Research Design

Research design is a systematic process or roadmap used by researchers to collect information and integrate various components of information for the purpose of addressing specific study problem and making sound decisions (Kathunia & Mugenda, 2012). Descriptive research design was used for this study. The design has the advantage of enhancing the effectiveness of the study, as it guarantees true characteristics of the population studied under minimal influence. Similarly, the descriptive research design enables the researcher to address quantitative and qualitative data to its simplest form.

3.3 Research Site

This study was conducted in Kajiado West Sub-County, in Kajiado County, Kenya. The focus on Kajiado West Sub-County was ideally based on the fact that despite having numerous sources of alternative energy, the residents still rely on fuel wood and Charcoal as their main source of energy.

Kajiado West sub-county borders Kajiado Central sub-county to the south east, Kajiado East to the North East, Kajiado North to the North and Narok County to the West as shown in Figure 3.1.

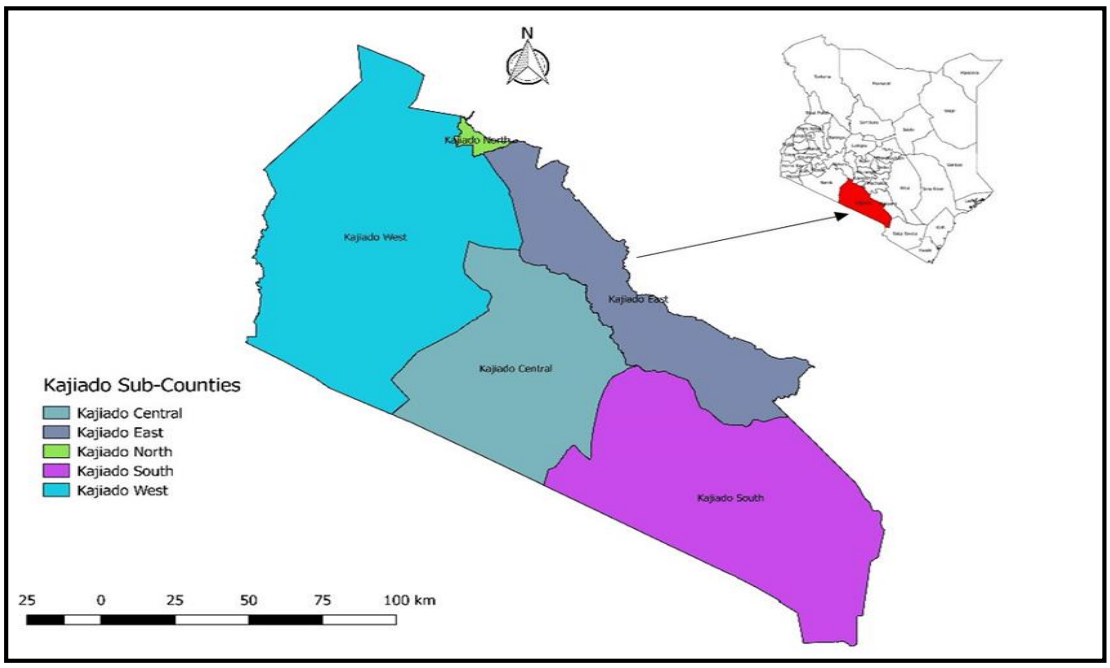


Figure 3.1: Map of Kajiado County, Showing the Location of Kajiado West

The area of Kajiado West sub-county is about 7,862.1 sq. km (KNBS, 2019) with five administrative wards namely; Keekonyokie Ward, Iloodokilani Ward, Magadi Ward, Ewuaso Oo Nkidong'i Ward and Mosiro Ward (Kajiado CIDP, 2018-2022). The largest is Magadi (2562.7 sq.km), Iloodokilani (1,634.9 sq.km), Keekonyokie (1,496.3), Mosiro (818.2sq.km), and Ewuaso Oo Nkidong'i (1,350 sq. km) as shown in Figure 3.2.

3.4 Target Population

Target population is the entire group of people or objects to which the researcher wishes to generalise the research finding, they therefore must meet the criteria set by

the researcher (Kothari, 2012). The target population for this study was Maasai pastoral households in Kajiado West sub county. The target area is endowed with considerable renewable energy sources such as sun light throughout the year especially in Magadi ward and windy conditions in parts of Keekonyokie and Iloodokilani wards. Despite having these immense alternative energy sources, the level of use is quite low and hence the study to find out the factors that influence the level of their use. The population of Kajiado West Sub County during the 2019 population census was 182,849 with 42,774 households in 407 groups (KNBS, 2019). The population density was estimated at 23 persons per square kilometer, the lowest in Kajiado County (KNBS, 2019). The average household size within the study area was estimated as 4.2 persons per Square kilometre.

The Maasai *Manyatta* (village or *boma*) was selected as the unit of analysis as most of the pastoral *Manyatta* had similar characteristics. A Maasai pastoral *Manyatta* was taken as the traditional village composed of 6 to 12 households living together in a single village with a single enclosure for housing livestock at night for various domestic and livestock management tasks, especially herding (Bekure et al., 1991). There were estimated 359 *Manyatta* that were engaged in pastoralism as their main livelihood option, these formed the sampling frame for this study.

3.5 Study Sample

A sample is defined as a smaller set of data that a researcher chooses or selects from a larger population by using a pre-defined selection method. These elements are known as sample points, sampling units, or observations. Creating a sample is an efficient method of conducting research. In most cases, it is impossible or costly and time-consuming to research the whole population. Hence, examining the sample

provides insights that the researcher can apply to the entire population (Mishra & Alok, 2017).

3.5.1 Study Sample Size

Sample size represents the total number of respondents retrieved from the target population that the researcher intends to study (Mugenda & Mugenda, 2012). The Maasai pastoral households were selected from *Manyatta* (village) located in the interior of the study area, only one household was selected to represent the *Manyatta*. The selected household within each *Manyatta* was included in the sampling frame. The sampling frame was composed of 359 households. The Kjercie and Morgan (1970) formula was used to calculate the sample size:

$$n = \frac{\chi^2 * N * P(1-P)}{(ME^2 * (N-1)) + (\chi^2 * P(1-P))}$$

Where: n = The required sample size, given by the following: χ^2 = The table value of chi square for one degree of freedom relative to the desired level of confidence which was 0.95. [The chi-square value used was 3.841], N = The population within the study area [359], P = The population proportion [assumed to be 0.50], as this magnitude yields the maximum possible sample size required, *ME* = desired margin of error (expressed as a proportion). This is the degree of accuracy as reflected by the amount of error that can be tolerated in the fluctuation of a sample proportion about the population P. The value of d was taken as 0.05, which is equal to plus or minus 1.96σp. ME^2= [0.05^2 =0.0025]. The study sample size n based on this calculation was 186 households (n = 186).

3.5.2 Sampling Procedure

The stratified random sampling technique was used for this study. Stratified random sampling involves division of the population of the study into smaller groups known as strata where a specific number of respondents are randomly selected to represent the entire group. In other words, sampling procedure addresses the techniques or process by which the researcher uses to select a group of respondents for the study (Burns & Grove, 2013).

The five administrative wards in Kajiado West formed the strata, they included: Keekonyokie, Iloodokilani, Magadi, Ewuaso Oo Nkidong'i and Mosiro Wards. The proportional allocation method was used to distribute the samples within the different wards as shown in Table 3.1.

Table 3.1: Proportional Allocation of the Study Samples to the Administrative Wards

Wards	***Manyatta***	**Proportional allocation**	**Sample**
Keekonyokie,	61	61/359*186	32
Iloodokilani,	48	48/359*186	25
Ewuaso Oo Nkidong'i	158	158/359*186	82
Mosiro	56	56/359*186	29
Magadi,	36	36/359*186	19
Total	**359**		**186**

3.6 Data Collection Methods

Data collection method addresses techniques that the researcher uses to collect information towards addressing existing study problem (Polit and Beck, 2004).

3.6.1 Data Collection Instrument

A structured questionnaire (Appendix B) was used to collect information regarding the participants and the research variables. The research variables included: awareness of alternative sources of energy, availability of technology for energy source, affordability of the energy source, and efficiency of the alternative energy source. The questionnaire was administered by the researcher with the help of research assistants.

3.6.2 Pilot Testing of the Research Instrument

Pilot testing is usually conducted before the initial study to establish whether the proposed research instruments capture what it is expected to address when presented to the target participants (Mugenda & Mugenda, 2008). The research instrument was pre-tested in Kajiado North Sub County. A sample of 20 participants were randomly selected and the questionnaire was administered to them. Corrections to the questionnaire were then done based on the responses received from the pilot group.

3.6.3 Instrument Reliability

Reliability in a research instrument is used to determine consistency of the research instrument when subjected to numerous measures (Campell & Fiske 2009). Ideally, the instrument should produce consistent results when tried severally. Cronbach Alpha was used in determining reliability of the instrument. The standardization of Cronbach alpha is that if the instrument produces an alpha of 0.7 and above, the research instrument was found to be reliable for data analysis (Cohen, 1988).

3.6.4 Instrument Validity

Instrument validity determines accuracy of the proposed study instrument before exposing it to the study. A valid research instrument is supposed to measure what it is meant to measure. The content of the research instrument must directly

address the specific research problem. The questionnaire was assessed by experienced experts and researchers in the department of Environment and Natural Resources Management and the board of postgraduate studies at Africa Nazarene University.

3.6.5 Data Collection Procedure

Permission for data collection was granted by the National Council for Science, Technology and Innovation (NACOSTI). Field visits were made on consent from the area local administration including area Chiefs and *Nyumba Kumi* heads. A sampling frame was developed and used in randomly selecting the households to be surveyed using a *table of random numbers*. Trained enumerators were then used to collect information from the household heads using the study questionnaire.

3.7 Data Analysis

Data processing is the process of carrying out the operations of data with aim of retrieving, transforming and classifying information (Kothari, 2012). Data processing aids in achieving efficiency in data analysis and ensuring that information has been categorised for easy retrieval. Data analysis entails the process of modelling data to retrieve useful information towards addressing study problem. The study used Statistical Package for Social Sciences (IBM SPSS version 26) as the primary tool of data analysis. The analysis entailed descriptive and inferential statistics as summarised in Table 3.2. In descriptive statistics, the study focussed on frequencies, percentages, means and standard deviation while in inferential statistics; the study focussed on regression analysis to determine level of relationship between variables, presented in linear regression equation represented by;

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \varepsilon$

Y = Level of use of alternative sources of energy

a = Constant coefficient

$_b$ = Beta of respective variables

X_1 = Awareness of alternative energy

X_2 = Technology availability and maintenance of the alternative energy source

X_3 = Affordability of use of alternative energy source

X_4 = Effectiveness of the alternative energy source

ε = Error term.

Collinearity and Multicollinearity statistics, in regression analysis, is the correlation between predictor variables (or independent variables), such that they express a linear relationship in a regression model. When predictor variables in the same regression model are correlated, they cannot independently predict the value of the dependent variable. Multicollinearity happens when independent variables in the regression model are highly correlated to each other. It makes it hard to interpret of model and also creates an overfitting problem. It is a common assumption that people test before selecting the variables into the regression model. To check multi-collinearity one can use the Variance Inflation Factor (VIF) for each independent variable, which is a measure of multicollinearity in the set of multiple regression variables. The higher the value of VIF the higher correlation between this variable and the rest. If the VIF value is higher than 10, it is usually considered to have a high correlation with other independent variables.

Table 3.2: Summary of Data Analysis

Research Questions	Independent variable	Dependent variable	Statistical analysis
(i) To what extent does awareness of alternative sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?	Awareness	Level of use of alternative source of energy	Descriptive statistics (mean, std. dev) and inferential statistics (linear regression)
(ii) How does technology availability and maintenance of alternative sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?	Technology availability and maintenance	Level of use of alternative source of energy	Descriptive statistic (mean, std. dev) and inferential statistics (regression analysis)
(iii)To what extent does affordability of alternative sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?	Affordability of energy source	Level of use of alternative source of energy	Descriptive statistics ((mean, std. dev) and inferential statistics (regression analysis)
(iv)How does effectiveness of the sources of energy influence their level of use by the Maasai pastoral community in Kajiado West, Kajiado County?	Effectiveness as a source	Level of use of alternative source of energy	Descriptive statistics (mean, std. dev) and inferential statistics (regression, analysis)

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents results of the study and their interpretation The chapter is divided into the following sections: (i) response rate (ii) characteristics of the participants, (iii) energy sources used by Maasai pastoral households, (iii) level of use of alternative sources of energy by Maasai pastoral households, (iv) influence of awareness of alternative sources of energy on their use, (v) Influence of technology availability of the level of use of alternative sources of energy, (vi) Influence of energy source affordability on the level of use of alternative sources of energy, (vii) influence of level of efficiency of alternative sources of energy on their use by Maasai pastoral households.

4.2 Response Rate

The sample size for this study was calculated to be 186 households. One hundred and eighty-three (183) households responded to the questionnaire, this gave a response rate of 98 %.

4.3 Characteristics of the Participants

This section of the thesis presents results related to the characteristics of the respondents, they include: gender of the respondents, age of the respondents, formal education level, household number, and livelihood sources.

4.3.1 Household Leadership

The sex of the head of the household was noted during the data collection and was analysed and the frequency distribution is shown in Table 4.2.

Table 4.2: Gender of the Household Head

Gender	Frequency	Percent
Male headed households	70	38.3
Female headed households	113	61.7
Total	**183**	**100.0**

The majority (61.7 %) of the households were led by females, while 38.3 % were led by men.

4.3.2 Age of Respondents

The descriptive statistics and the frequency distribution of the respondents' age are given in Table 4.3.

Table 4.3: Age of the Respondents

Age Categories in Years	Frequency	Percent
20-25	26	14.2
26-30	31	16.9
31-35	34	18.6
36-40	28	15.3
41-45	10	5.5
46-50	13	7.1
51 -55	19	10.4
56 and Above	22	12.0
Total	**183**	**100.0**

Mean 38.2±.907, Median 36, Mode 31, Std. Dev 12.27, Min 20 and Max 71

The mean age of the respondents was 38 (SD=12.27) years. The majority (65 %) of the respondents' age were below the mean age, while 35% were above the mean.

4.3.3 Formal Education Level of the Respondents

The respondents were asked to state the highest level of formal education they had attained. The information was then analysed and the frequency distribution is shown in Table 4.4.

Table 4.4: Household Heads' Level of Formal Education

Education Level	Frequency	Percent
Illiterate	59	32.2
Primary	24	13.1
Secondary	54	29.5
Graduate	40	21.9
Post- graduate	6	3.3
Total	**183**	**100.0**

The majority (67.8 %) had received formal education level of primary and above and only 32.2 % had not received any formal education.

4.3.4 Household Number

The household heads were asked to state the number of people living in their households. The information was analysed and the descriptive statistics and the frequency distribution are given in Table 4.5.

Table 4.5: Number of People Living in the Households

Household Number	Frequency	Percent
1-2	7	3.8
2.1 -3	10	5.5
3.1- 4	21	11.5
4.1- 5	33	18.0
5.1-6	29	15.8
6.1 -7	32	17.5
7.1 -8	18	9.8
8.1 -9	10	5.5
9.1-10	8	4.4
10.1-11	2	1.1
11.1-12	6	3.3
Above 12.1	8	4.4
Total	**183**	**100.0**

Mean 6, Median 6, Mode 5, Std. Dev 3, Min 2, Max 18

The households had an average household number of 6 (SD=3), with a range of 16 people. The households with more than seven (7) people formed 44.9 % of the households.

4.3.5 Household Livelihood Sources

The participants were asked to state the different livelihoods the household relied on, the responses were then summarized in a multiple response Table 4.6.

Table 4.6: Participants Livelihoods Sources (Multiple Response Table)

Livelihoods	Frequency	Percent
Pastoralism	162	88.5
Temporary Employment	83	45.4
Business	70	38.3
Crop production	54	29.5
Remittances	40	21.9
Tourism related Activities	30	16.4
Formal Employment	15	8.2

The participants were engaged in more than one livelihood source. Seven livelihood sources were identified by the participants, these included: Pastoralism (88.5 %), temporary employment as labourers (45.4 %), business (38.3 %), crop production (29.5 %), remittances (21.9 %), tourism related activities (16.4 %), formal employment (8.2 %).

4.4 Energy Sources Used by Maasai Pastoralists

Different energy sources used by Maasai pastoralists were documented in the study area, and the information was categorized into two main groups: Alternative sources of energy and conventional sources of energy.

4.4.1 Different Sources of Energy Used by Maasai Pastoralists

Twelve sources of energy were found to be used by Maasai pastoral households, six were categorized as alternative energy sources and six were categorized as conventional sources. The frequency distribution of the different energy sources used are given in Table 4.7

Table 4.7: Percent of Households Using Different Energy Sources

Source of Energy	Frequency	Percent
Alternative Energy Sources		
Solar	164	89.6
Wind	4	2.1
Bioenergy		
Agro-waste (biomass)	61	33.3
Biogas	20	10.9
Biodiesel (jojoba)	21	11.5
Electricity (Hydropower and Geothermal)	16	8.7
Conventional		
Fuel wood	155	84.7
Charcoal	172	93.9
Fossil Fuels		
Diesel	52	28.4
LPG	106	57.9
Paraffin	110	60.1
Petrol	67	36.6

The majority (93.9 %) of the households were found to use charcoal, while 2.1 % used wind energy. Conventional sources of energy had the highest use compared to the alternative energy sources. The conventional use included charcoal, fuel wood (84.7 %), paraffin (60.1 %), and LPG 57.9 %. The alternative energy sources on the other hand had low usage except solar (89.6 %), wind 2.1 %, agro-waste 33.3%, biogas 10.9 %, biodiesel 11.5 % and electricity 8.7 %.

4.4.2 Level of Use of Conventional Energy Sources

The household heads were asked to gauge their level of use of the conventional energy sources on a 6-point scale, ranging from 0= No use of the energy source, 1=very low level of use, 2= low level of use, 3= moderate level of use, 4= high level of use and 5 very high level of use. The scores were then averaged and are presented in Table 4.8.

Table 4.8: Level of Use of Different Energy Sources by Maasai Households

Source of Energy	Mean Level of Use	SD
Conventional		
Fuel wood	4.36	1.79
Charcoal	4.55	1.79
Fossil Fuels		
Diesel	0.41	0.92
LPG	1.61	1.87
Paraffin	3.75	1.97
Petrol	0.48	0.99
Conventional (Grand Mean)	3.06	1.17

The level of use of the conventional sources of energy was found to (M=3.06, SD 1.17).

4.5 Level of Use of Alternative Sources of Energy

The dependent variable for this study was the level of use of alternative sources of energy. The variable was operationalized as an index, which for this study included: solar, wind, hydro and geothermal and bioenergy. The participants were asked to rate their level of use of each of the four energy sources on a 6-point scale ranging from 0= No use of the energy source, 1=very low level of use, 2= low level of use, 3= moderate level of use, 4= high level of use and 5 very high level of use. The scores were then summed up and averaged. The descriptive statistics and the frequency distribution for the index in five categories are shown in Table 4.9.

Table 4.9: Descriptive Statistics and Frequency distribution of the index of Level of Use of Alternative Sources of Energy

Scale	Frequency	Percent
.00	16	8.7
.01 - 1	81	44.3
1.1- 2	65	35.5
2.1 -3	20	11.0
3.1- 4	1	0.5
Total	**183**	**100.0**

Mean 2.09±.057, Median 1, Mode .50, Std. Dev .780, min 0, Max 3.25

The mean level of use of alternative sources of energy by the Maasai pastoral households was 2.09 (medium level) and ranged between 0 and 3.25. This variable was used as the dependent variable in subsequent analysis. This frequency distribution was tested using the Chi-square Test of equality of categories and was found to be statistically significant as shown in Table 4.10.

Table 4.10: Chi-square test for the Equality of Categories for the Index of Level of Use of Alternative Sources of Energy by Maasai Pastoralists

Scale	Level of Use	Observed N	Expected N	Residual	Statistics
No use	No Use	16	36.6	-20.6	χ^2=129.65
,01 to 1	Very Low	81	36.6	44.4	*df*= 4
1.01-2	Low	65	36.6	28.4	*p*=.001
2.01-3	Medium	20	36.6	-16.6	
3.01-4	High	1	36.6	-35.6	
4.01-5	Very High	-	-	-	
Total		**183**			

The chi-square test revealed statistical ($p < .001$) significant differences among the different categories of household level of use of alternative sources of energy. The category of very Low (0.01-1) was statistically significantly (χ^2=129. 65, $df = 4$, $p < .001$) higher than the other categories, indicating that the majority of the households in the study area had a very low level of use of alternative sources of energy. This indicates a need for increase in the use of alternative sources of energy, which can be sustainable and a protection to the environmental resources.

4.6 Influence of Awareness on the Level of Use of Alternative Sources of Energy

The first objective of this study was to determine level of awareness of alternative energy (solar, wind, and bioenergy) sources and its influence on their level of use by Maasai pastoral households in Kajiado West, Kajiado County.

4.6.1 Level of Awareness of Alternative Sources of Energy

The level of awareness of alternative sources of energy was the independent variable. It was determined by asking the participants to rate their level of awareness of the different alternative sources of energy on a 6-point scale ranging from 0= Not aware, 1=very low level of awareness, 2= low level of awareness, 3= moderate level of

awareness, 4= high level of awareness and 5= very high level of awareness. The scores were then averaged and are presented in Table 4.11.

Table 4.11: Level of Awareness of Pastoral Households on Alternative Energy

Scale	Frequency	Percent
.00	10	5.5
.01-1	75	41.0
1.1 - 2	25	13.6
2.1- 3	59	32.3
3.1 - 4	14	7.6
Total	183	100.0

Mean 1.52±078, median 1.66, Mode 2.40, Std. Dev 1.05, min 1, max 4.

The level of awareness of the Maasai pastoral households on the alternative sources of energy was found to be low (M=1.52).

4.6.2: Determination of the Influence of Level of Awareness on the Use of Alternative Sources of Energy

The influence of the awareness on the level of use was determined by the use of bivariate linear regression. The dependent variable was the index of level of use of alternative sources of energy and the independent variable was the level of awareness of alternative energy sources. The results of the regression model are presented in Table 4.12.

Table 4.12: Regression Model Summary for Awareness and Level of Energy

R	***R* Square**	**Adjusted *R* Square**	**Std. Error of the Estimate**
0.633[a]	0.400	0.397	0.605

The model indicates an adjusted R^2 value of 0.397; meaning that the independent variable Pastoralists' awareness explained approximately 39.7 % of the

variation in dependent variable level of use of alternative sources of energy. The *F* test for the regression model is shown in Table 4.13.

Table 4.13: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	***Mean Square***	***F***	***p.***
Regression	44.368	1	44.368	120.835	0.001
Residual	66.459	181	.367		
Total	110.827	182			

The overall regression model was found to be significant (F (1, 181) =120.8, p <. 001). The regression coefficient of the model showing the *beta*, *t* statistics and the collinearity statistics is shown in Table 4.14.

Table 4. 14: Regression Coefficients for Awareness and Level of Use of Alternative Energy

	Unstandardized Coefficients		**Standardized Coefficients**			**Collinearity Statistics**
	B	**Std. Error**	***Beta***	***t***	***p.***	***VIF***
(Constant)	.381	.079		4.822	0.001	
level of Awareness	.468	.043	0.633	10.993	0.001	1.000

The regression analysis shows that pastoralists' level of awareness of alternative sources of energy had significant influence (β=.633, t=10.99, p<.001) on the level of use of alternative sources of energy in Kajiado west. This indicates that as the pastoralists' level of awareness is enhanced, it increases the level of use of alternative energy sources.

4.7 Influence of Technology Availability and Maintenance on the Level of Use of Alternative Sources of Energy

The second objective for this study was to assess the level of technology availability and maintenance needs of alternative sources of energy and its influence on the level of use by the Maasai pastoral community in Kajiado West, Kajiado County.

4.7.1 Technology Availability for Alternative Energy

The availability of technology for initial installation and maintenance of alternative energy sources was the independent variable. It was determined by asking the participants to subjectively rate the availability of technology for the different alternative energy sources using a 6-point scale ranging from 0= Not available, 1=very low level of availability, 2= low level of availability, 3= moderate level of availability, 4= high level of availability and 5= very high level of availability. The scores were then summed up and averaged and are presented in Table 4.15.

Table 4.15: Technology Availability for Alternative Energy Sources

Scale	Frequency	Percent
Below 1	15	8.2
1.1-2	134	21.3
2.20	14	7.7
2.1-3	15	3.8
Total	183	100.0

Mean 1.47, median 1.40, Mode 1, Std. Dev 0.529, min 0.8, Max 3.20

The level of availability of technology for alternative energy sources in Maasai pastoral households was found to be low (M=1.47) and ranged between 0.8 and 3.20.

4.7.2 Influence of Technology Availability on the Level of Use of Alternative Energy

The influence of the technology availability on the level of use of alternative energy in Maasai pastoral households in Kajiado west was determined by the use of

simple linear regression. The dependent variable was the index of level of use of alternative sources of energy and the independent variable was the level of technology availability of alternative energy sources. The results of the regression model are presented in Table 4.16.

Table 4.16: Regression Model Summary for Awareness and Level of Energy

R	***R* Square**	**Adjusted *R* Square**	**Std. Error of the Estimate**
0.402	0.162	0.157	0.716

The model indicates an adjusted R^2 value of 0.157; meaning that the independent variable technology availability for alternative energy sources was explained approximately 15.7 % of the variation in dependent variable level of use of alternative sources of energy. The *F* test for the regression model is shown in Table 4.17.

Table 4.17: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	***Mean Square***	***F***	***p***
Regression	17.944	1	17.944	34.967	0.001
Residual	92.883	181	.513		
Total	110.827	182			

The overall regression model was found to be significant (F (1, 181) =34.96, p <. 001). The regression coefficient of the model showing the *beta*, *t* statistics and the collinearity statistics is shown in Table 4.18.

Table 4.18: Regression Coefficients for Technology Availability and Level of Use of Alternative Energy

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	**Std. Error**	***Beta***	***t***	***p.***	***VIF***
(Constant)	.222	.157		1.417	0.158	
Technology Availability	.593	.100	0.402	5.913	0.001	1.000

The regression analysis shows that technology availability for maintenance of alternative energy sources had statistically significant influence (β=.402, t=5.91, p<.001) on the level of use of alternative sources of energy in Kajiado west. This indicates that technology availability influences the use of alternative energy in Kajiado West.

4.8 Influence of Affordability of Alternative Energy Sources on their Use by Maasai Pastoral Households

The third objective of this study was to assess the influence of affordability of alternative energy sources on their use by Maasai pastoral households in Kajiado West.

4.8.1 Affordability of Alternative Energy Sources

The independent variable affordability of alternative sources of energy was operationalized as an index that combined the subjective scoring by the participants on their perception of their affordability of different alternative energy sources using a 6-point scale ranging from 0= Not affordable, 1=very low affordability, 2= low affordability, 3= moderate affordability, 4= high affordability and 5= very high level of affordability. The scores were then summed up and averaged and their descriptive statistics and frequency distribution are presented in Table 4.19.

Table 4.19: Descriptive Statistics and Frequency Distribution of Affordability

Scale	Frequency	Percent
Below 1	47	25.7
1.1-2	44	24.0
2.1-3	27	14.8
3.1 -4	64	35.0
4.1-5	1	0.5
Total	183	100.0

Mean 2.12±.084, Median 2.20, Mode 3.20, Std. Dev 1.14, min 0, Max 4.60.

The independent variable level of affordability of alternative energy had a mean of (M=2.12) and ranged between 0 and 4.60.

4.8.2 Influence of Affordability of alternative Energy Sources on their Use

The influence of affordability of alternative energy sources on use of alternative energy by Maasai pastoral households in Kajiado west was determined by the use of simple linear regression. The dependent variable was the index of level of use of alternative sources of energy and the independent variable was the level of affordability of the alternative energy sources. The results of the regression model are presented in Table 4.20.

Table 4.20: Regression Model Summary for Level of Affordability of Alternative Energy Sources

R	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
0.648[a]	0.420	0.417	0.59594

The model indicates an adjusted R^2 value of 0.417; meaning that the independent variable affordability for alternative energy sources was explained approximately 41.7 % of the variation in dependent variable level of use of alternative sources of energy. The *F* test for the regression model is shown in Table 4.21.

Table 4.21: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	*df*	*Mean Square*	*F*	*p.*
Regression	46.546	1	46.546	131.065	0.001
Residual	64.280	181	.355		
Total	110.827	182			

The overall regression model was found to be significant (F (1, 181) =131.06, p <. 001). The regression coefficient of the model showing the *beta*, *t* statistics and the collinearity statistics is shown in Table 4.22.

Table 4.22: Regression Coefficients for Affordability and Level of Use of Alternative Energy

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	**Std. Error**	***Beta***	***t***	***p***	***VIF***
(Constant)	.153	.093		1.643	.102	
Alternative Energy Cost	.443	.039	0.648	11.44 8	0.001	1.000

The regression analysis shows that affordability of alternative energy sources had statistically significant influence (β=.648, t=11.44, p<.001) on the level of use of alternative sources of energy in Kajiado west. This indicates that affordability of alternative sources of energy influences their use by Maasai pastoral households in Kajiado West.

4.9 Influence of Efficiency of Alternative Sources of Energy on the Level of Use

The fourth objective of this study was to determine the influence of the efficiency of alternative sources of energy on the level of use of alternative sources of energy by Maasai pastoral households in Kajiado West.

4.9.1 Efficiency of Alternative Energy Sources

The independent variable efficiency of alternative sources of energy was operationalized as an index that combined the subjective scoring by the participants on their perception of the efficiency of different alternative energy sources using a 6-point scale ranging from 0= Not efficient, 1=very low efficiency, 2= low efficiency, 3= moderate efficiency, 4= high efficiency and 5= very high level of efficiency of the energy source. The scores were then summed up and averaged and their descriptive statistics and frequency distribution are presented in Table 4.23.

Table 4.23: Level of Effectiveness of Alternative Sources of Energy

Scale	Frequency	Percent
.00	7	3.8
.01- 1	78	42.6
1.1-2	43	23.4
2.1-3	40	21.8
3.1-4	15	8.1
Total	183	100.0

Mean 1.56±.071, Median 1.60, Mode .60, Std. Dev 0.972, Min 0, Max 4

The variable level of effectiveness of alternative sources of energy had a mean of (M=1.56) and ranged between 0 and 4.

4.9.2 Determining the Influence of Effectiveness of Alternative Energy Sources on the Level of Use by Maasai Pastoral Households

The influence of effectiveness of alternative energy sources on use of alternative energy by Maasai pastoral households in Kajiado west was determined by the use of

bivariate linear regression. The dependent variable was the index of level of use of alternative sources of energy and the independent variable was the level of effectiveness of the alternative energy sources. The results of the regression model are presented in Table 4.24.

Table 4.24: Regression Model Summary for Level of Effectiveness of Alternative Energy Sources

R	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
0.628[a]	0.394	0.391	0.60917

The model indicates an adjusted R^2 value of 0.391; meaning that the independent variable effectiveness of alternative energy sources explained approximately 39.1 % of the variation in dependent variable level of use of alternative sources of energy. The *F* test for the regression model is shown in Table 4.25.

Table 4.25: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	43.660	1	43.660	117.657	0.001
Residual	67.166	181	.371		
Total	110.827	182			

The overall regression model was found to be significant (F (1, 181) =117.65, p <. 001). The regression coefficient of the model showing the *beta*, *t* statistics and the collinearity statistics is shown in Table 4.26.

Table 4.26: Regression Coefficients for Efficiency and Level of Use of Alternative Energy

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	**Std. Error**	***Beta***	***t***	***p***	***VIF***
(Constant)	.307	.086		3.592	0.001	
Level of Effectiveness	.504	.046	0.628	10.847	0.001	1.000

The regression analysis shows that efficiency of alternative energy sources had statistically significant influence (β=.628, t=10.84, p<.001) on the level of use of alternative sources of energy in Kajiado west. This indicates that efficiency of alternative sources of energy influences their use by Maasai pastoral households in Kajiado West.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study, discussion of the results, conclusions of the study and the recommendations made.

5.2 Summary of the Study

This study aimed at assessing the factors influencing the level use of alternative sources of energy by Maasai pastoral households in Kajiado West. The study specifically examined four factors that affect the use of alternative sources of energy, these included: awareness of the energy source, Availability of technology, Affordability of the energy source, and efficiency of the energy source in providing energy to the households.

In achieving these objectives, the study used primary data which was collected using a structured questionnaire that was organized according to the key thematic areas corresponding to specific objectives of the study. The study then utilized descriptive statistics and inferential statistics to analyse the data.

The results showed that awareness of energy sources, availability of technology related to the alternative sources of energy, affordability of the energy source and efficiency of the energy source had statistically significant influence on the level of use by Maasai pastoral households in Kajiado West.

5.3 Discussion

The study findings for this study are discussed in this section based on the specific objectives stated in section 1.4 of this thesis.

5.3.1 Socio-economic Characteristics of Maasai Households

There are five key findings on the socioeconomic characteristics of the Maasai households arising from this present research. The socioeconomic characteristics assessed included household leadership, level of formal education, age, household number, and sources of livelihood.

First, women primarily led majority of the households in the study area, even though this had no significant effect on the dependent variable level of use of alternative sources of energy. The higher percentage of female-headed households in the area could be attributed to the issue of men migrating with animals in search of pasture. This result is consistent with previous studies in the area that have shown that men indeed move with animals in search of pasture and water leaving the women behind to run the households (Esho et al., 2021; Kajiado County, 2015). A female-headed household refers to a woman being in charge of managing the family as a result of either divorce, separation, immigration, or widowhood. These households are mostly affected by individual and psychological problems (Lebni et al., 2020). A study by Umar (2021) observed that men and women headed households had similar experiences on climate change impacts but differences existed in the way the two households adopted the mitigating measures.

Second, the literacy levels were found to be low, this finding agrees with the observations made in the area, that the level of formal education was low (Kajiado County, 2019). The 2019 Kenya Population and Housing Census report, found that at least 30 per cent of Kajiado County residents were illiterate, while the illiterate rate in the country was estimated at 18.47 % (KNBS, 2019).

Third, the average number of people living in the households was found to be 6, this number was found to be higher than the one for the sub-county (4.2), the whole county which was 3.5 and for the whole country which was 3.9 when compared with the 2019 population census (KNBS, 2019).

Fourth, majority of the household heads were involved in pastoralism as their main livelihood option in the study area, this meant that the majority of the households were involved in natural resources such as land, vegetation and animals. This compares well with the findings of Kombo and Ekisa (2015).

Fifth, the majority of the household heads were within 38 years of age, which is within the productive or working age group of between 15 and 64 years of age. The peak productive potential occurs at the age of between 33 to 44 years due to experience (Skirbekk, 2008).

5.3.2 Energy Sources Used by the Maasai Households in Kajiado West

The study found out that conventional and alternative energy sources were in use by Maasai pastoral households in Kajiado West. The conventional sources of energy used included: fossil fuel (paraffin, diesel, LPG, and petrol), fuelwood and charcoal. The alternative sources of energy, referred to as renewable energy sources like wind, fuel cells, solar, biogas/biomass, tidal, geothermal, are clean and abundantly available in nature. The results of this research indicate that despite the abundance and advantages alternative energy sources have over the conventional sources, they are not highly preferred by the people and a stiff completion between the two sources exists. The study found that the conventional energy sources were utilized more by the Maasai pastoral households in Kajiado West than the alternative sources of energy. This finding

differs with the situation in Tanzania, where the households use more than 90 % of biomass for their household use (Mwema & Gheewala, 2011). The Tanzanian situation differs from that of Kenya, Khan and Salek (2019) found that a series of rural electrification and other programs had resulted in the installation of more than 20,000 small-scale PV- systems since 1986. These PV systems now play a significant role in decentralized and sustainable electrification.

The ranking system used in this study compares well with the one used by Budak et al., (2019) who developed a ranking system that was able to assess the different ranking of alternative energy systems based on a 5 point criteria, which included cost of energy, efficiency, environmental impact, job creation, and security (resilience to incidents). They observed that there are differences in the rankings of energy alternatives for different cities, indicating that it is necessary to apply the decision support system developed in their study to help form customized energy strategies for cities with unique characteristics. In applying the decision support system to three cities, Chengdu in China, Eskisehir in Turkey, and Chicago in the United States of America showed that improving energy efficiency and development of solar and wind energy are the most preferred energy alternatives whereas nuclear and hydroelectric are the least preferred energy alternatives for these three cities. According to the estimation results obtained in the study, renewable energy has a positive and statistically significant effect on sustainable development both in developed countries and in developing countries. (ibid).

The study identified challenges that may hinder sustainable use of the renewable energy resources, despite the opportunities they have in enhancing sustainable

development and mitigating climate change (Güney, 2016). These challenges include market failures, lack of information, access to raw materials for future renewable resource deployment, and our daily carbon footprint (Owusu, & Asumadu-Sarkodie, 2016). The use of alternative sources of energy named as new and renewable energy sources have not been able to compete with conventional or traditional sources of energy due to lack of technological development and economic challenges (Sahin et al., 2020). A study in rural Ethiopia by Guta (2020) to determine household use of energy-efficient and renewable energy technologies found that richer households, educated household heads, participation in off-farm employment, and monetary incentives (credit and subsidy) increased the adoption of energy technologies.

The potential for alternative energy sources in Kajiado West were found to be good. This can be explained by the fact that there are recent developments that have occurred. Østergaard et al., (2020) reviewed recent developments in renewable energy technology and identified unexploited potentials for renewable energy, and concluded that systems for transforming alternative energy were good. Igbinovia and Krupka (2018) in their study concluded that: as renewable power technology is now becoming more inexpensive, there are indications that in some markets in the continent, renewable power technologies might become easily affordable as compared to non-renewable energy. Thus, Africa's economic success could indeed be driven by renewable energy (RE) technologies

5.3.3 Influence of Awareness of the Energy Sources on the Level of Use of Alternative Sources of Energy in Kajiado West

The level of awareness of alternative sources of energy by Maasai pastoralist had a statistically significant influence on the level of use of the alternative energy by the households. This could be attributed to the fact that the awareness of the existence and usefulness of the energy source would lead one to desire to use the resource. This finding agrees with the work of NETFUND (2017) in Narok, where they concluded that when the public was made aware of an energy resources, its utilization increased. Public awareness of the sources of energy and its usefulness enhances the utilization of renewable energy sources (Khambalkar et al., 2011).

Oluocha et al., (2020) found that Kenyan citizens living in both urban and rural areas, strongly approved the development of renewable energy technologies (73%) and believed that renewable energy technologies will reduce the cost of electricity (91%). Also, 69.5% of Kenyan respondents indicated a high level of awareness for renewable energy-related terms. In the current study the ordered logistic regressions revealed a significant relationship between the dependent variable “attitude” and independent variables of “awareness” and “education” for all renewables (solar, wind and geothermal) except biomass. The increase in the awareness of alternative sources of energy has also increased their use. The International renewable energy agency (IRENA, 2021, p 39) review of the installed capacities of renewables in Kenya concluded that there was an increased capacity in hydropower, geothermal, solar photovoltaic cells (PV), solar concentrated solar power (CSP), bioenergy, and wind when compared to 2012 capacities.

It was observed from the study that the public were aware of the different sources of energy. The study revealed that the participants were aware of the existing renewable energy sources, their non-polluting nature and that going for the utilization of renewable energy was a very good idea as similarly observed by Edsand & Broich (2020). The relationship between environmental education and awareness of renewable energy technologies (RETs) was found to be weak. Assali et al., (2019) developed a questionnaire to measure the awareness of youth of RE in Palestine and found that students' awareness and knowledge about RE were limited. Moula et al., (2013) found that 33 % of the Finnish population was not aware of long-term economic feasibility of using RETs. Karatepe et al., (2012) concluded that renewable energy education must be quickly and efficiently spread to future generations.in Turkey. Karytsas and Theodoropoulou (2014) examined the factors that determine knowledge on different forms of RES in Greece and found that the factors having a statistically significant relation with the different forms of renewable energy were gender, age, education level, head of household education level, environmentally friendly behaviour and having an occupation, studies or interests related to environment, technology or engineering.

Karasmanaki and Tsantopoulos (2019) explored the awareness about and attitudes towards RES of students majoring in the Department of Forestry and Management of the Environment and Natural Resources at the Democritus University of Thrace in Greece. Students supported renewables and had awareness about the current polluting energy system. Moreover, they had positive environmental attitudes and fully recognized the need for energy transition. Guven, and Sulun (2017) study aimed to explore the awareness and knowledge of pre-service teachers regarding renewable energy in Turkey's Mugla province using Renewable Energy Awareness

Scale and Renewable Energy Knowledge Level Test" found positive correlations between knowledge level and awareness. Alawin et al., (2016) found that lack of awareness and shallow knowledge about energy and renewable energy technologies among senior students in faculties of engineering.

5.3.4 Influence of Technology Availability on the Level of Use of Alternative Energy Sources in Kajiado West

The availability of technology in installing and maintenance of alternative sources of energy had a statistically significant influence on the level of use of alternative energy by Maasai pastoral households in Kajiado west. This is true in that after the initial purchase, most of the appliances related to alternative energy sources end up remaining unused when they need repair due to lack of spares or the technology to repair the gadgets. The technical maturity of a particular technology determines the potential to further refine it – and, consequently, the potential for further cost reductions. Yet there are also technological and operational parameters that limit the potential for cost reductions, despite very good energy yield prospects (Synwoldt & Reis, 2011).

The study findings agree with Wassie, and Adaramola (2019) work at the geographic level in the East African region, where they concluded that the impact of the technologies is limited and undeveloped. Technology was identified as one of the main barriers to the willingness to invest in wind-generated electricity. This is particularly true in cases where core renewable energy technologies are not provided in many places or are not sustained well in some areas where present in the developing countries, especially Sub-Saharan Africa. Because of lack of trained personnel to train, demonstrate, maintain and operate renewable energy structures, especially in regions

with low education levels, people are unwilling to import the technologies for fear of failure. This was also realized by Akinyele et al. (2019) that lack of technical expertise, high technology cost and lack of project funding, including a lack of enabling policies to drive the technologies was evident. Khan and Reza (2019) found that Developing countries generally do not have elaborate policies to support development of renewable energy technologies; they lack plans and strategies, laws and regulatory frameworks, market mechanisms, financial tools, and incentives.

Smil (2019) concluded that energy generation in the future would rely more on technology that aims at changing from the long-term dominant centralized system to distributed energy generation systems that depend on small-scale decentralized, local or onsite generation of energy through tapping on renewable energy sources. The decentralized system call for an integrated system design of microgrids (MGs) to help in the realization of sustainable energy supply pattern in a decentralized manner for improving community resilience and environmental sustainability (Zhang et al., 2020).

5.3.5 Influence of Affordability of the Alternative Energy Sources on the level of use of the alternative energy by Maasai pastoral Households in Kajiado West

The affordability of alternate energy sources by Maasai pastoralists was found to statistically significantly influence the level of use of the alternative energy sources. The alternative energy sources have a high initial purchase cost that can be prohibitive to many pastoral households. The main limitation of alternative energy sources is the investment cost and the natural resource availability, such as solar irradiation, wind, organic matter for biomass systems (Synwoldt & Reis, 2011). Affordability in particular remains a critical barrier to scaling up these solutions. Even though people without electricity access often pay a lot for their energy sources, such as kerosene and

candles – sometimes more than they would pay for the same service if they had electricity access – the upfront costs for off-grid systems may still be higher than most consumers are willing or able to pay. Akinyele et al., (2019) concluded that lack of technical expertise, high technology cost and lack of project funding, including a lack of enabling policies to drive the technologies was evident. Bidzi and Long, (2017) study found that, as renewable energy technologies require high upfront investments; public-private partnerships (PPP) can provide the needed capital to supplement limited public sector funding for technology and innovation of renewed energy technology (RET).

5.3.6 Influence of Efficiency of Energy Source on the Level of Use of Alternative Sources of Energy by Maasai Pastoral Households in Kajiado West

The efficiency of the energy source was found to statistically significantly influence the level of use of alternative energy source by Maasai pastoral households. The efficiency of an energy source in meeting the energy needs of the households is a factor that comes into consideration when one is deciding on the energy source to use. This view was supported by Abolhosseini, et al., (2014) who concluded that alternative energy sources, which are renewable in nature need technologies for enhancing the efficiency of the energy source to produce energy in a cost effective sustainable manner. Wojuola and Alant, (2017) working in Nigeria realized significant positive correlations between perceived usefulness, perceived ease of use and intention to use renewed energy technologies (RET). They concluded that there was need for both formal and informal energy education in the country to remove negative perceptions about RET by providing information on how RET works. Aliyu et al., (2018) concluded that African countries could overcome the persistent energy crisis in the continent by utilizing the naturally gifted renewable energy sources by providing proper technology, awareness and skills for harnessing the resources, and address energy challenges such as energy

efficiency measures (which include grid extension, energy storage technology, and seasonal variation).

In developing policies for efficient energy systems for the future, Welsch et al. (2017) concluded that the system needs to be reliable, flexible, secure energy, affordable, renewable, transition to a low carbon energy, technology and regulatory actions, socio-economic costs of energy supply interruptions, energy storage capacity to guard against scarcity in imported energy,

5.4 Conclusions

The following conclusions were made from the study:

(i) The Maasai pastoral households in Kajiado West were found to have low level of use of alternative sources of energy. In comparison the households used the conventional sources of energy more than the alternative energy sources.

(ii) Awareness of alternative sources of energy had statistical significant influence on the level of use of alternative energy sources by Maasai pastoral households in Kajiado west.

(iii) Availability of technology for installing and maintaining the alternative energy source had a statistically significant influence on the level of use of the alternative sources of energy by Maasai pastoral households in Kajiado West.

(iv) Affordability of alternative energy sources by Maasai pastoral households in Kajiado West had statistically significant influence on the level of use of the alternative energy sources.

(v) The efficiency of the alternative source of energy had a statistically significant influence on the level of use by Maasai pastoral households in Kajiado West.

5.5 Recommendations

Based on the findings of the study, the following recommendations were made:

The planning for the implementation of the alternative sources in Kajiado west should take into consideration the factors found in this study to affect adoption by the pastoral households, these factors include: creating awareness of alternative sources of energy, provision of technology related to the energy source, affordability of technology and improving the efficiency of the energy sources.

The need for technology in developing and maintaining alternative sources of energy will require the county government of Kajiado to create multi-stakeholder networks of people and organizations related to the supply, installation and maintenance of alternative energy sources in Kajiado West to ensure a sustainable use of the alternative energy sources.

The need for creating awareness and knowledge on alternative energy sources will require the county government to create public-private partnerships to enhance capacity building of the households to transferring the alternative energy technology to the users. This will create efficiency use of alternative energy and enhance their supply and use by the households.

5.6 Recommendations for Further Research

The following are recommended to be done for further research within the Maasai pastoral households in Kajiado West:

(a). Determine the influence of multi-stakeholder platforms in the enhancement of the use of alternative sources of energy

(b). Assess how alternative sources of energy can be enhanced in the area.

REFERENCES

Abolhosseini, S. Heshmati, A. & Altmann, J. (2014) A Review of Renewable Energy Supply and Energy Efficiency Technologies. IZA DP No. 8145

Akinyele, D. Babatunde, O. Monyei, C. Olatomiwa, L. Olkediji, A. Ighravwe, D. Onile, A. Onasanya, A. Temikotan, K. (2019). Possibility of solar thermal power generation technologies in Nigeria: Challenges and policy directions. *Renewable Energy Focus* 29: 24-41. https://doi.org/10.1016/j.ref.2019.02.002.

Alawin, A.A. Rahmeh, T.A. .Jaber, J.O. Loubani, S. Dalu, S.A. Awad, W. Dalabih, A. (2016) Renewable energy education in engineering schools in Jordan: Existing courses and level of awareness of senior students *Renewable and Sustainable Energy Reviews* 65 2016, Pages 308-318 https://doi.org/10.1016/j.rser.2016.07.003

Aliyu, B.K., Modu, B., Tan, C.W. (2018) A review of renewable energy development in Africa: A focus in South Africa, Egypt and Nigeria. *Renewable and Sustainable Energy Reviews* 81 (2): 2502-2518

Assali, A. Khatib, T. & Najjar, A. (2019) Renewable energy awareness among future generation of Palestine Renewable Energy 136: 254-263

Bass, F.M. (2016). *The Adoption of a Marketing Model: Comments and Observation.* Cambridge: Cambridge publications.

Bekure, S., de Leeuw, P.N., Grandin, B.E. & Neate, P.J.H. (1991). *Maasai herding*. An analysis of the livestock production system of Maasai pastoralists in eastern Kajiado District, Kenya. ILCA system study 4. ILCA (international Livestock Centre for Africa), Addis Ababa, Ethiopia. 172 pp.

Bidzi, Z.E.C. & Long, P. W. (2017) investment motivation in renewable energy: A PPP approach. *Energy Procedia* 115: 229–238.

Budak, G., Chen, X., Celik, S. & Ozturk, B. (2019) A systematic approach for assessment of renewable energy using analytic hierarchy process. *Energy, Sustainability and Society* 9:37 https://doi.org/10.1186/s13705-019-0219-y

Burns, N. & Grove, S.K. (2003) *Understanding Nursing Research*, (3rd ed.), Philadelphia: W.B. Saunders Company.

Centre for Climate and Energy Solutions (2018) Effects of availability of technology on adoption of adoption of renewable energy. *C2ES Journal*, *3*(2), 45-68.

Chen, C. & Arpan, A. (2017). Relationship between technology acceptance model and sustainable energy technology: investigating smart meter acceptance in the United States, energy, *Research and Social Science*, *25*(2), 93-104.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Sciences* (2nd Ed), New York: Psychological press.

Couture, S., Garcia, S. & Reynaud, A. (2012). Household energy choices and fuel wood consumption: an econometric approach using French data. *Energy Econ 34*(6), 1972–1981.

Diaz, P., Adler, C., & Patt, A. (2017). Stakeholders' perspective on renewable energy infrastructure poses a risk to energy policy implementation, a case of hydropower plant in Switzerland. *Energy Policy Journals*, *108*(8), 21-28.

Edsand, H.E., & Broich, T. (2020). The Impact of Environmental Education on Environmental and Renewable Energy Technology Awareness: Empirical Evidence from Colombia. *International Journal of Science and Math Educ* **18:** 611–634 https://doi.org/10.1007/s10763-019-09988-x

Ekardt, F., & Hövel, A. (2009). Distributive Justice, Competitiveness and Transnational Climate Protection. Carbon & *Climate Law Review3*, (6), 102–114.

Esho T, Komba E, Richard F, Shell-Duncan B. (2021) Intersections between climate change and female genital mutilation among the Maasai of Kajiado County, Kenya. *J Glob Health;11*: 04033. 1-10.

Everlyne, A.C., Agnes, N.O., & David, A.M. (2013). Socio-economic factors influencing adoption of Energy–Saving technologies among smallholder farmers: The case of West Pokot County, Kenya. *International Journal of Agricultural Management and Development*, *3*(4), 289-301.

Ganda, F. & Ngwakwe, C. (2014). Problems of sustainable energy in sub-Saharan Africa and possible solutions. *Mediterranean Journal of Social Sciences*, *5*(6), 453.

Gitone, I. (2017). Determinants of adoption of renewable energy in Kenya. *Unpublished Journal*, University of Nairobi.

Gosden, E. (2015). UK coal plants must close by 2025, Amber Rudd announces. *The Independent*. London: UK.

Griffith-Jones, S., Ocampo, J.A. & Spratt, S. (2012). Financing renewable energy in developing countries: Mechanisms and responsibilities. *European Report on Development Journals, 11*(9), 65-78.

Güney, T. (2016) Renewable energy, non-renewable energy and sustainable development International *Journal of Sustainable Development & World Ecology* 26 (5):389-397. https://doi.org/10.1080/13504509.2019.1595214

Guta, D.D. (2020) Determinants of household use of energy-efficient and renewable energy technologies in rural Ethiopia *Technology in Society* 61: 101249https://doi.org/10.1016/j.techsoc.2020.101249

Guven, G. & Sulun, Y. (2017) Pre-service teachers' knowledge and awareness about renewable energy Renewable and Sustainable Energy Reviews 80: 663-668 https://doi.org/10.1016/j.rser.2017.05.286

Harvey, F. (2016). Energy storage vital to keep UK lights on, say MPs. *The Guardian*. London: UK.

Hauser, J.R. & Shugan S.M. (2010). *Intensity Measures of Consumer Preference, Operation Research, 28* (2), 278-320.

Igbinovia, F. O. and Krupka, J. (2018) "Renewable Energy Integration in Africa: A Case Study of the Adoption of New Technology by the Electricity Transmission Company of Nigeria," *2018 International Conference on Power System Technology (POWERCON)*, 2018, pp. 2034-2042, doi: 10.1109/POWERCON.2018.8602197.

Johnson, O. & Nyambane, A. (2016). County energy planning in Kenya: Local participation and local solutions in Migori County. *Stockholm Environment Institute Journals*, 16(1), 1-42.

Johnson, O. & Nyambane, A. (2016). County energy planning in Kenya: Local participation and local solutions in Migori County. *Stockholm Environment Institute Journals*, *16*(1), 1-42.

Kajiado County (2019). *Kajiado County Renewable Energy Atlas*, Kajiado County press release.

Kajiado County Government (2019) *Kajiado County Strategic Plan (2014/15 – 2018/2019).* Re-orienting HIV and AIDS response in a devolved system of Government

Kantai, P. (2012). Inside Kenya’s 23 billion shilling charcoal industry; Environment *Liaison Centre International. EcoForum, 24*(4), 24-56.

Karasmanaki, E. & Tsantopoulos, G. (2019) Exploring future scientists' awareness about and attitudes towards renewable energy sources *Energy Policy* 131: 111-119

Karatepe, Y. Neşe, S.V. Keçebaş, A. Yumurtacı, M. (2012). The levels of awareness about the renewable energy sources of university students in Turkey *Renewable Energy* 44: 174-179

Karekezi, S. & Kimani, J. (2014). Status of Power Sector Reform on the Poor. Energy Policy, *Special Issue*, *30*(2), 11–12.

Karekezi, S. (2013) Renewable in Africa – Meeting the Energy Needs of the Poor', *Energy Policy*, *30*(2), 11-12.

Kariuki, D. (2018) Barriers to Renewable Energy Technologies Development. Energy Today DOI: dx.doi.org/10.1515/energytoday-2018-2302

Kariuki, D. (2018). Barriers to renewable energy technologies development. *America Energy Society Journals*, *3*(7), 47-89.

Karytsas, S. & Theodoropoulou, H. (2014) Socioeconomic and demographic factors that influence publics' awareness on the different forms of renewable energy sources Renewable Energy 71: 480-485

Kathuni, L.K. &Mugenda, N. G. (2012). Direct Sales Strategy, Product Differentiation: A Tool of Competitive Advantage and Optimal Performance, *European Scientific Journal* 9(34), 1857 – 7881.

Katy, L., Roshni, P., Munir, H., & Dalia, M. (2012). Climate Change: Mitigation and Adaptation. *Advocates for International Development Journals*, *2*(6), 56-78.

Keriri, I. (2013). Factors influencing adoption of solar technology in Laikipia North Constituency Kenya. *Unpublished Journal*, The University of Nairobi.

Khambalkar, V. P.,Katkhede, S. S., ,Dahatonde, S. , Korpe, N. D. & Nage, S. M. (2011) Renewable energy: An assessment of public awareness International *Journal of Ambient Energy* 31 (3): 133-142. https://doi.org/10.1080/01430750.2010.9675112

Khan, K.A. & Reza, S.M.Z. (2019). The Situation of Renewable Energy Policy and Planning in Developing Countries *IJARIIE* 5 (4): 557-565

Khan, K.A. & Salek, M.A. (2019). A Study on Research, Development and Demonstration of Renewable Energy Technologies *IJARIIE* 5 (4): 2395-4396

Kimutai, S., Kiprop, A., & Siagi, Z. (2019). Factors affecting the number of household energy source in Kenya. Generalised linear model, *International Journal of Novel Research in Engineering and Science*, *6*(2), 27-32.

Kitheka, E., Kimiti, J., Oduor1, N., Wanza, J., Ingutia, A., & Githiomi, J. (2019). Factors influencing adoption of Biomass energy conservation technologies in selected areas in Kitui County. *Unpublished Journals*, University of Nairobi, Kenya.

Kitsao, N. (2018) Factors influencing access to renewable energy by rural families, A case of Solar lanterns project in Isiolo County. *Unpublished Journal*, University of Nairobi.

Kothari, C.R. (2012). *Research Methodology. Methods and Techniques*. Delhi: New Age International Publishers.

Kombo, N.P. & Ekisa, G.T. (2015) The Impacts of Land Use Changes on Livelihood of the Maasai Community in Kajiado County, Kenya. Ethiopian Journal of Environmental Studies and Management. 8 (4):433-441. DOI: 10.4314/ejesm.v8i4.8 Vol. 8 No. 4 (2015)

Krejcie, R.V., & Morgan, D.W., (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement. Educational and Psychological Measurement* 30: 607-610.

Kuhudzai, R. (2020). *Kenya Meets Renewable Energy Generation Target*. Clean technia publications.

Laplume, A., Karan, S. & Reginald, L. (2008). Stakeholder Theory: Reviewing a Theory That Moves Us. *Journal of Management*. *34*(6): 1152–1189

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford UP.

Lebni, J.Y., Gharehghani, M.A.M., Soofizad, G. Bahar khosravi, B., Ziapour, A. & Irandoost, S.F.(2020) Challenges and opportunities confronting female-headed households in Iran: a qualitative study. *BMC Women's Health 20*:183 https://doi.org/10.1186/s12905-020-01046-x

Legris, P., John, I., & Pierre, C. (2013). Why do people use information technology? A critical review of the technology acceptance model, *Information & Management*, *40*(3), 191-204.

Lins, C. & Murdock, H.E. (2017). The Impact of Renewable Energy Technologies on Global Energy Efficiency. UN Chronicle.

Mackenzie, W. (2019) the cost of converting USA energy system to renewable energy. *Tale Journals of Environment Studies*, *1*(1), 1-40.

Mcfarland, D., & Hamilton, D. (2006). Adding contextual specificity to the technology acceptance model. *Computers in Human Behaviour*, *22*(3), 427-447.

Miles, S. (2012). Stakeholders: essentially contested or just confused? *Journal of Business Ethics*. *108* (3): 285–298.

Mishra, S.B. & Alok, S. (2017) *Handbook of Research Methodology*. A Compendium for Scholars & Researchers. New Delhi: India: Educreation Publishing.

Moula, M.M.E., Maula, J. Hamdy, M. Fang, T. Jung, N. Lahdelm, R. (2013) Researching social acceptability of renewable energy technologies in Finland *International Journal of Sustainable Built Environment* 2(1): 89-98

Mugenda, O. & Mugenda, A. (2008). *Research Methods: Quantitative and Qualitative Approaches*. Nairobi: Act Press.

Mugenda, O.M., & Mugenda, A.G. (2012). *Research Methods: Quantitative and Qualitative Approaches*. Nairobi: Act press.

Munyaka, P. (2019). *Highlights of Kenya's Energy Act 2019*. Rodl & Partner publications.

Mutua, J., & Kimuyu, P. (2015). Household energy conservation in Kenya: estimating the drivers and possible savings. *Environment for Development Discussion Paper-Resources for the Future*, *3*(4), (15-04).

Mwema F. & Gheewala, S.H. (2011) A Review of Biomass Energy Dependency in Tanzania Energy Procedia 9: 338-343.

NETFUND (2017) *Factors influencing household adoption of renewable energy technologies in Rural Kenya*. National Environment Trust Fund and Kenya Industrial Research and Development Institute publications.

Nfah, E., & Ngundam, J. (2012). Identification of stakeholders from sustainable renewable energy applications in Cameroon. *Renewable and Sustainable Energy Reviews*, *16*(7), 4661-4666.

Obwatho, S. (2014). *Academic Research Writing: The Logical Sequence*. Nairobi: Starbright services Ltd.

OECD (2019). *Factors influencing implementation of alternative sources of energy in the world*. Available at: https://www.c2es.org/content/renewable-energy.

Oluocha, S. Lal, P. Susaeta, A. Vedwan, N. (2020) Assessment of public awareness, acceptance and attitudes towards renewable energy in Kenya. *Scientific African 9*: 1-13. https://doi.org/10.1016/j.sciaf.2020.e00512

Østergaard, P.A., Duic, N., Noorollahi, Y. Mikulcic, H. Kalogirou, S. (2020) Sustainable development using renewable energy technology *Renewable Energy 146*: 2430-2437

Owusu, P.A. & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering 3*:1, 1167990, DOI: 10.1080/23311916.2016.1167990

Protection Energy (2017) Local renewable energy and resources use in Manhattan, *Environment Protection Agency Journals*, *1*(2), 1-34.

Pundo, M.O., & Fraser, G.C. (2006). Multinomial logit analysis of household cooking fuel choice in rural Kenya: The case of Kisumu district. *Agrekon, 45*(1), 24-37.

Renewable World Energy (2018) Different uses of energy in our daily lives in rural and urban regions, U*npublished Journal*, Renewable energy world USA,

Sarkodie, S., & Ozturk, I (2020). Investigating the Environmental Kuznets Curve hypothesis in Kenya: A multivariate analysis. *Renewable and Sustainable Energy Reviews*, *1*(17), 109-481.

Sena, K. (2018). Kipeto wind energy project. A case study on best practice in community engagement in energy projects. *International Fund for Agricultural Development (IFAD) Publications*, *2*(4), 18-35.

Silva, C. (2018) factors influencing the development of renewable energy strategies; the case of Lolland and Samso Island in Denmark [Master thesis, Lunds University].

Skirbekk, V. (2008). Age and Productivity Potential: A New Approach Based on Ability Levels and Industry-Wide Task Demand. *Population and Development Review*, *34*, 191–207. http://www.jstor.org/stable/25434764

Smil, V. (2019) Distributed Generation and Megacities: Are Renewables the Answer? *IEEE Power & Energy Magazine* 17 (2): 37 – 41. DOI: 10.1109/MPE.2018.2884112

Synwoldt, C. & Reis, A. (2011). Cost trends of Renewable Energy Technologies for the Power Generation. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Umar, B.B. (2021) Adapting to Climate Change Through Conservation Agriculture: A Gendered Analysis of Eastern Zambia. *Frontiers in Sustainable Food Systems 5*: 748300. 1-18. https://doi.org/10.3389/fsufs.2021.748300.

UNEP (2011). *Global Trends in Renewable Energy' Analysis of Trends and Issues in the Financing Renewable Energy*. UNEP publications.

Venkatesh, V., Morris, M.G., Davis, G.B. & Davis, F.D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425.

Wanjiru, H., & Ochieng, F.X. (2013). Underpinning Factors for the Development of a Commercialization Strategy for Small Wind. *Innovation and Development Journals, 3*(9)-904–910.

Wassie, Y.T. & Adaramola, M.S. (2019) Potential environmental impacts of small-scale renewable energy technologies in East Africa: A systematic review of the evidence *Renewable and Sustainable Energy Reviews 111*: 377-391

Welsch, M., Pye, S., Keles, D., Faure-Schuyer, A., Dobbins, A., Shivakumar, A., Deane, P., Howells, M. (2017) *Europe's Energy Transition, Insights for Policy Making* Academic Press.

Wojuola, R. N. & Alant, B.P. (2017) Public perceptions about renewable energy technologies in *Nigeria African Journal of Science, Technology, Innovation and Development 9*(4): 399-409 https://doi.org/10.1080/20421338.2017.1340248

Wu, G. (2015). Renewable Energy Zones for the Africa Clean Energy Corridor. *International Renewable Energy Agency (IRENA) and Lawrence Berkeley Journals*, 18(7), 134-165.

Yibeltal T. Muyiwa, W. Fig, S.A. (2018) Potential environmental impacts of small-scale renewable energy technologies in East Africa: A systematic review of the evidence.1123445678–1011–1516

Zhang, W., Valencia, A., Gu, L., Zheng, Q.P., Chang, N. (2020) Integrating emerging and existing renewable energy technologies into a community-scale microgrid in an energy-water nexus for resilience improvement. *Applied Energy 279*: 1-18 (115716)

APPENDICES

Appendix A: Cover Letter

Dear Respondent,

RE: REQUEST FOR YOUR PARTICIPATION IN A RESEARCH PROJECT

My name is John Kanini, currently pursuing a course towards completion of Masters of Science in Environment and Natural Resource Management from Africa Nazarene University.

In partial fulfilment of the requirements of the award of the degree, I am conducting a study on factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West Kajiado County. You have been voluntary selected to participate in this study where you are only required to give response with respect to study questions.

Your participation will be highly appreciated.

Yours Sincerely,

John Kanini

Appendix B: Questionnaire

INSTRUCTION: **Please, fill in the spaces with the required responses in the spaces provided**

NB: The provided information will only be used for academic purposes

---

General Information

1. Gender

   Male ☐

   Female ☐

2. Age category

   20-25 years old ☐

   26-30 years old ☐

   31-35 years old ☐

   36-40 years old ☐

   41 and above ☐

   3. Highest level of Education attained

   None ☐

   Primary ☐

   Secondary ☐

   Graduate ☐

   Post graduate ☐

Part I: Level of use of Alternative sources of energy

Respondents are required to rate their level of use of alternative sources of energy on a 6-point scale as follows: 0=Not Use, 1= very low level of use, 2= low level of use, 3= Moderate level of use, 4= high level of use and 5= very high level of use

Commonly used alternative sources of energy	**Yes/ No**	**Level of Use**				
		Lighting	**Cooking**	**Domestic Equipment**	**Commercial Equipment**	**Other**
5. Solar panel						
6. Wind						
Bio-energy						
7. Agro-waste (biomass)						
8. Biogas						
9. Biodiesel						
10. Hydro-Electricity						
11. Geothermal						
12. Charcoal						
13. Wood fuel						
Fossil fuels						
14. LPG						
15. Diesel						
16. Paraffin						
17. Petrol						

Part II: Awareness of Alternative Sources of Energy

The purpose of this section is to present questions in relation to the first objective meant to determine the influence of awareness of alternative sources of energy on the level of their use. Respondents are required to rate their level of awareness on a 6-point scale as follows: 0=Not Aware, 1= very low level of awareness, 2= low level of awareness, 3=

Moderate level of awareness, 4= high level of awareness and 5= very high level of awareness.

Level of awareness of alternative sources of energy	**0**	**1**	**2**	**3**	**4**	**5**
18. Solar panel						
19. Wind						
20. Agro-waste (biomass)						
21. Biodiesel						
22. Biogas						
23.						
24. Hydro power						
25. Geothermal						
26. Wood fuel						
27. Charcoal						
28. LPG						
29. Diesel						
30. Paraffin						
31. Petrol						

The purpose of this section is to present questions in relation to the usage of alternative sources of energy among the people of Kajiado West, Kajiado County. Respondents are required to give responses based on the given Likert scale and spaces provided where 1 = strongly disagreed, 2 = Disagree, 3 = undecided, 4 = Agree and 5 = Strongly Agree

Opinion variables	**1**	**2**	**3**	**4**	**5**
32. There is increased connectivity of alternative sources of energy in Kajiado West					
33. The rate of usage of alternative sources of energy is growing in Kajiado County					

Part III: Technology availability and maintenance

The purpose of this section is to present questions in relation to the second objective of the study meant to determine the influence of technology availability and maintenance of alternative sources of energy on the level of their use. Respondents are required to rate the level of technology availability on a 6-point scale as follows: 0=Not Available, 1= very low level of availability, 2= low level of availability, 3= Moderate level of availability, 4= high level of availability and 5= very high level of availability.

	Technology availability and maintenance	**Level of availability**					
Source of energy	**Yes/No**	**0**	**1**	**2**	**3**	**4**	**5**
34. Solar panel							
35. Wind							
36. Agro waste (biomass)							
37. Biodiesel							
38. Biogas							
39. Hydropower							
40. Geothermal							
41. Fuel wood							
42. Charcoal							
Fossil fuel							
Diesel							
LPG							
Paraffin							
Petrol							

Part IV: Affordability of source of energy

Respondents are required to rate their level of technology affordability on a 6-point scale as follows: 0=Not Affordable, 1= very low level of affordability, 2= low level of affordability, 3= Moderate level of affordability 4= high level of affordability and 5= very high level of affordability.

	Affordability of technology	**Level of Affordability**					
Source of energy	**Yes/No**	**0**	**1**	**2**	**3**	**4**	**5**
43. Solar panel							
44. Wind							
45. Agro waste (biomass)							
46. Biodiesel							
47. Biogas							
48. Hydropower							
49. Geothermal							
50. Fuel wood							
51. Charcoal							
Fossil fuel							
Diesel							
LPG							
Paraffin							
Petrol							

The purpose of this section is to present questions in relation to third objective of the study meant to determine the influence of cost of alternative source of energy on the level of their use. Respondents are required to give responses based on the given Likert scale and spaces provided where 1 = strongly disagreed, 2 = Disagree, 3 = undecided, 4 = Agree and 5 = Strongly Agree

Opinion variables	**1**	**2**	**3**	**4**	**5**
52. Alternative sources of energy requires high installation cost					
53. Alternative source of energy requires high maintenance cost					
54. The procurement of alternative sources of energy cost is high					

PART V: Effectiveness as a Source of Energy

The purpose of this section is to present questions in relation to fourth objective of the study meant to determine the effectiveness of alternative sources of energy on the level of their use. Respondents are required to rate the level of energy technology effectiveness on a 6-point scale as follows: 0=Not Effective, 1= very low level of effectiveness, 2= low level of effectiveness, 3= Moderate level of effectiveness, 4= high level of effectiveness and 5= very high level of effectiveness.

	Effectiveness of Technology	**Level of Effectiveness**					
Source of energy	**Yes/No**	**0**	**1**	**2**	**3**	**4**	**5**
55. Solar panel							
56. Wind							
57. Agro waste (biomass)							
58. Biodiesel							
59. Biogas							
60. Hydropower							
61. Geothermal							
62. Fuel wood							
63. Charcoal							

Fossil fuel							
Diesel							
LPG							
Paraffin							
Petrol							

Opinion variables	**1**	**2**	**3**	**4**	**5**
64. Alternative source of energy can be used for energy generation					
65. Alternative source of energy can be used as source of income					
66. Alternative source of energy is a renewable energy					
67. Alternative source of energy can present many uses					
68. Alternative source of energy is highly considered by residents					

Appendix C: Field Photos

A maasai manyatta surrounded by a thorn fence

Inside a Maasai manyatta showing individual houses

Maasai huts fitted with solar panel

A Maasai woman outside her hut fitted with a solar panel

Grass thatched mud houses with solar panels

A modern Maasai house made of iron sheets and fitted with a solar panel

A stone walled house fitted with a solar panel

An iron walled church with solar panels

A dispensary fitted with a solar panel

A solar rechargeable battery connected to the solar panels

A TV connected to house solar system

Appendix D: Approval Letter from ANU

AFRICA NAZARENE
UNIVERSITY

14th April 2021

RE: TO WHOM IT MAY CONCERN

Kanini, John Wandere (18M01DMEV009) is a bonafide student at Africa Nazarene University. He has finished his course work and has defended his thesis proposal entitled: - ***"Factors influencing the level of use of different sources of energy among the Maasai Pastoral Community in Kajiado West, Kajiado County"***.

Any assistance accorded to him to facilitate data collection and finish his thesis is highly welcomed.

Sincerely,

Dr. Titus Mwanthi
Ag. Deputy Vice Chancellor, Academics

Appendix E: NACOSTI Letter

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **409528**

Date of Issue: **29/April/2021**

RESEARCH LICENSE

This is to Certify that Mr.. JOHN WANDERE KANINI of Africa Nazarene University, has been licensed to conduct research in Kajiado on the topic: FACTORS INFLUENCING THE LEVEL OF USE OF DIFFERENT SOURCES OF ENERGY AMONG THE MAASAI PASTORAL COMMUNITY IN KAJIADO WEST, KAJIADO COUNTY KENYA for the period ending : 29/April/2022.

License No: **NACOSTI/P/21/10263**

409528

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX F: Map of Kajiado West, showing the Administrative Units