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Socio-economic factors influencing adoption of solar energy technologies: a case of households in Narok County.

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SOCIO-ECONOMIC FACTORS INFLUENCING ADOPTION OF SOLAR ENERGY TECHNOLOGIES: A CASE OF HOUSEHOLDS IN NAROK COUNTY

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the dissertation contains no material previously published or written by another person except where due reference is made in the dissertation itself.

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ABSTRACT

The energy sector in Kenya contributes significantly to the country's economic development by creating employment opportunities and raising people's living standards. However, there is slow adoption of renewable energy, especially solar energy in the country due to various socioeconomic challenges, which is now a major concern to the government because if this remains unchecked, it may derail the country in achieving vision 2030 and other development goals. The purpose of this study, therefore, was to examine the influence of socioeconomic factors (household income, education of household head, dwelling characteristics, and household demographic characteristics) influencing adoption of solar energy in Narok County. The specific objectives of the study include: to evaluate the influence of household income, education of household head, household dwelling characteristics, and household demographic characteristics on the adoption of solar energy technologies in Narok County. The study is anchored on Technology Acceptance Model, the Unified Theory of Adoption and Use of Technology (UTAUT), and the Energy Ladder & Stacking hypothesis. Descriptive research design was adopted with a target population of households in Narok County. Random sampling was applied in this study where 400 respondents were proportionally distributed across the 6 counties respondents randomly selected to participate in this study. Semi-structured questionnaires were used to collect the primary data. The data was analyzed into both descriptive and inferential statistics. Descriptive research design was used to determine socio economic factors that influence adoption of solar energy. Regression analysis was also used to identify which factors played a significant role in explaining adoption of solar energy technology in Narok County. The study findings show that there was significant positive correlation between all the socioeconomic factors of household income, education of household head, household dwelling characteristics and household demographics characteristics and the adoption of solar energy technology adoption in Narok County. The findings play a great role in not only extending frontiers of knowledge in green energy strategic business management and regulations research, but also in informing key players in making sound solar energy technology business environment decisions for better green energy adoption.

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LIST OF ABRREVIATIONS AND ACRONYMS

FDI	Foreign direct investment
IDAE	Institute for the Diversification and Saving of Energy
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
MW	Megawatt
MWh	Megawatt-hour
OECD	Organization for Economic Co-operation and Development
PHS	Pumped Hydro Storage
PPP	Public Private Partnerships
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
RES	Renewable Energy Sources
RET	Renewable Energy Technology
UTAUT	Unified Theory of Adoption and Use of Technology
SET	Solar Energy Technologies

DEFINITION OF TERMS

Adoption of Technology:	Refers to the process of accepting, integrating, and using new technology.
Customer satisfaction:	Is a measure of how products and services offered by the organization meet or surpass customer expectations.
Households:	These are defined and independent family units in a specified location.
Lean Manufacturing:	Is a methodology that focuses on minimizing waste in manufacturing setups while at the same maximizing productivity.
Lead Time:	Total time required to complete one unit of a product or service.
Quality Products:	Is incorporating features that have the capacity to meet customer needs and give customer satisfaction.
Social-Economic Factors:	These are factors such as education, religion, income, social support, gender, employment that shape an individual's consumption patterns. These factors can accelerate or decelerate the need to adopt solar energy by a household.

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CHAPTER ONE:
INTRODUCTION TO THE STUDY

1.1. Background of the study

International Energy Agency (IEA) defines access to energy as the ability of a household to obtain affordable, reliable, and clean energy for cooking and electrification (IEA, 2020). Access to electricity is a prerequisite for economic and sustainable development of any economy (World Bank, 2018). However, over 1 billion people globally live without electricity in their homes, 2.5 billion (about 40% of the world's population) rely on traditional biomass to meet virtually all their domestic energy needs of which majority reside in Sub-Saharan Africa (IEA, 2019). Due to the high cost of energy involved in acquiring electricity in developing nations, many countries are embarking on alternative solutions such as solar energy but are faced with numerous socioeconomic challenges (Lin and Kaewkhunok, 2021).

Electricity is considered a vital component in economic growth (Irfan et al, 2021). However, the continuous use of traditional sources in electricity generation is the primary cause of global climate change (Ahmad et al., 2020). As a result, to combat global warming, the world must transition to clean energy sources (Hussain et al, 2021; Ahmad et al, 2021). Solar Energy is the heat and light energy from the Sun, resulting from nuclear fusion at its core. In one day, the sun sends 10,000 to 15,000 times more energy to the earth than we can all collectively use (Msafiri, 2009). Solar power is the conversion of sunlight into electricity, either directly or using Photovoltaic (PV) technology, which captures solar energy for household electricity, and the solar thermal technology, which harnesses solar energy for home heating purposes (Schelly, 2010) by converting the suns radiation into direct current electricity using semiconductors. Solar energy, therefore, is considered the world's most abundant energy form and source, which is corroborated by the constant emission of solar energy from the sun all year round (Păceşilă, 2015). While this is so, Pinner and Rogers (2015) note that the adoption of solar energy technology has been unhurried. In contrast to this, many studies have posited that the world's current solar energy is enough to provide electricity for the whole world despite variations in production potentials (Johanson et al., 2004).

1.1.1 Adoption to Solar Energy Technology

Solar PV, a form of clean energy, has become more common in recent times and reached a global installed capacity of 303 GW, with a healthy annual 33-percent growth rate (Pan et al., 2019). By 2025, solar PV is projected to meet 4% of the global electricity demand (IEA,2020). Solar PV, a novel energy green technology, effectively decreases the cost of imported oil and minimizes carbon dioxide (CO_2) emissions (Rezaee, Yousefi and Hayati,2019). Different countries have taken steps to raise the proportion of solar energy in their portfolio structure (Merino, Herrera and Valdés, 2019; Valdés and Leon, 2019). According to the sustainable global progress report 2020, solar PV rose 12% and generated electricity of 115 GW in 2019. Until 2019, the estimated worldwide solar PV output reached 627 GW (REN21, 2021).

The value of solar PV is highlighted by the fact that home appliances are one of the largest sources of CO_2, accounting for 70% of global emissions (Ali et al., 2020). Therefore, IRENA (2020) reported that the share of solar PV to generate electricity globally has increased by 28.3%. Securing African benefits in a global green transition is the tenet of initiatives such as the 2021 African Union's Green Recovery Action Plan (GRAP) (African Union 2021), and previous initiatives such as the 2016 Africa Renewable Energy Initiative (AREI). The African Development Bank (AfDB) has sought to grow finance for African renewable energy, launching its New Deal on Energy for Africa in 2016 with the aim to achieve universal adoption to energy by 2025 (AfDB,2021). In 2017, the Bank achieved 100% renewable energy in its energy portfolio approving power generation projects with a cumulative 1,400 MW from renewable energy in the same year (AfDB, 2021a).

The African continent has a rich source of solar energy and in the recent years, solar PV has become a viable alternative source of electricity for both small and large-scale application in Africa (AU, 2021). With this realization, within the African domain, solar energy is now gaining prominence as a market commodity rather than a product of donor projects (Mutua and Kimuyu, 2015). Solar PV projects are believed to boost the quality of life for residents in numerous ways, such as providing job opportunities for people (Irfan et al, 2019), they can help to reduce CO_2 emission (Sweerts et al,2019) and it is the cheapest source of renewable energy and is helpful to sustain the prices of electricity (Kabir et al, 2018). However, Africa currently has only 5 GW of installed solar capacity (IRENA 2021a), compared to a total estimated potential of 315 GW by 2040, as envisioned by the African Union 2063 Agenda and the IEA African Case scenario (IEA 2019). Yet, integration of solar PV for on-grid storage increases the solar PV fraction which consequently leads to a 6% reduction in operation and investment costs by 2050 (Felix, 2021).

Currently, Kenya is among the countries in the Sub-Saharan Africa (SSA) that are still in energy crisis due to various socioeconomic challenges (Takase, Kipkoech & Essandoh, 2021). According to George, et al. (2019), adoption to modern and renewable energy for a long time has been mainly centered around urban areas and hence considered to be a privilege in many countries, and it is same case in Kenya. Furthermore, in Kenya, access to electricity (% of population) was reported at 69.7 % in 2019 (Takase, Kipkoech & Essandoh, (2021). To address the electricity access gap, the government of Kenya has devised several policies and programs to increase adoption of alternative renewable energies, such as solar photovoltaic devices (Takase, Kipkoech & Essandoh, 2021; Energy Africa, 2018). However, various socioeconomic factors have been documented to affect households and institutions when making the decision to invest in generating energy through solar panel technologies (Klepacka et al, 2018).

1.1.1.1 Adoption of Solar Energy Technology in Kenya

In Kenya, according to George, et al (2019), the Ministry of Energy and Petroleum manages energy adoption overall strategy and provides advice on the production and growth of energy sub-sector, including power, petroleum, and renewable energy. He continues to state that there still exist various challenges limiting adoption to the modern energy in Kenya. Indeed, due to some socioeconomic challenges, only 22.7 percent of households countrywide are connected to the national electricity grid (KNBS, 2019).

According to Kiprop, Matsui, and Maundu (2019), renewable energy in Kenya was first introduced in the early 1970s by foreign investors. Today, the path to adopt clean and affordable energy is contained in the national strategy that aims to increase adoption to energy to all citizens by 2020 (World Bank, 2020). However, despite many challenges, there has been efforts to promote and accelerate adoption to solar energy in Kenya. For instance, to complement the last mile project in regions that do not have a grid, the Government launched the Kenya Off-grid Solar Adoption

Project (KOSAP) running between 2017 and 2022. The project leverages solar technology to provide electrification to 277,000 households, 1100 public facilities and community facilities (health facilities, education facilities, and administrative offices), 380 water pumps and enterprises in 14 underserved counties that collectively account for 20 per cent of the country's population, and 72 per cent of the country's total land area. With an estimated renewable energy generation capacity of 96 MW, the project targets to provide electricity through 120 solar hybrid mini-grids and off-grid standalone solar systems. The KOSAP is part of the Kenya National Electrification Strategy (KNES) that targets to scale up off-grid electricity adoption by undertaking 35,000 connections through 121 new mini-grids and 1.96 million connections through standalone solar home systems (Ministry of Energy, 2018a). Narok County is part of the KOSAP, which aims to provide electricity to parts of the country that are not served by the national grid (Mutuku and Mbatia, 2020).

Another important strategy applied in solar energy adoption is Energy Adoption Explorer (EAE). EAE use geospatial data on demographics, socio-economic activities, energy resource availability, power infrastructure, environment, adoption to finance, and more in building more inclusive energy plans, while also accounting for critical development outcomes across Kenya. According to George et al (2019), the increased uptake of off-grid power in Kenya has been attributed to several factors, such as the availability and adoption of affordable solar panels, removal of tariffs on solar energy technologies among other government policy interventions. However, only around 1.2 percent of the households in Kenya had installed solar energy systems by the year 2019 due to various socioeconomic challenges which are yet to be explored and documented (Mburugu & Gikonyo, 2019).

This study was therefore born focusing on Narok County as a case study because it is one among those categorized as energy marginalized in Kenya (Takase, Kipkoech & Essandoh, 2021; George, et al., 2019; KNBS, 2020b). Research has shown that Narok County residents have heavily relied on firewood as a source of energy for cooking (Ministry of Energy, 2018b; Mutuku and Mbatia, 2020; Ministry of Energy, 2018a). Since 2018, the various Government of Kenya intervention to increase energy adoption such as KOSAP and EAE initiatives have not born many fruits as evidenced by approximately 80 percent of the County households still depending on the usage of charcoal and firewood (Wood, 2018; KNBS, 2020b). Therefore, this study comes at the right time to unravel the factors influencing adoption to solar energy technology despite the government of Kenya KOSAP, EAE, among other initiatives trying to ensure accelerated solar energy adoption among households in Narok County.

1.1.2 Socioeconomic Factors Affecting Adoption of Solar Energy

Research has shown that solar energy technology adoption faces numerous challenges, with most in the Sub-Saharan Africa (SSA) rural settings (Takase, Kipkoech & Essandoh, 2021; George, et al., 2019; KNBS, 2020b; Ministry of Energy, 2018b; Mutuku and Mbatia, 2020; Ministry of Energy, 2018a). Only a few studies have attempted to highlight the specific socioeconomic factors and mostly in the developed world (e.g. Khan, 2020; Khan, 2020; Elliott and Lindley, 2017; IRENA, 2020; Bhamidipati, et al., 2021).

About thirty years ago, the research community intensified its interest in the acceptability and deployment of technology in both private and organizational contexts (Guta, 2018). A sizable set of data on user traits and behavior associated with technology adoption had been produced through technology acceptance research by the year 2000 (Zeru & Guta, 2021). To comprehend the adoption of the technology, many models and theories have been developed, which collectively accounted for 40% of the variation in technology usage intention (Zeru & Guta, 2021). In this study, the four independent socio-economic variables of household income, education of household head, dwelling characteristics and demographics characteristics) were selected an mapped as applied in the original UTAUT model variables.

Household income is the gain or recurring advantage that results from labour or capital and is typically quantified in money (Ekbring, 2022). Depending on its initial and ongoing expenditures, technology adoption is influenced by the amount and frequency of revenue. People weigh the costs and benefits of a suggested technology before deciding whether to embrace it (consciously or unconsciously) (Ekbring, 2022). For this study, the constructs on income will include Level and frequency of income, type and status of occupation and other competing costs.

The education of household head, on the other hand, covers all disciplines and programmed categories that may be met at different stages of development, spanning the educational progression from the most fundamental to the most complex learning experience that can be both formal and informal (Rothman, 2011). Informal education is that which is frequently provided outside of a formal educational setting, whereas formal education is that which is frequently provided in a classroom setting at an academic institution. Professional certifications in a variety of disciplines, including accounting, finance, marketing, human resources, and law, may also be included in the degree of education (Besley et al., 2011). Education advancement is essential for technological acceptance, according to Valero (2021), as it helps match a person's knowledge of the suggested technology and ease of its acceptance. The constructs of education in this study will include type of education, level of education and training on solar technology.

According to Takase, Kipkoech, and Essandoh (2021), dwelling characteristics are one of the key factors influencing the adoption of technology since they serve as a platform for the expression of socioeconomic position. According to Mutuku and Mbatia (2020), dwelling features can be thought of as an intermediary structural factor connecting more general societal processes and impacts with a person's immediate social and physical environment. It creates a physical or social space in which social ties and healthy interpersonal relationships are nurtured and maintained while offering physical security, protection from the elements, and a key role in deciding an individual's source of identity and belonging. The three main housing features that are relevant to the adoption of technology are the material, meaningful, and geographical dimensions, according to a study on dwelling characteristics (George et al., 2019). The term "material dimension" refers to the immediate physical and structural elements of a home, such as its location, size, foundation, wall and floor structures, and roofing, that provide a protected area and amenities for preserving physical well-being. When it comes to an individual's experiences, the meaningful dimension of dwelling characteristics creates a sense of belonging and control in the home that supports ontological security, order, continuity, and meaning. This sense of personal and social identity may promote technology adoption. The spatial dimension deals with where housing is situated in relation to the facilities and services required to support the technology used (George, et al., 2019).

The demographic characteristics of the household's members refers to the composition, number, and identity of members of the household as discussed by Etogo & Naidu (2022). This offers a summary of the population features and their development among household residents. The demographic context is important in determining how technology will be adopted since it gives a broad overview of the social and cultural aspects as well as the attitudes, values, and beliefs of the family members regarding the adoption of new practices. For the purpose of this study, household demographic characteristics construct includes household members size, age, gender, occupation, and the household members energy use and needs.

Globally, several studies have recently explored the relationships between adoption of solar energy and socioeconomic factors include: Moorthy, Patwa, and Gupta's (2019); Ba-kundukize' et al. (2021); Irfan, Yadav and Shaw (2021); Blimpo et al. (2020), among others. They all indicate the importance of factors such as education, household composition, income, gender, residency among other socioeconomic factors in influencing adoption of solar energy technologies. Studies analyzing relationships between solar energy adoption and pure economic considerations include Thompson, Ajiboye, Oluwamide, and Oyenike (2021); Fleiß et al. (2017); and Jäger-Waldau (2020). They all demonstrate the importance of income factors and related cost-benefit considerations in adoption of solar energy technologies. Other related factors such as quality awareness, availability and adoption issues have also been recently explored by some authors such as Thompson, Ajiboye, Oluwamide, and Oyenike (2021); Sievert and Steinbuks, 2020); and Dagnachew et al. (2020), among others.

1.1.3 The Socioeconomic Status of Narok County and Adoption to Power Energy

Narok County is one of the 47 counties created by the Constitution of Kenya 2010 (CoK, 2010) with the county headquarters being in Narok town, off Narok Nakuru road. The County is situated in the Great Rift Valley in the Southern part of the Country where it borders the Republic of Tanzania to the South, Kisii, Migori, Nyamira and Bomet counties to the West, Nakuru County to the North and Kajiado County to the East. Narok County covers an area of 17,933.1 square kilometers and shares an economic block with Kajiado County. Pastoralism, agricultural cultivation, tourism, trading, and other small-scale businesses are the county's main economic activity. Within the County is the renowned Maasai Mara Game Reserve, home to one of the "seven Wonders of the World"—the Great Wildebeest Migration. Residents of the county rely on a powerful ecological system for agriculture, tourism, water, and a variety of other advantages (NGEC, 2017).

According to the latest census (KNBS, 2019), Narok County has a total population of 1,157,873 with equal 50% gender distribution. There are 241,125 households spread within an area of 17,932 square kilometers translating to 65 persons per square kilometer population density. The population is spread within the seven sub-counties as follows: Narok East (115,323), Narok North (251,862), Narok South (238,472), Narok West (195,287), Trans Mara East (111,183), Trans Mara West (245,714), and Mau Forest (32) according to the Kenya national bureau of statistic (KNBS, 2019). The annual population change of Narok County is estimated to be at 3.1% (2009-2019) which is higher than the national average of 1.9% (KNBS, 2019). Among the County's estimated population, 49.3 per cent were male and 50.6 per cent female (KNBS, 2019). There were 9,046 (0.9%) people with impairments in the population. 33.0 percent of the population was under the age of 18, with 51.0% of them being female. There are 65 people per km2 in the County. 2.4% of the total population, 51.6% of which were women, were classified as elderly (age 65 and older). In 2019, 52.7% of the population (4 to 22 years old) was enrolled in school. Compared to the national poverty rate of 36.1% in 2015–2016, Narok County's overall poverty rate was 22.6% (KNBS, 2019). In addition, 22.4% of people lived in food poverty, and 70.8 percent of people experienced multidimensional poverty, which is defined as lacking access to information, housing, adequate food, clean water, sanitation, and hygiene, as well as education, knowledge of health and nutrition, and other basic necessities.

As of 2017, the Gross County Product (GCP) of Narok County made up 2.4% of the total Gross Domestic Product (GDP). According to NGEC (2017), the GCP increased from Ksh. 92,987 million in 2013 to Ksh. 179,226 million in 2017. This is an annual average growth rate of 18.5%. 67.2% of GCP was given by the agriculture sector, while 30% and 2%, respectively, came from the service and other industries sectors (NGEC, 2017). Construction, wholesale and retail trade, transportation, and storage are all included in the services industry. With maize and wheat as the principal crops, agriculture is mostly dominated by livestock husbandry and both small- and large-scale agricultural cultivation (NGEC, 2017).

Narok County is categorized as a marginalized county as nearly two-thirds of the County is classified as semi-arid (Narok DEAP 2009-2013). Communities in Narok face frequent drought occurring every four years, increasing the vulnerability of the inhabitants. (Takase, Kipkoech & Essandoh, 2021; George, et al., 2019; KNBS, 2019). Literature has also shown that residents of Narok County experience the challenge of adopting solar energy technology as most heavily relied on firewood (71%) as a source of energy for cooking (Ministry of Energy, 2018b; Mutuku and

Mbatia, 2020; Ministry of Energy, 2018a). Therefore, despite a 20 percent increase in households' electricity connectivity by 2019 through KOSAP and EAE initiatives, usage of charcoal and firewood is still high in the county (Wood, 2018). Therefore, accelerating solar energy technology adoption is critical in enhancing clean power in Narok County. Furthermore, the government KOSAP, EAE, among other initiatives are trying to ensure accelerated solar energy adoption among households in the marginalized areas in Kenya, Narok included.

International Trade Administration (2022) reports that Kenya's power sector has grown steadily during the previous 20 years. Furthermore, Kenya possesses exceptional renewable resources, as shown by its position as one of the world's lowest cost geothermal power developers. Kenya has also made a concerted effort to widen access to the power grid, more than doubling that access from 32% of homes in 2013 to 75% of households in 2022. Rural Kenya has a 65% access rate compared to 100% in metropolitan areas. Kenya's Narok County, which is primarily a rural area, has a 65% average access rate to electricity. By the year 2022, the national electrification strategy target intended to attain universal access with a respectable level of service quality. However, the COVID-19 pandemic had a detrimental impact on the industry, as businesses reduced operations and power demand fell (International Trade Administration, 2022).

1.2. Problem Statement

It has been established that studies dealing with the adoption of solar energy systems by rural households are rare and literature on the same has been scarce (Klepacka et al, 2018). In Kenya, for instance, only a few studies (EPRA, 2018; Elmer and Brix, 2014) concern themselves with solar energy advantages and disadvantages thereby losing in-depth analysis of the socio-economic aspects (Kiprop, Matsui & Maundu, 2019). Onsomu (2013) conducted a similar study which sought to examine the social-economic impacts of photovoltaic solar installation using the Borabu division in Kenya, his study seems to have been exploratory by nature, focusing on different aspects from the title and broad. The study specific objectives were to determine the impact of governmental organizations in Photovoltaic solar installation and usage; to evaluate the environmental impact of Photovoltaic solar installation and usage; to assess the climatic impact of Photovoltaic solar installation and usage, and to assess the impact of costs in the installation of PV panels in Borabu Division. These studies bring forth conceptual and contextual gaps compared to the purpose that this study sought to address. Conceptually, the studies focused on advantages and disadvantages as well as the impact of installation of solar energy technologies that included environmental, climatic, and cost impact. Contextually, the scope in terms of location and time differences compared to the scope of this study were noted.

The purpose of this study, therefore, is to assess the influence of socioeconomic factors; household income, education of household head, household dwelling characteristics, and household demographic characteristics affecting the adoption of solar energy technology in Narok County. The three studies (EPRA, 2018; Elmer & Brix, 2014; and Onsomu, 2013) are also very different in methodology and design aspects. Therefore, it is clear the study goes deeper and specific on socioeconomic aspects left out by previous studies hence would fill the gap in existing knowledge. The empirical literature review has shown that no similar study has been done focusing on current study's socioeconomic factors influencing adoption of solar energy technology among a nomadic community with strong sociocultural traditions like it is in this case. Thus, leaving a research gap in this area.

1.3 Research Objectives

The study was guided by general and specific objectives.

1.3.1 General Objective

The main objective of the study was to examine socio-economic factors influencing adoption of solar energy technologies in Narok County because despite government and NGOs efforts, literature and empirical reviews stated earlier has also shown that residents of Narok County experience the challenge of adopting energy technology and are heavily relied on firewood as a source of energy. The study seeks to understand the factors that hinder or advance the use of solar energy technology.

1.3.2 Specific Objectives

i. To determine the influence of household income in the adoption of solar energy technologies in Narok County

ii. To evaluate the influence of education of the household head on the adoption of solar energy technologies in Narok County
iii. To determine the influence of household dwelling characteristics in the adoption of solar energy technologies in Narok County
iv. To assess the influence of household demographic characteristics in the adoption of solar energy technologies in Narok County

1.3.3 Research Questions

i. What is the influence of household income on the adoption of solar energy in Narok County?
ii. What is the influence of education of the household head on adoption of solar energy in Narok County?
iii. Do household dwelling characteristics influence the adoption of solar energy technologies in Narok County?
iv. Does household demographic characteristics influence the adoption of solar energy technologies in Narok County?

1.4 Significance of the study

This study focuses on assessing the influence of socioeconomic (household head income, education of household head, dwelling characteristics and household demographic characteristics) on adoption of solar energy. Reviewed previous literature is characterized by differences in theoretical, methodological, and practical applications, with some giving very contradictive findings (Bollinger and Gillingham, 2012; Müller and Rode,2013; Kiprop, Matsui, and Maundu (2019)). Theoretically, this study goes deeper and specific on socioeconomic issues (household head income, education of household head, dwelling characteristics, and household demographic characteristics) left out by previous studies hence would fill the gap in existing theoretical knowledge. Methodologically, the specific interest in Narok County is selected and sampled because it one of the counties under the government of Kenya KOSAP and EAE, initiatives that is seeking to accelerate solar energy adoption among households since 2018 but with little success so far.

Practically, the findings of this study are significant to several stakeholders, such as policymakers in both national and county governments, in developing frameworks and policies that will improve solar energy technologies adoption for sustained developments. These findings will be beneficial to the government by enhancing the understanding of the critical socio-economic and the extent to which each of the factors influence the adoption of solar energy technologies and further enhance structural and administrative actions. Through these findings, the government can develop appropriate strategies to close the solar energy technologies adoption gap in the rural Kenya and achieve vision 2030. Further, the findings are important for researchers and other scholars as theoretical and empirical reference material while carrying out similar studies in solar energy technology.

1.5 The scope of study

The study only focused on socio-economic factors influencing adoption of solar energy in Narok County. Contextually, the study only focused on socio-economic factors including household head income, education of household head, household dwelling characteristics and household demographic characteristics influencing the adoption of solar energy in Narok County. The study adopted a descriptive research design and targeted households within Narok County. The unit of analysis for the study include households in Narok County.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents pertinent literature review including a theoretical foundation of the study a discussion of the main solar energy socio-economic factors influencing adoption of solar energy. Further, a conceptual framework and a summary of research gaps to be addressed by the study are included in this chapter.

2.2 Theoretical Review

A theoretical review is an examination of available models and theories from literature on which the conceptual framework was anchored and that subsequently informs the problem statement of the study (Mugenda and Mugenda, 2008). The study was anchored on Technology Acceptance Model (TAM) and the Unified Theory of Adoption and Use of Technology (UTAUT) was used to explain adoption of technology and the Energy Ladder and Fuel stacking hypothesis to explain the socio-economic factors that affect behavior.

2.2.1 Technology Acceptance Model

In 1989, Fred Davis proposed the Technology Acceptance Model (TAM), which he later expanded with Vekantesh V (Lai, 2017). TAM has emerged as one of the most popular and reputable research models for predicting how individual users will react to and make use of information systems and technology. The model illustrates the factors influencing technology acceptance and how consumers behave and adopt new technologies across a wide range of user demographics (Lai, 2017). According to the notion, a user's actual use of a certain technology depended on their intention to do so (Lai, 2017).

Perceived usefulness and perceived ease of use are the major internal characteristics of technology acceptance, according to the model. The likelihood that new technology will improve a potential user's experience is known as perceived usefulness, and it promotes the use of information technology to raise staff productivity. The degree to which potential users perceive something to be simple to use and require little effort is referred to as its ease of use (Mailu, 2019). Other external qualities, such as social, cultural, and political variables, have an impact on these two internal characteristics. The user's appraisal of the technology's desirability, which results in a behavioral intention to use the application, determines whether they will utilize it.

TAM has been used by academics all over the world to assess the adoption of various technology systems Shafeek (2011) used TAM to evaluate the acceptance and use of eLearning systems by teachers; Muller-Seitz et al. (2009) used TAM in the security sectors to evaluate the acceptance of the radio frequency identification (RFID); Ervasti & Helaakoski (2010) used a model founded on TAM to understand mobile service adoption; Portz et al. (2018) applied the TAM to explore a hospital patient portal user experience, intent to use, and use behavior by older adults with multiple.

However, there have been some critiques of TAM, with Mathieson (1991) and Yi, Jackson, Park, and Probst (2006) making the case that human and social variables should be considered while developing the model to account for how technology is used and accepted (Lai, 2017).

This model is relevant to the study as we seek to understand the adoption and intent of use of solar technology in Narok County.

2.2.2 Unified Theory of Adoption and Use of Technology (UTAUT)

In "User Acceptance of Information Technology: Towards a Unified View" (Vankatesh et al., 2003), Venkatesh and colleagues developed the unified theory of acceptance and use of technology (UTAUT), a paradigm for technology adoption. The UTAUT seeks to explain users' initial technology system usage intentions and subsequent usage behavior. According to the theory, there are four main constructs: enabling factors, effort expectations, social influence, and performance expectations.

The four main components' effects on usage intention and behavior are said to be moderated by factors such as gender, age, experience, and voluntariness of use. The theory was created by reviewing and combining the eight models that earlier research had used to explain how people used information systems: theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, combined theory of planned behavior and technology acceptance model, model of personal computer use, diffusion of innovations theory, and social cognitive theory. UTAUT was further validated by Venkatesh et al. (2003) in longitudinal research, and they discovered that it accounted for around 50% of the variance in actual usage and 70% of the variance in behavioral intention to use (BI).

Saleh, Haris and Ahmad (2014) have successfully applied the Unified Theory of Adoption and Use of Technology (UTAUT) model in their conceptualization of solar energy adoption study arguing that it is most suited for application in solar energy technological adoption studies because it unifies eight major previously used models in user technology acceptance and utilization studies. The eight models combined in UTAUT are namely the theory of reasoned action (TRA), the technology acceptance model (TAM), the theory of planned behavior (TOPB), the motivational model (MM), the innovation diffusion theory (IDT), the model of PC utilization (MPU), the social cognitive theory (SCT), and a model combining TAM and TOPB (C-TAM-TOPB). Through this combination, UTAUT sums up the main constructs from all eight models to five independent variables, which predict technology usage intention and technology usage overall behavior (Tan, 2013; Venkatesh et al., 2003). In this way, UTAUT sufficiently enabled capturing of all socioeconomic factors explain not only adoption, but also acceptance, availability, and utilization of technological innovations at individual, organizational and regional space scale (Saleh, Haris and Ahmad (2014). In this study, therefore, the four independent variables (household income, education of household head and household context that include dwelling and demographic characteristics) were well mapped into these original UTAUT variables.

According to Saleh, Haris and Ahmad (2014). The UTAUT is considered the most powerful predictive model that relies on behavioral models from several acceptance theories which were developed to predict technology adoption. The key benefit is that the UTAUT offers a helpful means to measure households' behaviors towards the acceptance of a new technology to improve acceptance (Anderson et al., 2006). The UTAUT model will be therefore used in this study due to its strong theoretical foundation, comprehensiveness, and high explanatory power. Therefore, UTAUT application had a positive impact and an extremely immense contribution towards solar energy systems adoption.

2.2.3 Energy Ladder and Fuel Stacking Hypothesis

Kirk Smith presented the energy ladder hypothesis to the World Health Organization (WHO) in the early 1990s, parallel to the fuel-wood issue that began to develop in the 1970s and 1980s

(Toole, 2015). The energy ladder was created to establish a hierarchical relationship between the type of fuel used for cooking and heating and the increase in household income. The customer typically chooses to buy more "superior" things and less "inferior" goods when wealth rises, according to consumer economic theory (Paunio, 2018). Consumer economic theory was subsequently connected to energy by researchers, who demonstrated that households behave similarly to consumers by attempting to maximize their use of energy utilities in accordance with their economic standing. Therefore, as a household's wealth increases, it begins consuming fuels that are found on higher ranks of the energy ladder and switches to cleaner and more expensive fuels (LPG, solar, and electricity), thereby moving up the ladder (Toole, 2015).

The process of fully ascending the energy ladder can be described as a linear movement consisting of three distinct phases. The first phase is when a household achieves socioeconomic stability, which motivates it to give up inefficient, cheap, and polluting fuels; the second is when the household reduces its reliance on traditional fuels by switching to transition fuels like kerosene and coal; and finally, the third phase is when the household completely switches to LGP, solar, and electricity (Erdmann & Haigh, 2013). The Energy Transition refers to this transition from a less-than-optimal fuel to a more-than-optimal one.

According to Paunio (2018), however, economic growth alone cannot be viewed as the primary and only driver for households to change their energy-use behavior as other significant drivers, such as: environmental and social pressure, technological advancement, resource availability, people's choices, levels of urbanization, and living standards, also play a significant role in forming these decisions. As a result, households are influenced by a complex and interactive web of influences when making decisions about replacing their fuel source. This switching process is interlaced and interrelated rather than occurring as a sequence of straightforward independent processes. As a result, the process of switching fuels is not one-way, and homes can utilize both more modern fuels for some reasons and more conventional ones for other household needs. Researchers found that the novel concept of "Fuel Stacking" has greater applicability for explaining home energy behavior after taking these factors into account (Erdmann & Haigh, 2013). According to the "Fuel-Stacking" concept, households do not completely switch to other fuel types as their income rises; instead, they employ an energy mix or as part of a menu. The households in that situation use a variety of fuels to generate their energy, mixing superior fuels more than inferior ones (Erdmann & Haigh, 2013).

The energy stacking opposes the idea that households should fully change the fuels they use as their wealth rises and instead proposes an alternate habit of using several fuels concurrently (Paunio, 2018).

2.3 Empirical Review

The empirical review involved examination of the available and relevant empirical literature that relates to solar energy adoption and the socioeconomic factors to accelerating its adoption. Generally, existing literature clearly indicates that the energy demand of households forms a crucial component of the complete energy demand of nations, which shapes the paradigms of energy systems (Grunewald et al., 2012). The literature also points out that the socio-economic development and survival of individuals and society largely hinge on the availability of energy (Agyeman et al., 2020). Despite this assertion, majority of the world's population does not have access to electricity (Taale & Kyeremeh, 2016), with the situation being more profound in the case of Africa where an estimated 635 million (57%) are without electricity (Metayer et al., 2015; REN21, 2019). In Kenya, only 50% have access to electricity where only 19.7% in Narok County accessing electricity. Parallel to the assertion of the lack of electricity in Africa, most households have been heavily reliant on energy sources such as cow dung, firewood, charcoal, and palm kernel among others, which have been identified to have adverse impacts on human health, and the environment because they trigger deforestation and the greenhouse emissions (Sovacool, 2012). However, the continent has a huge and abundant source of renewable energy. The capacity of the continent's annual solar radiation ranges from 5 to 7 kWh/m2 (Brüderle, 2010).

Solar PV deployment in most countries in Africa has mainly been driven by rural (off-grid) electrification (Samoita et al., 2020). According to Samoita et al. (2020), a key technical challenge for integration of PV technology is the temporal match with the demand; solar power is available during the day and there must be a viable way of harnessing it for use when the sun is not up. There also exist numerous socioeconomic challenges when it comes to solar energy deployment in rural households (Ashnani et al., 2014: Kruzner et al., 2013; Heng et al., 2020). The specific study socioeconomic variable relationships are as discussed below:

2.3.1 Effect of Household Income on Adoption of Solar Energy Technology

Income, for the purpose of this study has been categorized as, Level and frequency of income, type and status of occupation and other competing costs. Income is one of the main factors likely to affect purchase of efficient appliances and influence energy consumption (Santin et al. (2009), Vassileva, Wallin and Dahlquist (2012) Ding et al. (2016) and Zhao et al. (2012)). In the context of the adoption of RSPVs; (Lam, (1998); Billino (2009), Ugulu (2019) and Qu, Hong & Jin (2019) found that household income levels propel the willingness to adopt solar PVs. Several researchers have since analyzed the role of income and found that it is positively and significantly related to the adoption of solar energy (Guta (2018); Legesse (2016). Another study conducted by Entele (2020) and in Ethiopia and Gyamfi et al (2015) and Abokyi et al (2018) in a Ghanaian sample found that consumers have a high willingness to pay for solar energy to generate electricity, and the tendency to pay is positively influenced by household income. These results are consistent with the study from rural Pakistan where the results show that households with high annual income can afford the solar PV system and prefer it to complement their energy needs (Ahmar et.al, 2022).

While some studies have found a contrary finding that low-income households have a stronger tendency to install solar PVs (Bollinger and Gillingham, 2012; Müller and Rode,2013); the study by Vassileva et al. (2013) showed that it is more challenging to target high-income households for solar energy consumption, due to their low interest in energy efficient products and their “fear” of losing social status.

Anteneh (2019) and Legesse (2016) revealed the effects of the occupation and business type on solar home system adoption. Legesse (2016) showed that consumers’ perceptions about solar PV benefits such as energy protection measures, combating climate change, and energy-saving is shaped by occupation (Komendantova and Yazdanpanah, 2017). One study found that farmers’ assumptions about perceived solar PV benefits had a major impact on their adoption in India (Kumar et al., 2020).

2.3.2 Effect of Education of Household Head on the Adoption of Solar Energy Technology

In this study, education is looked at in three contexts: type of education, level of education and training on solar technology. A few scholars have conducted studies in developing countries as well to analyze the consumers' level of education and its influence on their willingness to adopt solar PV. For instance, Guta (2018) investigated the determinants of household adoption of solar home system and found that education level of the head has a positive effect on solar home system adoption. Mensah and McWilson (2021), Gyamfi et al (2015) and Abokyi et al (2018) conducted studies in Ghana and found that level of education influenced adoption of solar home systems (SHSs) such that the higher the education level, the higher the adoption. Alrashoud and Tokimatsu (2019) examined considerations that may either empower or dissuade Saudi Arabian people from purchasing solar photovoltaic (PV) systems and found that education had the greatest positive effect. Ahmar et al. (2022) also found that education had the highest effect among all the demographic variables that were considered in the study. In their logistic regression study, they reported that a 1-year increase in education of the household head increases the odds ratio of PV system adoption by 1.42. Another study conducted by Entele (2020) in Ethiopia found that consumers have a high willingness to pay for solar energy to generate electricity, and the tendency to pay is positively influenced by education. Abera (2019) examined determinants of lighting Energy transitions in rural Ethiopia, who revealed level of education and adoption to modern communication technologies have a positive influence on the adoption of renewable energy resources including solar.

Training delivered to households affects the adoption of solar home system. To be more confident about the innovations, training can help people towards the adoption and active usage of the technologies provided (Bizien, 2017), adds crucial value in the minds of trainees where they acquire this by performing practically the knowledge or the information they read and heard from different sources (Ali, 1997). A study conducted in Kenya found that there is a positive relationship between the individuals who had received informal or formal training on solar systems and use (Keriri, 2013). Thompson, Ajiboye, Oluwamide, and Oyenike (2021) established that adoption of solar energy in Nigeria was slow because consumers in the country were often unaware of the benefits associated with solar energy.

The adoption of solar home systems by households is significantly influenced by the amount of awareness and understanding (Naomi, 2014). Therefore, it is important to raise awareness and provide accurate information to help people better grasp the advantages and drawbacks of renewable technology (Rashid, 2012). The rise of the market demand for clean energy is hampered by households' lack of access to relevant knowledge about the adverse health effects linked to the inefficient combustion of solid fuels (Beyene, 2018). The adoption of solar home systems is influenced by the training provided to households. Training can assist people in adopting and actively using the supplied technologies, so they feel more confident about the advances (Bizien, 2017).

Other researchers have analyzed the role of general social factors in the adoption of solar energy (e.g., Bollinger and Gillingham, 2012; Noll et al., 2014; Graziano and Gillingham, 2015; Rode and Weber, 2016). This literature concludes that learning from other adopters influences the probability that one adopts as well, hence word-of-mouth is considered an important channel for accelerated adoption. The studies also concluded that adopting solar energy may be considered as a very visible form of climate-friendly behavior, where people are more likely to go green when they see others, locally, going green (Carattini et al., 2017). Therefore, imitation is considered another plausible channel for accelerated adoption.

2.3.3 Effect of Household Dwelling Characteristics on the Adoption of Solar Energy Technologies

Household dwelling characteristics that include the household capital available, household location (rural/urban), type of dwelling (permanent/semipermanent), and household energy use and needs have been shown to be positively and significantly associated with the adoption of solar energy (Ahmed et al., 2022). The place of residency, either rural of urban, and type of housing (roof, wall and floor type) have been used in a study in rural Bangladesh Asaduzzaman et al. (2010) who found that cost of the technology and adoption due to rural divide influence adoption of solar energy. Similarly, Hillerbrand and Goldammer (2018) used similar measures and established that low-income rural households were increasingly adopting or tapping solar energy to bring the desired change into their livelihoods and protect the environment. Furthermore, Thompson, Ajiboye, Oluwamide, and Oyenike (2021) used same indicators in conducting a study in rural

Nigeria to determine factors affecting households' preferences levels for solar energy and revealed that dwelling characteristics significantly contributed to the preference for solar energy. Similarly, Guta (2018) used same indicators when seeking to determine the factors contributing to households' adoption of solar energy in the rural Kebeles, Ethiopia. The study concluded that types of housing particularly living in tenements or huts were found to be negatively associated with adoption of solar PV.

Scholars have distinguished between traditional and renewable energy sources, making purchasing decisions based on their occupation and socio-economic status (Colmenares-Quintero,2020). As a result, potential solar energy consumers were found to be more of professional caliber who appreciate green energy initiatives and act as promotors to increase residents' understanding of the advantages of solar power use for improved air quality and lower carbon emissions (Madurai Elavarasan and Pugazhendhi, 2020). Further research carried out by Palm, Eidenskog and Luthander (2018) in Sweden found that people who are constantly aware of the benefits of solar PV and how it helps to alleviate the burden of electricity are highly motivated to adopt solar PV. According to Chamberlain (2018), people in green energy promotion occupation were more likely to adopt the solar PV.

In rural Kenya, Onsomu (2013) sought to examine the social-economic impacts of photovoltaic solar installation using the Borabu division in Kenya as a case study. The specific objective of the study was to assess the influence of environmental factors, climatic factors, and cost of installation on the installation of solar energy. The findings established those existing environmental policies affected the installation of solar systems. Further, the study established that the high cost of installation and prevailing climatic conditions positively influenced installations and use of PV solar systems. However, Kiprop, Matsui, and Maundu (2019) carried out a study to determine the effect of household consumers' adoption of solar energy technology in Nairobi and Uasin Gishu Counties and revealed that income or other social-economic factors did not correlate with the adoption of renewable energy.

2.3.4 Effect of Household demographic characteristics on the Adoption of Solar Energy Technologies

Household demographic characteristics have been shown to be significantly associated with the adoption of solar energy technology (Ahmed et al., 2022). The findings of the study show that a unit increase in the family size increases the probability of solar energy technology adoption by 2.16 percent. However, in their study of solar adoption in Seychelles in the context of 100 percent access to electricity, Etogo and Naidu (2022) did not find significance of family size, gender and age. Gender of household head was also found to be insignificant for the type of solar PV adopted (Briguglio and Formosa, 2017)

Chodkowska-Miszczuk and Szyman´ska (2011) emphasizes the age of the farm head, referring to it as one of the most important influencers of solar energy adoption. The socio-demographic characteristics of farm heads were also the main subject of research by the team led by Brudermann, et al., (2013). The factors influencing the adoption of solar home systems by households were studied by Anteneh (2019). The author demonstrated that age and family size had a negative impact on willingness to pay for a solar home system, but that marriage, the gender of the household head, and the educational level of the children have beneficial effects. Additionally, he stated that it is statistically significant that families headed by women are less likely to acquire solar home systems than are households headed by men. In contrast, Guta (2018) also looked into the factors that influence whether or not a household adopts a solar home system. The results demonstrated that the adoption of solar home systems is positively influenced by the household head's age, family size, and degree of education. In addition, the author discovered that homes headed by men are less likely to install solar panels than their female counterparts. This is consistent with Partick's (2009) finding that households headed by women are more likely to install solar home systems than their male counterparts.

According to Abera (2019), who looked at the factors influencing lighting energy transitions in rural Ethiopia, marriage, educational attainment, the gender of the household head, and contemporary communication technology all have a favorable impact on the uptake of renewable energy sources like solar. Family size, however, has a detrimental impact on the uptake of solar household systems.

2.4 Overview of Literature and Research Gaps

In this chapter, the study appraised the relevant theoretical and empirical literature that formed the basis of this research work. The literature review has covered socioeconomic factors that are associated with the adoption of solar power technology in diverse contexts. While some studies have found significant and the largest effect of education on adoption of solar technology, others have found no significance. Higher household incomes have also been linked to a high adoptability of solar energy; given that higher incomes eliminate the cost barrier towards adopting solar technology. The results on the gender of the household head have shown mixed results. While limited studies exist within the Kenyan context, the focus on dwelling characteristics has been scarcely explored, with this study having a broader definition of household context.

This study therefore hopes to contribute to this literature by analyzing the socioeconomic factors that determine households' adoption of Solar Technology in Narok; an area that is largely marginalized and nomadic therefore less likely to adopt solar power technology as demonstrated by Lin and Kaewkhunok (2021).

2.4.1. Summary of Research Gap

Variable	Authors	Purpose of Study	Findings	Research Gap
Effect of income on adoption of solar energy adoption.	Lam (1998); Billino (2009), Ugulu (2019) and Qu, Hong & Jin (2019)	Factors likely to affect purchase of efficient appliances and influence energy consumption	Household income levels propel the willingness to adopt solar PVs	Studies were conducted in Asia and other developing economies. This study fills the geographical gap in Kenya
	Guta (2018) and Legesse (2016	Role of income in adoption of solar PVs	Income is positively and significantly related to adoption of solar PVs	The methodology was quantitative and there were little descriptive values for objectivity. This study applies a mixed methodology to cater for both objective and subjective data.
	Entele (2020), Gyamfi et al (2015) and Abokyi et al	Income and adoption of solar technology	Tendency to pay is positively influenced by household income	Studies were conducted in several African economies.

	(2018), Ahmar et.al, (2022)			This study fills the geographical gap in Kenya.
	Bollinger and Gillingham, (2012), Müller and Rode, (2013), Vassileva et al. (2013)	Factors affecting purchase of solar PVs	Low-income households have a stronger tendency to install solar PVs	Studies were conducted in developed economies. This study fills the geographical gap in Kenya
Effect of Education on the Adoption of Solar Energy Technology	Mensah and McWilson (2021), Gyamfi et al (2015) and Abokyi et al (2018)	Determinants of household adoption of solar home system	Education level of the head has a positive effect on solar home system adoption	Studies were conducted in several African economies. This study fills the geographical gap in Kenya.
	Alrashoud and Tokimatsu (2019), Ahmar et al. (2022), Entele (2020)	Considerations that may either empower or dissuade people from purchasing solar photovoltaic (PV) systems	Consumers have a high willingness to pay for solar energy to generate electricity, and the tendency to pay is positively influenced by education	Studies were conducted in several African economies. This study fills the geographical gap in Kenya.
	Bizien, 2017, Keriri, 2013, Thompson, Ajiboye, Oluwamide, and Oyenike (2021)	Training delivered to households affects the adoption of solar home system.	There is a positive relationship between the individuals who had received informal or formal training on solar systems and use	The studies used a desktop review with secondary data. This study uses primary data.
Effect of Household dwelling Characteristics on the Adoption of Solar Energy Technologies	Ajiboye, Oluwamide, and Oyenike (2021), Hillerbrand and Goldammer (2018)	Determine factors affecting households' preferences levels for solar energy	Household dwelling characteristics significantly contributed to the preference for solar energy	Studies were conducted in several African economies. This study fills the geographical gap in Kenya.
Effect of Household demographic characteristics on the Adoption of Solar Energy Technologies	Ahmed et al., 2022,	Effect of family size in acceptance of solar technology	A unit increase in the family size increases the probability of solar energy technology adoption by 2.16 percent	The study specifically focused on general household factors. This study includes other socioeconomic factors.

	Etogo and Naidu (2022), Briguglio and Formosa, 2017,	Effect of household characteristics in adoption of solar PVs	No significant relationship between of family size, gender, and age	Studies were conducted in several African economies. This study fills the geographical gap in Kenya.

2.5 Conceptual framework

Conceptual framework is a conjectured model that depicts the variables in the study as well as the correlation amongst the dependent, intervening (moderating) and independent variables (Kothari, 2014). This study postulates the interaction between the three socioeconomic factors (independent variables) and their influences in accelerating the adoption of solar energy technologies (Dependent variable) as discussed in section 2.3 above. The conceptual framework is as depicted below.

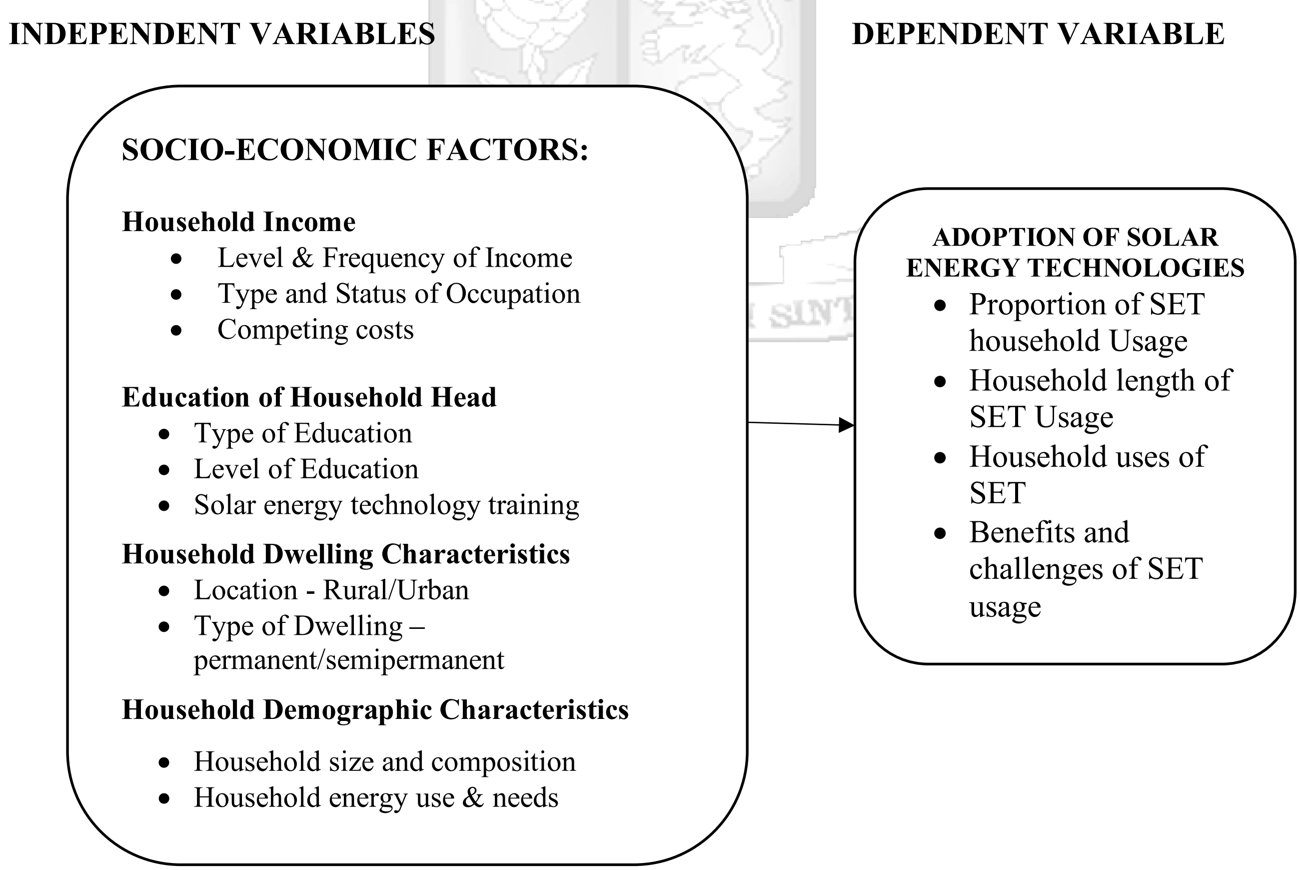

Figure 2.1: Conceptual framework (Source: Researcher, 2022)

2.5.1 Operationalization of Variables

Fig 2.1 shows that the study considered the Dependent variable to be the adoption of solar technology. This was influenced by the independent variables are the household income level, level of education, dwelling characteristics, and the household demographic characteristics. It was expected that the variables greatly affected the adoption or lack of it in households in Narok County.

The various variables under study were measured as indicated below:

Table 2.1: Operationalization of Variables

Objective	Indicators	Measurement	Data Analysis
To determine the influence of household income in the adoption of solar energy technologies in Narok County	• Level & Frequency of Income • Type and Status of Occupation • Competing costs	Qualitative & Quantitative	Descriptive & correlation analysis
To evaluate the influence of education of household head on the adoption of solar energy technologies in Narok County	• Type of Education • Level of Education • Solar Energy Technology Training	Qualitative & Quantitative	Descriptive & correlation analysis
To determine whether dwelling characteristics influences the adoption of solar energy technologies in Narok County	• Location – Rural/Urban • Type of dwelling – permanent / semipermanent • Household Ownership	Qualitative & Quantitative	Descriptive & correlation analysis
To determine whether household demographic characteristics influences the adoption of solar energy technologies in Narok County	• Household size and composition • Household energy use and needs	Qualitative & Quantitative	Descriptive & correlation analysis
Assessment of Adoption of solar energy technology	• Proportion of SET household Usage • Household length of SET Usage • Household uses of SET • Benefits and challenges of SET usage	Qualitative & Quantitative	Descriptive

Source: Researcher (2022)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the conceptual framework and the methods that were used to collect and analyze data for this study. This section also includes the research design, the population of the study, the sampling design and sample size to be used. It further provides a step-by-step process of the data collection techniques/methods and in addition data analysis and ethical considerations.

3.2 Research Philosophy

A research philosophy describes how information should be obtained, examined, and used. Epistemology (what is known to be true) and doxology (what is thought to be true) are both parts of research philosophy. Positivism and interpretivism are the two main research philosophies that have been discovered and employed in the field of social science (Kothari and Garg 2016). Positivists hold that reality is constant and that it is possible to observe and describe it objectively without affecting the occurrences under investigation. To find symmetry in and establish links between some of the constituent pieces, this entails manipulating reality by changing just one independent variable (Cooper & Schindler, 2006). On the other hand, interpretivists contend that reality can only be fully comprehended by subjective interpretation and intervention. They assert that while there may be numerous ways to interpret reality, each of these ways is a component of the scientific information they are seeking (Cooper & Schindler, 2006).

The study adopted a positivist research approach. The role of a researcher under the positivist approach or paradigm is the use of a clear qualitative and quantitative approach in investigating a phenomenon (Saunders, Lewis & Thornhill, 2009). This approach requires a thorough focus and examination of facts, establishes causality, and reduce the phenomenon to simple and comprehensible elements, formulate and test hypotheses and test them to arrive at informed conclusion (Kothari, 2004). This study adopted a positivist philosophy because it used quantitative tools when measuring the research variables.

3.3 Research Design

Research design is an overall strategy that a researcher chooses to integrate the components of the research study more coherently and logically to ensure the research problem is effectively addressed (Thompson Burdine, Thorne & Sandhu, 2021). The current study employs both descriptive and inferential statistics. The inferential statistics method involved observations as well as describing the behavior of the study subject without manipulating or influencing it. Descriptive research design describes attitudes, characteristics, values, and behavior (Mugenda & Mugenda, 2003). Therefore, in this study, the descriptive correlational design enabled describing of the various socio-economic factors influencing adoption of solar energy technology in Narok County.

3.4 Location of the Study

The study was conducted in Narok County, which is situated in the Great Rift Valley in the Southern part of the Country where it borders the Republic of Tanzania to the South, Kisii, Migori, Nyamira and Bomet Counties to the West, Nakuru County to the North and Kajiado County to the East. According to the latest census, Narok County had a total population of 1,157,873 with 241,125 households spread within an area of 17,932 square kilometers translating to 65 persons per square kilometer population density (KNBS, 2019). The population is spread within the seven sub-counties as follows: Narok East (115,323), Narok North (251,862), Narok South (238,472), Narok West (195,287), Trans Mara East (111,183), Trans Mara West (245,714), and Mau Forest (32) and 30 wards, according to the Kenya national bureau of statistic (KNBS, 2019).

3.5 Target Population and Sampling Frame

Kothari (2004) defines a target population as that population that the researcher wants to generalize the study's findings. Therefore, the target population of this study involved all the 241,125 households in Narok County (KNBS, 2019). The average size of each household is 4.8 individuals (KNBS, 2019).

A sampling frame as defined by Sekaran & Bougie (2016) as the source material or device from which a sample is drawn. It is a list of all those within a population who can be sampled, and may include individuals, households, or institutions. The sample frame of this study consisted of a list of households within Narok County.

Table 3.2: Population of Study

Sub County Name	Total Population	Males	Females	No. of Households	Persons/SqKms
NAROK EAST	115,323	58,699	56,617	25,078	56
NAROK NORTH	251,862	128,024	123,829	59,996	117
NAROK SOUTH	238,472	118,441	120,029	46,723	52
NAROK WEST	195,287	97,085	98,198	38,658	35
TRANS MARA EAST	111,183	54,545	56,637	20,506	359
TRANS MARA WEST	245,714	122,220	123,491	50,132	97
MAU FOREST	32	28	4	32	..
Total	1,157,873	579,042	578,805	241,125	

Source: KNBS, 2019

3.6 Sample size and sampling Technique

A sample refers to the finite segment of the population that is chosen for investigation to generalize the entire population (Ragab & Arisha, 2018). In other words, a sample is a representative subset of the entire population that is systematically investigated to make inferences concerning the same population of interest. According to Creswell (2012) sampling refers to the systematic process of selecting representative elements of the population to allow investigators to predict and make conclusions about the population using inferential statistics. Sample precision, level of significance, margin of error and confidence levels are the key reasons as to why researchers may opt to undertake sampling of populations in research investigations as opposed to undertaking a census (Blumberg, Cooper & Schindler, 2014).

Sample size is defined as the total number of elements in a population of interest to an investigator that is precisely and objectively chosen to represent the characteristics of the population (Babbie, 2016). Furthermore, they observe that an optimum sample exhibits and meets the characteristics and requirements of reliability, accuracy, precision, efficiency, representativeness, has acceptable confidence levels and flexibility. Random sampling was applied in this study. It involves giving all households an equal opportunity to be selected and participate in the study. (Kombo & Tromp, 2006).

Following the proposed sampling design, the study selected the sample size using Slovin's formula.

$$\textbf{Sample Size (n)} = N / (1 + Ne^2)$$

where:

n = Sample size of the Households to be studied
N = The population of Household in Narok County which is 241,125
e = Margin of error which is 5%

$$n = 241{,}125 / (1 + 241{,}125\,(0.05)^2)$$

n = 399.3

Based on the sampling size of 400 the sampling frame was distributed proportionally across the sub counties and randomly selected as indicated in the table 3.2 below.

Table 3.2 Sample Distribution

Sub County Name	No. of Households	Distribution of Questionnaire
NAROK EAST	25,078	42
NAROK NORTH	59,996	100
NAROK SOUTH	46,723	78
NAROK WEST	38,658	64
TRANS MARA EAST	20,506	34
TRANS MARA WEST	50,132	83
MAU FOREST	32	0
Total	241,125	400

3.6 Research Instruments

The study collected both secondary and primary data. The primary data was collected using questionnaires bearing both open-ended and closed-ended questions to collect both quantitative and qualitative data required for analysis in the study. The use of a questionnaire also made it easy to analyze data in a standardized manner. The questionnaire was divided into sections to cover all the variables in the study. Most of the questions used qualitative and quantitative options for the respondents to select agreement to the provided statements regarding various socio-economic factors influencing adoption of solar energy in the county.

3.6.1 Data collection Procedures

The primary data was collected using researcher-administered questionnaires procedures because of the level of education of people in Narok County and the technical nature of issues under study. Data was collected through administration of questionnaires for the respondents. However, an introductory letter from Strathmore University and authorization from the National Commission for Science and Technology and Innovation was first obtained before undertaking the study. An introduction letter with an explanation of the purpose of the study was also attached by the researcher to enhance trust and assure privacy and observation of ethical standards throughout the study. An opening remark offering guidance to the respondents on how the questionnaire should be filled and seeking personal consents was also done. The researcher also enlisted research assistants who were thoroughly trained on the data collection procedures and ethical considerations.

After gathering data, editing was conducted to ensure the accuracy of the data collection instrument. The compiled data was then coded, organized, and encoded into SPSS for analysis.

3.7 Research Quality

In this study, the internal reliability and validity was determined through proper designing of the questions and adoption from previous similar studies where possible, while careful construction of the questionnaire and pilot testing was also considered (Saunders, Thornhill, et al., 2019).

3.7.1 Reliability

Reliability refers to consistency, verification and stability of the data collection instrument used in the study. This means that the questionnaire is reliable if in its repeated use shows consistent and stable measures of the variables (Sekaran and Bougie, 2016). The internal consistency of the distinct parts of the questionnaire are tested using Cronbach's alpha. According to Sekaran and Bougie (2016), Cronbach's alpha is an internal test of reliability undertaken through calculation of the averages of all possible split-half reliability coefficients. Existing literature concludes that the higher the reliability coefficients after consistent testing and verification of the research instruments, the better the reliability of the data collection tool. Bryman (2012) argues that Cronbach's alpha values greater than or equal to 0.70 are treated as satisfactory levels of attainment of reliability test. Therefore, for the purpose of this study, all constructs with Cronbach's alpha values greater than or equal to 0.70 were accepted.

The pilot study was conducted with a sample of 15 household-heads but who were not included in the actual study. The goal of pilot testing was to improve the data collection instruments and enhance their reliability and validity, as well as provide insight on the planned data analysis techniques effectiveness as well as spotlighting the financial and human resource requirements (Doody & Doody, 2015).

3.7.2 Internal validity

Validity refers to the degree to which a research data collection instrument accurately measures what it intends to measure to enhance the integrity of inferences arising to a research study (Babbie, 2016). This study utilized content validity and construct validity to test the validity of the questionnaire during the pilot testing phase. Construct validity refers to the extent to which a concept or behavior is translated into accurate operational and functioning indicators (Taherdoost, 2016). Construct validity was determined by establishing the contribution of each construct to the total variance generated in a phenomenon Kombo and Tromp (2006). Construct validity of the questionnaire was tested by Analysis of Moment structures (AMOS) version 21 software using the confirmatory factor analysis technique. This was statistically tested through convergent validity and discriminate validity, which are subsets of construct validity. This was guided in making inferences from the study results to predict the theories and hypothesis that are used to anchor the research study. Content validity refers to the extent to which questions in the data collection tool accurately reflect the concepts being measured (Rusticus, et al., 2014). The questionnaire was tested for content validity during the pilot testing stage to determine the representativeness of the variable indicators.

3.8 Data Analysis and Presentation

Data analysis was undertaken using SPSS version 21 for multiplicity of different methods. The first method was to undertake diagnostics tests. Secondly, descriptive statistical analysis conducted in order guide in making statistical decisions using as mean and standard deviation. Tables were used to present the descriptive data. Thirdly, regression analysis was also employed to estimate the relationship existing between the dependent and independent variables. Factor analysis technique was specifically used to transform any possible set of correlated variables into observations comprising of linearly non correlated explanatory variables (Kothari & Garg, 2014). Analysis of qualitative data was specifically done through content analysis. Hsieh and Shannon (2005) defined qualitative content analysis as a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns. This research used Pearson correlation to analyze the relationship between the dependent and independent variables.

The study hypothesis was then tested using the analysis of variance (ANOVA) F-test statistic to determine the goodness of fit of the model. Inferential statistics derived from multiple linear regression (MLR) analysis was utilized to predict the regress and through execution of rigorous and robust tests of statistical significance as well as ANOVA from the data collected using SPSS version 21.

3.8.1 Data analysis Model

The logistic regression model was employed in determining the socioeconomic factors that affect the adoption of solar energy technology. The analysis was conducted using descriptive statistics because the feedback was majorly quantitative in nature. This study was guided by several researcher papers that had applied logistic regression in determining socio economic factors influencing adoption of solar energy technologies (Ahmar et al., 2022, Ahmed et al., 2022, Gitone 2010, Etongo and Naidu, 2022).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where:

Y= Represents the dependent variable (Adoption of solar Energy)
β_0= Constant
β_1...........β_i=Represents the regression coefficients
X_1= Household income
X_2= Education of household head
X_3 = Household dwelling characteristics
X_4 = Household demographic characteristics

ε = represents the error term

The coefficient of determination (R^2) was adopted in assessing the goodness of fit of the regression model because it best reflects the study sample size and the number of explanatory variables in the model (Zikmund et al, 2013). Using SPSS, the regression model was tested on how well it fits the data. The significance of each independent variable was tested. The study used the F-test to establish the significance of the overall model at a 95% confidence level. The p-value for the F-statistic applies in determining the robustness of the model. The conclusion was based on p-value where if the p-value is less than 0.05 then it is concluded that the variable is significant and is a good predictor of the dependent variable and that the results are not based on chance. If the p-value is greater than 0.05 then the variable is not significant in explaining variations in the dependent variable.

3.10 Ethical Considerations

The right code of behaviour regarding the rights of the respondents is referred to as research ethics. To collect data, the researcher had to obtain permission from Rwandan insurance firms. This was made possible by a letter from Strathmore Business School identifying the researcher as a student at the university. To avoid a breach of confidence, the researcher further said that the information gathered will not be disclosed to any unapproved parties. The responders' privacy was guaranteed. The respondents were provided with information on the nature and goals of the study to give them enough knowledge before they chose to participate. All information gathered is kept secret and handled with the highest discretion. Additionally, permission from NACOSTI was requested to perform the study.

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CHAPTER FOUR
RESULTS AND FINDINGS

4.0 Introduction

The data analysis, presentation, and result interpretation are outlined in this chapter. This study's goal is to assess socioeconomic factors affecting adoption of solar technology energy in Narok County. Questionnaires were used to gather the current data, which was then analyzed to provide a solution to the problem statement's query. This chapter begins by outlining the response rate before moving on to assess each research objective individually.

4.1 Response rate

284 of the 401 respondents who were targeted for the study responded, as indicated in Table 4.1. This resulted in a 71% study response rate. Based on the criteria put forward by Kothari and Garg (2016), who state that a response of above 50% is sufficient for statistical analysis, this was declared appropriate for study.

Table 4.1: Response Rate

Sub County Name	Distribution of Questionnaires	Response Rate	Percentage Response
NAROK EAST	42	31	74
NAROK NORTH	100	73	73
NAROK SOUTH	78	54	69
NAROK WEST	64	39	61
TRANS MARA EAST	34	22	65
TRANS MARA WEST	82	65	78
MAU FOREST	0	0	0
Total	400	284	71

Source: Researcher (2023)

4.2 Major Source of Energy in Narok County

To understand the major source of energy for the respondents in Narok, the study sought their response on all the sources of energy they most frequently used. Electricity was most used with 158 (55.63%) followed by firewood 146 (51.41%), kerosine stove 112 (39.44%), charcoal burner 101 (35.56%), gas burner 93 (32.75%), Kerosine lamps 86 (30.28%) and solar power as least used with 53 (18.66%) as shown in table 4.2 below.

Table 4.2: Major Source of Power

Major Source of Power	Frequency	Percentage
Firewood	146	51.41
Charcoal Burner	101	35.56
Kerosine lamps	86	30.28
Kerosine Stove	112	39.44
Gas Burner	93	32.75
Electricity	158	55.63
Solar Power	53	18.66
Other	0	0

Source: Researcher (2023)

4.3 Adoption of Solar Energy Technology in Narok County

The study's major objective was to evaluate the socio-economic factors that affect the adoption of solar energy technology in Narok County. It was therefore important to first determine the level of adoption of the solar technology. When asked whether the respondents have ever used solar technology in their homes, 198 (69.72%) indicated that they had not, while only 86 (30.28%) had used it.

For those that had used the technology, 42 (48.84%) had purchased them, 23 (26.74%) had acquired them from NGOs and other organizational donations, 12 (13.95%) from county governments, 4 (4.65%) from community initiatives and the remaining 5 (5.81%) from other sources. When asked how long they have used the solar energy technology in their household, 37 (43.02%) indicated less than 2 years, 29 (33.72%) between 3-5 years, 16 (18.60%) between 6-10 year and 4 (4.65%) over 10 years. The average use was 4.3 years with a standard deviation of 2.8

years. Regarding the major uses of the solar technology, 67 (77.91%) indicated electronics, 47 (54.65%) lighting, and 6 (6.98%) for each of cooking and other uses. When asked about the benefits derived from the use of the solar technology, 53 (61.63%) indicated the reduction of power costs, 39 (45.35%) efficient use of energy, 37 (43.02%), better availability of power and energy, and 29 (33.72%) diverse application of the solar power. Regarding the challenges faced in using the solar technology, a majority 46 (53.49%) indicated high maintenance costs, 32 (37.21%) dependence on weather, 24 (27.91%) theft and vandalism and 17 (19.77%) inadequate storage and space of the solar equipment.

Those that had not used the solar energy technology indicated cost of purchase and installation as the greatest barrier at 145 (73.23%). Other reasons were high maintenance cost at 106 (53.54%), No information at 64 (32.32%), No storage space at 38 (19.19%) and 31 (15.66%) were not interested.

Table 4.3: Adoption of Solar Energy Technology in Narok County

Statement	Response	Frequency	Percentage	Mean/SD
Have you ever used solar energy technology in your home?	Yes	86	30.28	
	No	198	69.72	
Total		**284**	**100**	
How did you acquire the Solar technology	Self-purchase	42	48.84	
	County government donation	12	13.95	
	NGO and other organization donation	23	26.74	
	Community/SACCO initiatives	4	4.65	
	Other	5	5.81	
Total		**86**	**100.00**	
How long have you used solar energy in your household	Less than 2 years	37	43.02	
	3-5 years	29	33.72	4.3 / 2.8
	6-10 years	16	18.60	
	Over 10 years	4	4.65	
Total		**86**	**100.00**	
What are the major uses of your solar technology? (Select all appropriate)	Lighting	47	54.65	
	Cooking	6	6.98	
	Electronics (Tv, Radio, Phone charging)	67	77.91	

	Other	6	6.98	
What benefits have you derived from the use of Solar technology? (Select all appropriate)	Reduced Costs	53	61.63	
	Efficient use of energy	39	45.35	
	Better availability of power and energy	37	43.02	
	Diverse application	29	33.72	
What challenges have you encountered using the Solar technology? (Select all appropriate)	Weather dependent	32	37.21	
	Inadequate Storage and space	17	19.77	
	Theft and vandalism	24	27.91	
	High maintenance cost	46	53.49	
If no, why? (Select all appropriate)	Cost of purchase and installation	145	73.23	
	No Storage and space	38	19.19	
	High maintenance cost	106	53.54	
	Not interested	31	15.66	
	No information	64	32.32	

Source: Researcher (2023)

4.4 Socio-Economic Factors Affecting Adoption of Solar Energy Technology

4.4.1 Household Income

The study's first objective was to assess the household income factor and its effect on adoption of solar energy technology. For this study household income was categorized as Level and frequency of income, type and status of occupation and other competing costs.

Most of the respondents 179 (63.03%) were self-employed while the proportion of those with paid employment and unemployed was nearly similar with 53 (18.66%) and 52 (18.31%) respectively. Informal occupation had most respondents with 162 (57.04%) with formal occupation at 122 (42.96%). Regarding the main source of income for the household, 99 (34.86%) was farming activities, 74 (26.06%) was salaried activities, 60 (21.13%) were trading activities while 51 (17.96%) had no main source of income.

Regarding the average monthly level of income, below Ksh. 10,000 and between Ksh. 20,000 and 29,000 had similar response rates at 75 (26.41%), followed by between Ksh. 30,000 and 39,000 at 56 (19.72%), between Ksh. 10,000 and 19,000 at 41 (14.44%) and above Ksh. 40,000 at 37 (13.03%). The average income level of the respondents was Ksh. 22,852 with a standard deviation of Ksh. 13,685. When asked about the frequency of income, the responses varied with a greater proportion 88 (30.99%) receiving quarterly, followed by 61 (21.48%) monthly, 57 (20.07%) daily, and 49 (17.25%) weekly.

When asked about other competing costs, food was top of the respondents list with 113 (39.79%), followed by clothing 72 (25.35%), School fees 51 (17.96%), and utilities 37 (13.03%). The majority proportion of energy use in the household budget was less than 10% as reported by 159 (55.99%) while 88 (30.99%) reported between 10%-20%, 30 (10.56%), and 7 (2.48%) reporting over 30%. The average proportion of energy use in the household budget is 11% with a standard deviation of 7.7%.

Table 4.4 Occupation, Income Level and Frequency

Statement	Response	Frequency	Percentage	Mean/SD
What is your employment status	Paid Employed	53	18.66	
	Self Employed	179	63.03	
	Unemployed	52	18.31	
Total		**284**	**100**	
Type of employment	Formal	122	42.96	
	Informal	162	57.04	
Total		**284**	**100**	
What are your households' main sources of income?	Farming	99	34.86	
	Trading	60	21.13	
	Salaried	74	26.06	
	None	51	17.96	
Total		**284**	**100**	
What is your average Monthly income?	Below Ksh. 10,000	75	26.41	
	Ksh.10,000 – 19,000	41	14.44	
	Ksh. 20,000 – 29,000	75	26.41	22,852 / 13,685
	Ksh. 30,000 – 39,000	56	19.72	
	Ksh. 40,000 and above	37	13.03	
Total		**284**	**100**	
What is the frequency of your income?	Daily	57	20.07	
	Weekly	49	17.25	
	Monthly	61	21.48	

	Quarterly	88	30.99	
	Semi-annually	15	5.28	
	Annually	14	4.93	
Total		**284**	**100**	
What are your main expenses in the household?	Food	113	39.79	
	Clothing	72	25.35	
	School Fees	51	17.96	
	Utilities	37	13.03	
	Other	11	3.87	
Total		**284**	**100**	
What is the proportion of energy use expenses (heating, lighting, cooking, power…etc.) in your household budget?	Less than 10%	159	55.99	11 / 7.7
	10% - 20%	88	30.99	
	20% - 30%	30	10.56	
	Over 30%	7	2.46	
Total		**284**	**100**	

Source: Researcher (2023)

4.4.2 Education of Household Head

The study's second objective was to assess the education of household head factor and its effect on adoption of solar energy technology. For this study education of household head was categorized as type of education, level of education and training on solar technology.

The basic literacy level of the respondents was formal education by 131 (46.13%) followed by reading, writing and arithmetic 76 (26.76%), informal education 56 (19.72%), while the remaining 21 (7.39%) were illiterate. Regarding the highest level of education, 85 (29.93%) was secondary education, 44 (15.49%) college certificate, 42 (14.79%) College diploma, 39 (13.73%) primary education, 34 (11.97%) university degree and 33 (11.62%) had no formal education.

Regarding training on solar energy technology, 180 (63.38%) of the respondents had not received any while the other 104 (36.62%) had received some form of training. Out of the respondents that had received the solar technology training, 67 (64.42%) felt that the training had improved their efficiency in the use of the technology while the other 37 (35.58%) felt it had not. Majority of the respondents that had not received any training on solar technology (138 (76.67%) would have liked to receive the training while the remaining 42 (23.33%) would not.

The major sources of information on solar energy technology for the respondents was radio 91 (32.04%), TV 63 (22.18%), community gatherings 59 (20.77%), social media 42 (14.79%) and Newspaper 29 (10.21%).

Table 4.5 Type of Education, Level of Education and Training on Solar Technology

Statement	Response	Frequency	Percentage	Mean/SD
What is your basic literacy level?	Illiterate	21	7.39	
	Reading, writing, arithmetic	76	26.76	
	Formal education	131	46.13	
	Informal education	56	19.72	
Total		**284**	**100**	
What is your highest level of formal education?	No education	33	11.62	
	Primary	39	13.73	
	Secondary	85	29.93	
	College Certificate	44	15.49	
	College Diploma	42	14.79	
	University Degree	34	11.97	
	Postgraduate	7	2.46	
Total		**284**	**100**	
Have you ever received any training on Solar energy technology? (If yes. move to next, if No, move to D5)	Yes	104	36.62	
	No	180	63.38	
Total		**284**	**100**	
If yes, do you feel the training has improved your efficiency of use and adoption of solar technology?	Yes	67	64.42	
	No	37	35.58	
Total		**104**	**100**	
If No, would you like to receive training on Solar energy technology?	Yes	138	76.67	
	No	42	23.33	
Total		**180**	**100**	
Where do you find information about the latest solar energy technology	Newspaper	29	10.21	
	TV	63	22.18	
	Radio	91	32.04	
	Social Media	42	14.79	
	Community Baraza	59	20.77	
Total		**284**	**100**	

4.4.3 Household Dwelling Characteristics

The study's third objective was to assess household dwelling characteristics and its effect on adoption of solar energy technology. For this study household dwelling characteristics were categorized as available household capital, household location (rural/urban), type of dwelling (permanent/semipermanent) and household equipment.

Most of the respondents' households had corrugated iron sheets for roofing 189 (66.55%), while 56 (19.72%) were thatched and the remaining 39 (13.73%) had tiled roofing. Regarding wall quality, 139 (48.94%) had wooden walls, 67 (23.59%) had mud walls, 55 (19.37%) stone walls and 23 (8.10%) brick walls. On the quality of the floor, the majority 175 (61.62%) were cemented, 54 (19.01%) earth, and 47 (16.55%) tiled. The household location dwelling was almost evenly matched with 149 (52.46%) being rural while the other 135 (47.54%) being urban. Regarding the size of the household dwelling, 46.48% lived in less than 3 acres of land, 39.08% in between 3 and 6 acres of land and 14.43% in over 6 acres of land.

Most of the respondents 233 (82.04%) had not done any upgrades on the solar technology while an almost similar proportion 201 (70.77%) had not acquired any solar technology in the recent past.

Table 4.6 Household Dwelling Characteristics

Statement	Response	Frequency	Percentage	Mean/SD
Assess the **QUALITY** of the House or the Residence of the Respondent: ROOFING	Thatched	56	19.72	
	Corrugated Iron Sheets	189	66.55	
	Tiles	39	13.73	
Total		**284**	**100**	
Assess the **QUALITY** of the House or the Residence of the Respondent: WALL	Mud	67	23.59	
	Wood	139	48.94	
	Stone	55	19.37	
	Bricks	23	8.10	
Total		**284**	**100**	

Assess the **QUALITY** of the House or the Residence of the Respondent: FLOOR	Earth	54	19.01	
	Cement	175	61.62	
	Tiles	47	16.55	
	Other	8	2.82	
Total		**284**	**100**	
How would you best describe your residence, where you live?	Rural	149	52.46	
	Urban	135	47.54	
Total		**284**	**100**	
How would you best describe where you work?	Rural	155	54.58	
	Urban	129	45.42	
Total		**284**	**100**	
What is the size of the household dwelling	Less than 3 acres	132	46.48	
	3-6 acres	111	39.08	
	6+ acres	41	14.43	
Total		**284**	**100**	
What was your latest acquisition of the Solar energy technology	TV	8	2.82	
	Radio	24	8.45	
	Lighting	37	13.03	
	Phone	14	4.93	
	None	201	70.77	
Total		**284**	**100**	
Have you done any upgrading of your solar energy technology?	Yes	51	17.96	
	No	233	82.04	
Total		**284**	**100**	

Source: Researcher (2023)

4.4.4 Household Demographic Characteristics

The final objective of the study was to assess the household demographic characteristics and its effect on the adoption of solar energy technology. Table 4.7 below, shows that out of the total sampled respondents to the study, 195 (68.66%) were men, and the remaining 89 (31.34%) were women. This indicates that there are more men than women as household leaders. The margin of difference between the men and women is significant, which is consistent with the present social and cultural practices where men are considered head of households. In terms of age, the largest age bracket of the respondents was between 31-40years (53.87%), followed by 20-30 years (19.72%), then 41–50 years (16.55%) and finally above 50 years accounting for 9.86% of the respondents. This means that Majority of the respondents in Narok County households were above the age of 30, with an average age of 37 years and standard deviation of 9.3 years.

Regarding the marital status of the respondents, majority of the respondents were married at 244 (85.92%), 19 (6.69%) were widowed, 12 (4.23%) were single and the remaining 9 (3.17%) were either separated or divorced. Our of the married respondents, majority 171 (70.08%) were in a monogamous marriage while 73 (29.92%) were in a polygamous marriage. More than half of the respondents 156 (54.93%) were sole decision makers in the household while the remaining 128 (45.07%) had a shared decision-making role. The respondents had lived in Narok for diverse periods, a greater number, 91 (32.04%) had been residents for 16-20 years, followed by 68 (23.94%) for over 21 years, and 57 (20.07%) for 6-10 years. The average length of stay was 15 years with a standard deviation of 6.5 years.

Table 4.7: Demographic Characteristics of Household Head

Gender	**Frequency**	**Percentage**	**Mean/SD**
Male	195	68.66	
Female	89	31.34	
Total	284	100	
Age	**Frequency**	**Percentage**	
20-30	56	19.72	
31-40	153	53.87	37 / 9.3
41-50	47	16.55	
51-60	20	7.04	
Over 61	8	2.82	
Total	284	100	
Marital Status	**Frequency**	**Percentage**	
Single	12	4.23	
Married	244	85.92	
Widowed	19	6.69	
Separated/Divorced	9	3.17	
Total	284	100	
Type of Marriage	**Frequency**	**Percentage**	
Monogamy	171	70.08	
Polygamy	73	29.92	
Polyandry	0	0.00	
Other	0	0.00	

Total	244	100	
Role in Household Decision Making	**Frequency**	**Percentage**	
Sole Decision maker	156	54.93	
Shared Decision making	128	45.07	
Other	0	0.00	
Total	284	100	
Length of Stay in Narok	**Frequency**	**Percentage**	
Less than 5 yrs	26	9.15	
6-10 yrs	57	20.07	
11-15 yrs	42	14.79	15 / 6.5
16-20 yrs	91	32.04	
over 21 yrs	68	23.94	
Total	284	100	

Source: Researcher (2023)

Regarding the number of members in the household, 132 (46.48%) respondents had between 4 and 6 members, 111 (39.08%) had more than 7 and 41 (14.43%) had less than 3 members. When asked how many children the respondents had, 101 (35.56%) respondents had between 4-6 children, while 95 (33.45%) had between 2-4 children. When asked the level of education that the children are, 175 (61.62%) indicated they had children in primary and secondary schools, 83 (29.23%) indicated they had children in college/university/vocational training while 54 (19.01%) had children who were either employed or self-employed.

Table 4.8 Household Demographic Characteristics

Statement	Response	Frequency	Percentage	Mean/SD
What is the total number of members in this household	Less than 3	41	14.43	
	4-6	132	46.48	
	7+	111	39.08	
Total		**284**	**100**	
How many Children do you have	None	16	5.63	
	Less than 2	38	13.38	
	2-4	95	33.45	
	4-6	101	35.56	
	6-8	20	7.04	
	9+	14	4.93	
Total		**284**	**100**	
	Yes	175	61.62	

Do you have children who are still in primary or secondary school	No	109	38.38	
Total		**284**	**100**	
Do you have Children in College/University/Vocational Training?	Yes	83	29.23	
	No	201	70.77	
Total		**284**	**100**	
Do you have children employed/self-employed?	Yes	54	19.01	
	No	230	80.99	
Total		**284**	**100**	

Source: Researcher (2023)

4.5 Correlation and Regression Analysis

4.5.1 Effect of Household Income on the Adoption of Solar Energy Technology

The study also sought to determine the effect of income on the adoption of solar energy technology. Correlation and regression analysis is presented in Table 4.9 below.

Table 4.9: Effect of Household Income on the Adoption of Solar Energy Technology

		Y
X1 – Household Income and adoption of SET	Pearson Correlation (R)	.547**
	Sign. (2-tailed)	.001
	N	284

Model	R Square	Adjusted R square	Std, Error of Estimate	Sig. F Change
Household Income and adoption of SET	.215	.192	.3547	.000

Source: Researcher (2023)

The findings show a moderate positive correlation (r=0.547, p value = 0.001) between income of household head and the adoption of Solar Energy technology (SET). According to the regression model, R square, income of household head accounts for 0.215, or 21.5% of adoption of solar energy technology. For population, the value of adjusted R square =0.192 represents the overall correlation of income in adoption of SET. Additionally, given that p-value (sig) = 0.0000<0.05, the study's findings show that the regression model considerably well predicts the findings (5% significance level) and is a good fit for the data.

4.5.2 Effect of Education of Household Head on the Adoption of Solar Energy Technology

The study also sought to determine the effect of education on the adoption of solar energy technology. Correlation and regression analysis is presented in Table 4.10 below.

Table 4.10: Effect of Education of Household Head on the Adoption of Solar Energy Technology

		Y
X1 – Education of household head and adoption of SET	Pearson Correlation (R)	.732**
	Sign. (2-tailed)	.001
	N	284

Model	R Square	Adjusted R square	Std, Error of Estimate	Sig. F Change
Education of household head and adoption of SET	.331	.276	.4254	.000

Source: Researcher (2023)

The findings show a significant positive correlation (r=0.732, p value = 0.001) between education of household head and the adoption of Solar Energy technology (SET). According to the regression model, education accounts for R square of 0.331, or 33.1% of adoption of SET. For population, the value of adjusted R square =0.276 represents the overall correlation of education of household head on adoption of SET. Additionally, given that p-value (sig) = 0.0000<0.05, the study's findings show that the regression model considerably well predicts the findings (5% significance level) and is a good fit for the data.

4.5.3 Effect of Household Dwelling Characteristics on the Adoption of Solar Energy Technology

The study also sought to determine the effect of household dwelling characteristics on the adoption of solar energy technology. Correlation and regression analysis is presented in Table 4.11 below.

Table 4.11: Effect of Dwelling Characteristics on the Adoption of Solar Energy Technology

		Y
X1 – Demographic characteristics and adoption of SET	Pearson Correlation (R)	.523**
	Sign. (2-tailed)	.001
	N	284

Model	R Square	Adjusted R square	Std, Error of Estimate	Sig. F Change
Demographic characteristics and adoption of SET	.256	.242	.5142	.000

Source: Researcher (2023)

The findings show a significant positive correlation (r=0.523, p value = 0.001) between household dwelling characteristics and the adoption of Solar Energy technology (SET). According to the regression model, household economic resources account for R square of 0.256, or 25.6% of adoption of SET. For population, the value of adjusted R square =0.242 represents the overall correlation of household dwelling characteristics on adoption of SET. Additionally, given that p-value (sig) = 0.0000<0.05, the study's findings show that the regression model considerably well predicts the findings (5% significance level) and is a good fit for the data.

4.5.4 Effect of Household demographic characteristics on the Adoption of Solar Energy Technology

The study also sought to determine the effect of household demographic characteristics on the adoption of solar energy technology. Correlation and regression analysis is presented in Table 4.12 below.

Table 4.12: Effect of Household demographic characteristics on the Adoption of Solar Energy Technology

		Y
X1 – Household demographic characteristics and adoption of SET	Pearson Correlation (R)	.416**
	Sign. (2-tailed)	.001
	N	284

Model	R Square	Adjusted R square	Std, Error of Estimate	Sig. F Change
Household demographic characteristics and adoption of SET	.223	.198	.3412	.000

Source: Researcher (2023)

The findings show a positive correlation (r=0.416, p value = 0.001) between household demographic characteristics and the adoption of Solar Energy technology (SET). According to the regression model, household demographic characteristics account for R square of 0.223, or 22.3% of adoption of SET. For population, the value of adjusted R square =0.198 represents the overall correlation of household demographic characteristics on adoption of SET. Additionally, given that p-value (sig) = 0.0000<0.05, the study's findings show that the regression model considerably well predicts the findings (5% significance level) and is a good fit for the data.

4.6 Inferential Statistics

4.6.1 Logistic Regression

Table 4.7 below shows Logistic regression model. The results revealed that respondents' household income levels between Ksh. 10,000 to Ksh. 19, 000 are 1.4 times more likely to adopt solar energy than those with income less than Ksh 10,000. Similarly, those with income between Ksh. 20,000 to Ksh. 29,000 are 1.3 times more likely to adopt solar energy compared to those with income below Ksh. 10,000. Those with income above Ksh. 29,000 are 2.7 times more likely to adopt solar energy compared to with income less Ksh. 10,000.

Education of household heads is also significant in explaining adoption of solar energy technology. Those with primary level of education are 0.109 times less likely to adopt solar energy compared to those with no education. Similarly, those with secondary level of education are 0.307 times less likely to adopt solar energy compared to those with no education, and people with college and above level of education are 0.173 times less likely to adopt solar energy than those with no education.

Household size was also found to be significant in explaining adoption of solar energy technology. Household with members between 3 and 6 are 2.4 times more likely to adopt solar energy compared to family with less than 3 members, while those with 7 members and above are 10.3 times more likely to adopt solar energy compared to those with less than 3 members. Place of residence was found to be significant in explaining adoption of solar technology. Those residing in rural areas are 2.4 times more likely to adopt solar energy compared to those residing in urban areas. Families with children in school are 1.12 times more likely adopt solar compared to those without children in school.

Table 4.13: Logistic Regression

Variables	Categories	B	S.E.	Wald	df	Sig.	Exp(B)
Education Level	No education			18.763	3	.000	
	Primary	-2.220	.602	13.606	1	.000	.109
	Secondary	-1.182	.578	4.177	1	.041	.307
	College and above	-1.753	.611	8.242	1	.004	.173
Income Levels	less than Ksh10,000			6.651	3	.084	
	Ksh10K-19K	.320	.769	.173	1	.677	1.377
	Ksh20k-29k	.236	.770	.094	1	.760	1.266
	Above Ksh29000	.991	.771	1.652	1	.199	2.694
HH Size	Less than 3			35.476	2	.000	
	3 to 6	1.229	.282	19.045	1	.000	3.418
	>7	2.327	.446	27.248	1	.000	10.250
Residential	Rural	.876	.362	5.859	1	.016	2.401
Children	Yes	.115	.384	.090	1	.765	1.122
Constant		.560	.923	.368	1	.544	1.750

Source: Researcher (2023)

CHAPTER FIVE
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The summary, discussion, conclusions of the objective findings are presented in chapter five. The chapter concludes with recommendations for policy, practice and future research derived from the findings.

5.1 Summary of Study

The primary objective of this study was to determine the socio-economic factors affecting the adoption of solar energy technology in Narok County. Based on this, the specific goals were to: determine the influence of household income in the adoption of solar energy technologies in Narok County; evaluate the influence of education of household head on the adoption of solar energy technologies in Narok County; determine the influence of demographic characteristics in the adoption of solar energy technologies in Narok County; and assess the influence of household demographic characteristics on the adoption of solar energy technologies in Narok County

The Technology advance model served as the study's theoretical foundation to determine the connection between socioeconomic factors and SET adoption. The study aimed to close any conceptual, theoretical, empirical, or contextual gaps. The study was carried out in Kenya, Narok County, filling in a gap as earlier studies of a similar nature were primarily conducted in developed European and Asian economies. Conceptually, the study used and the unified theory of adoption and use of technology (UTUAT), which is one of the most popular and reputable research models for predicting how individual users will react to and make use of information systems and technology. The socio-economic factors of household income, education of household head, demographic characteristics and household demographic characteristics were used. The empirical review presented numerous studies from diverse economies that had comparable and dissimilar conclusions, demonstrating the existence of both comparable and dissimilar findings among experts. The study aimed to fill this void in the Kenyan economy, particularly the County of Narok.

Because positivism is concerned with objective viewpoints, the study embraced this as well as the descriptive and inferential study designs. The population was 241,125 households in the 7 sub counties within Narok County. The intended sample size was 400 respondents, utilizing structured questionnaires, to gather data. The study's response rate was 71%, which was deemed adequate to allow for the analysis of the data gathered. Regression analysis and descriptive statistics were used to analyze the data. The Strathmore University Ethics Review Board evaluated and accepted the proposal, and NACOSTI also granted the researcher a research authorization.

5.2 Discussion of the Findings

This section provides a summary of the findings and discussions thereafter.

5.2.1 Adoption of Solar Energy Technology

The study first sought to determine the level of adoption of the solar technology in Narok County households. The findings showed that less than a third of the respondents had used solar energy technology. Out of those that had used SET, a majority had acquired the equipment through self-purchase, NGOs, and other organizations donations. These findings are consistent with those published by the Kenya Bureau of Statistics (2019) that indicate a very low SET uptake in the country. Narok country however has a higher uptake than other parts of the country mainly due to the semi-arid nature of the area and due to high penetration of NGOs seeking to introduce energy efficient power sources. Majority of them had used the SET for less than 5 years indicating recent acquisitions. The major use of the SET was lighting and electronic purposes. The use of SET for less than 5 years is also consistent and in line with the Kenya Government launch of the Kenya Off-grid Solar Adoption Project (KOSAP) running between 2017 and 2022 to leverage solar technology and provide electrification to 277,000 households in Kenya.

The respondents derived benefits from the use of SET which included the reduction of power costs, efficient use of energy and better availability of power and energy. However, they also experienced challenges in the use of SET that included high maintenance costs and the SET dependence on weather. Theft and vandalism as well as inadequate storage and space of the SET were also challenges, though in a smaller proportion. Those that had not used the solar energy technology indicated cost of purchase and installation and high maintenance cost as the greatest barrier at to the purchase of SET. The barriers to adoption are however not consistent with George et al (2019) findings, that noted the increased uptake of off-grid power in Kenya has been attributed to availability of affordable solar panels through removal of tariffs on solar energy technologies among other government policy interventions.

5.2.2 Effect of Household Income on the Adoption of Solar Energy Technology

The study's first objective was to assess the household income level and frequency as well as type and status of occupation factors and their effect on adoption of solar energy technology. Most of the respondents were self-employed with largely informal occupations. Their main source of income for the household therefore included informal activities such as farming and trading. The average monthly income level of the respondents was Ksh. 22,852 with a standard deviation of Ksh. 13,685 with varied frequency of income. The respondent's greatest energy competing costs was food and clothing. The energy use in the household budget however accounted for less than 10% of total household budget with a collective average of 11% and a standard deviation of 7.7%. The findings show a moderate positive correlation between income and the adoption SET. Income accounted for 21.5% of adoption of SET. Specifically, self-employed respondents formed the majority of those who have used solar energy with no significant association between status of employment, and type of occupation and use of solar energy technology. Farmers were most likely to be the highest users of SET to be the ones using solar energy.

These findings on household income level are consistent with the findings of Santin et al. (2009), Vassileva, Wallin and Dahlquist (2012) Ding et al. (2016) and Zhao et al. (2012), among others, who found that household income levels propel the willingness to adopt SET. However, the findings were contrary to those of Bollinger and Gillingham, 2012; Müller and Rode,2013 who found that low-income households have a stronger tendency to install SET.

5.2.3 Effect of Education of Household Head on the Adoption of Solar Energy Technology

The study's second objective was to assess the effect of type of education, level of education and training on SET adoption of the household head. Most of the respondents were in the category of formal education or had basic reading, writing and arithmetic types of education. A large proportion of the respondents had lower than college certificate level of education. Nearly two thirds of the respondents had not received any training on SET use. They would however like to receive training. The respondents that had received some training felt that it had improved their efficiency in the use of the technology. The major sources of information on solar energy technology for the respondents were radio, TV and community gatherings. The findings show a significant positive correlation between education and the adoption of SET and accounted for 33.1% of adoption of SET. The proportion of adoption of SET was highest in the respondents with secondary education and higher as well as those that had received training on the usage of SET.

The findings are consistent with those of Guta (2018), Mensah and McWilson (2021), Gyamfi et al (2015) and Abokyi et al (2018) who investigated the determinants of household adoption of solar home system and found that education level has a positive effect on SET adoption and that the level of education influenced adoption of SET such that the higher the education level, the higher the adoption. Similarly, the study findings on training agreed with those of Keriri (2013), who found that there is a positive relationship between the individuals who had received informal or formal training on SET and its use.

5.2.4 Effect of Household Dwelling Characteristics on the Adoption of Solar Energy Technology

The third objective was to assess demographic characteristics of the household that included the household location, type of dwelling, available household capital and its effect on adoption of SET. Most of the respondents' households had corrugated iron sheets for roofing, a combination of wooden and mud walls, and cement floors. The household location of the respondents was almost equally located in rural and urban settings, with a majority dwelling in land that was smaller than 6 acres. The findings show a significant positive correlation between dwelling characteristics and the adoption of SET.

5.2.4 Effect of Household Demographic Characteristics on the Adoption of Solar Energy Technology

The final objective was to comprehend the demographic traits of the respondents. Most responders were monogamous married men, over the age of 30, and largely sole decision makers in their households. The majority of the respondents had been residents of Narok County for more than 11 years. The major source of energy was electricity for lighting and electronics purposes and firewood for cooking and heating. Solar energy was the least used power source. According to Hammer (2011), the absence of these demographic characteristics would put the researcher at risk of adopting an absolutist approach, which implies a similarity in response without the influence of these crucial characteristics. Therefore, without assuming absolutes, we may say that most respondents from the chosen sample possessed the necessary traits to be able to give the study with the necessary data.

Most of the households had more than 4 members living in the houses with an average of 4 or more children, most of whom were in primary and secondary schools. Further findings indicated that households in rural settings and those with more children had a higher probability of adopting SET than those in urban settings with fewer children. These findings agree with those of Ahmed et al., (2022) Thompson, Ajiboye, Oluwamide, and Oyenike (2021) and Hillerbrand and Goldammer (2018), who concluded that a unit increase in the family size and other household context factors increased the probability of solar energy technology adoption. However, the study differs from that of Briguglio and Formosa (2017) and Etogo and Naidu (2022) who did not find significance of family size, gender, and age in Seychelles in adoption of SET.

5.3 Conclusion

This study concludes that in Narok County, adoption of solar technology increases steadily with an increase in household income. It was also noted that increase in level of education up to a certain level increases adoption, this declines with further increase in education. Rural settlement is a significant factor that highly influences Narok residents to adopt solar energy. Also, household size, the more the number of families the higher the chance of residents in Narok to adopt solar energy. Lastly, families with children in school are more willing to adopt solar energy.

5.4 Recommendation

This study makes the following recommendations.

Cost Consideration

The solar technology devices and equipment should be made affordable to the residents with low income to improve adoption and use. Solar energy technology distributors should distribute affordable products and develop flexible payment plans to improve adoption. The government should be involved in reduction of importation cost, tariffs, duties, or barriers to lower product cost and provide targeted subsidies to households with low income.

Product Offering and Warranty

Solar Energy distributors should customize products that are robust to withstand the harsh rural environment where the targeted users are based. Also, warranty and replacements for customers with products malfunction to improved adoption and usage. Setting up repair centers for products and training of technicians to provide after-sales.

Education and Training of Household head

More investment in awareness campaigns targeted to improve knowledge of solar technology functionality and capability to improve adoption. More seminars in rural areas involving training of households to increase awareness and knowledge dissemination on the benefits of using solar equipment in households as a safer option to other traditional sources including fossil fuels.

Expansion of Knowledge

This study could focus on different geographies or demographics to shed light and add knowledge on factors affecting adoption of solar energy technology.

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APPENDICES

APPENDIX I: LETTER OF INTRODUCTION

VICTOR AGANDI

STRATHMORE UNIVERSITY.

NAIROBI

Date: ________________________

Dear Sir/Madam,

I am a Master of Business Administration student at Strathmore University. As per the requirement in this course, I am required to conduct a research project on the "INFLUENCE OF SOCIO-ECONOMIC FACTORS ON ADOPTION TO SOLAR ENERGY IN KENYA: A CASE OF NAROK COUNTY". I kindly request you to participate in this research by completing the attached questionnaire.

Please answer all the questions as honestly as you can based on your knowledge and experience in solar energy technology adoption and utilization matters. To ensure confidentiality, you do not have to include your name. The data collected will be for academic purposes only and will be availed to you on request and adoption from Strathmore University library.

Yours Faithfully

VICTOR AGANDI

APPENDIX II: QUESTIONNAIRE

QUESTIONNAIRE

VICTOR AGANDI
STRATHMORE UNIVERSITY.
NAIROBI

Date: ________________________

Dear Sir/Madam,

I am a Master of Business Administration student at Strathmore University. As per the requirement in this course, I am required to conduct a research project on the "**SOCIO-ECONOMIC FACTORS INFLUENCING ADOPTION OF SOLAR ENERGY TECHNOLOGIES: A CASE OF NAROK COUNTY**". I kindly request you to participate in this research by completing the attached questionnaire.

Please answer all the questions as honestly as you can based on your knowledge and experience in solar energy technology access and utilization matters. To ensure confidentiality, you do not have to include your name. The data collected will be for academic purposes only and will be availed to you on request and accessible from Strathmore University library.

Yours Faithfully

VICTOR AGANDI

SECTION A: PERSONAL PROFILE

No.	Questions and Filters		Code	Skip
A1	Sub County			
A2	Ward			
A3	Gender of the respondent (Interviewer to observe)?	○ Male ○ Female	1 2	
A4	How old are you?	○ 20-30yrs ○ 31 - 40 Years ○ 41 - 50 years ○ 51 - 60 years ○ Over- 61 years	1 2 3 4 5	
A5	What is your marital status?	○ Single ○ Married ○ Widowed ○ Divorced /Separated	1 2 3 4	
A6	If married, how many wives)	○ 1 ○ 2 ○ 3 ○ 4	1 2 3 4	
A7	What is your role in decision making in the household	○ Sole decision maker ○ Shared decision making ○ Other	1 2 3	
A8	How long have you lived in Narok County	○ Less than 5 years ○ 6-10 years ○ 11-15 years ○ 16-20 years ○ 21 and above years	1 2 3 4 5 6	
A9	What is/are your major source of power for lighting, cooking, heating? (Select all appropriate)	○ Firewood ○ Charcoal burner ○ Kerosine lamps ○ Kerosine stove ○ Gas burner ○ Electricity ○ Solar power ○ Other	1 2 3 4 5 6 7 8 9	
		SECTION B: ADOPTION OF SOLAR ENERGY TECHNOLOGIES		
B1	Have you ever used solar energy technology in your home? (If yes, continue from B2 – B6, if no, move to B6)	○ Yes ○ No	1 2	

B2	Is solar your only source of power and Energy?	o Yes o No	1 2	
B3	If No, what other sources of Energy and power do you use?	o Firewood o Charcoal burner o Kerosine lamps o Kerosine stove o Gas burner o Electricity o Other	1 2 3 4 5 6 7	
B4	How did you acquire the Solar technology	o Self-purchase o County government donation o NGO and other organization donation o Community/SACCO initiatives o Other	1 2 3 4 5	
B5	How long have you used solar energy in your household	o Less than 2 years o 3-5 years o 6-10 years o Over 10 years	1 2 3 4	
B6	What are the major uses of your solar technology?	o Lighting o Cooking o Electronics (Tv, Radio, Phone charging) o Other	1 2 3 4	
B7	What benefits have you derived from the use of Solar technology? (Select all appropriate)	o Reduced Costs o Efficient use of energy o Better availability of power and energy o Diverse application o Other	1 2 3 4 5	
B8	What challenges have you encountered using the Solar technology?	o Weather dependent o Expensive Storage and space o Theft and vandalism o High maintenance cost o Other	1 2 3 4 5	
B9	If no, why?	o Cost of purchase and installation o No Storage and space o High maintenance cost o Not interested o No information o Other	1 2 3 4 5 6	

				SECTION C: INCOME
C1	What is your employment status	o Paid Employed o Self Employed o Unemployed o Employer o Unemployed	1 2 3 4 5	

C2	Type of employment	○ Formal ○ Informal	1 2	
C3	What are your sources of income?	○ Farming ○ Trading ○ Salaried ○ None	1 2 3 4	
C4	What is your average Monthly income?	○ Below Ksh. 10,000 ○ 10,000 – 19,000 ○ 20,000 – 29,000 ○ 30,000 – 39,000 ○ 40,000 and above	1 2 3 4 5	
C5	What is the frequency of your income?	○ Daily ○ Weekly ○ Monthly ○ Quarterly ○ Semi-annually ○ Annually	1 2 3 4 5	
C6	What are your main expenses in the household?	○ Food ○ Clothing ○ School Fees ○ Utilities ○ Other	1 2 3 4	
C7	What is the proportion of energy use expenses (heating, lighting, cooking, power…etc) in your household budget?	○ Less than 10% ○ 10% - 20% ○ 20% - 30% ○ Over 30%	1 2 3 4	
SECTION D: EDUCATION				
D1	What is your basic literacy level?	○ Illiterate ○ Reading, writing, arithmetic ○ Formal education ○ Informal education	1 2 3 4	
D2	What is your highest level of formal education?	○ No education ○ Primary ○ Secondary ○ College Certificate ○ College Diploma ○ University Degree ○ Postgraduate	1 2 3 4 5 6 7 8	
D3	What informal education and training (if any) have you done?	○ None ○ Farming ○ Animal husbandry ○ Vocational training (carpentry, sewing, trading….etc)	1 2 3 4	

D4	Have you ever received any training on Solar energy technology? (If yes. move to next, if No,	○ Yes ○ No	1 2	

	move to D5)			
D5	If yes, do you feel the training has improved your efficiency of use and adoption of solar technology?	○ Yes ○ No	1 2	
D6	If No, would you like to receive training on Solar energy technology?	○ Yes ○ No	1 2	
D7	Where do you find information about the latest solar energy technology	○ Newspaper ○ TV ○ Radio ○ Social Media ○ Community gatherings/Baraza ○ Other	1 2 3 4 5 6	
D8	Have you done any upgrading of your solar energy technology?	○ Yes ○ No	1 2	
D9	What was your latest acquisition of the Solar energy technology	○ TV ○ Radio ○ Lighting ○ Phone	1 2 3 4	
SECTION E: HOUSEHOLD CONTEXT				
E1	Assess the **QUALITY** of the House or the Residence of the Respondent: ROOFING	○ Thatched ○ Corrugated Iron Sheets ○ Tiles	1 2 3	
E2	Assess the **QUALITY** of the House or the Residence of the Respondent: WALL	○ Mud ○ Wood ○ Stone ○ Bricks ○ Other	1 2 3 4	
E3	Assess the **QUALITY** of the House or the Residence of the Respondent: FLOOR	○ Earth ○ Cement ○ Tiles ○ Other	1 2 3 4	
E4	How would you best describe your residence, where you live?	○ Rural ○ Urban	1 2	
E5	How would you best describe where you work?	○ Rural ○ Urban	1 2	
E6	What is the total number of members in this household	○ Less than 3 ○ 4-6 ○ 7+	1 2 3	
E7	What is the number of each gender in the household?	○ Male ________________________ ○ Female _____________________		
E8	How many Children do you have	○ None ○ Less than 2 ○ 2-4	1 2 3	

		○ 4-6 ○ 6-8 ○ 9+	4 5 6	
E9	Do you have children who are still in primary or secondary school	○ Yes ○ No	1 2	
E10	Do you have Children in College/University/Vocational Training?	○ Yes ○ No	1 2	
E11	Do you have children employed/self-employed?	○ Yes ○ No	1 2	
E12	Are you the head of this household	○ Yes ○ No	1 2	
E13	What is your household energy use and needs?	○ Lighting ○ Cooking ○ Electronics (Tv, Radio, Phone charging) ○ Other	1 2 3 4	
E14	What is the size of the Land that you reside in as a household?	○ Less than 3 acres ○ 3-6 acres ○ Over 6 acres	1 2 3	

APPENDIX III: CLEARANCE FROM ETHICAL APPROVAL

Strathmore UNIVERSITY

26th September 2022

Mr Agandi, Victor
victor.agandi@strathmore.edu

Dear Mr Agandi,

RE: Socio-Economic and Demographic Factors Influencing Access to Solar Energy in Kenya

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU- master's** research proposal. Your application reference number is **SU-ISERC1483/22.** The approval period is from **26th September 2022 to 25th September 2023.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-ISERC within 48 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-ISERC within 48 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to SU-ISERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and obtain other clearances needed.

Yours sincerely,

for: **Dr Ben Ngoye,**
Secretary; SU-ISERC

Cc: Prof Fred Were,
Chairperson; SU-ISERC

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APPENDIX IV: NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **373665**

Date of Issue: **07/October/2022**

RESEARCH LICENSE

This is to Certify that Mr.. Victor Agandi of Strathmore University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Narok on the topic: SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS INFLUENCING ACCESS TO SOLAR ENERGY IN KENYA: A CASE OF NAROK COUNTY for the period ending : 07/October/2023.

License No: **NACOSTI/P/22/20728**

373665

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions