Available on: https://jnsrr.ep-journals.org/ E-ISSN: 3051-3766 P-ISSN: 3051-3758

Journal of Natural Science Research and Review

Volume: 02 Issue: 02 February-2026

Solar Power Adoption Among Rural Households in Bondo Sub-County

Peter Oyugi Makene

Taita Taveta University, Voi, Kenya Department of Business and Management Sciences, School of Business, Economics, and Social Sciences

Dr. Peter Shibairo Misango

Taita Taveta University, Voi, Kenya

Dr. Stella Munyole

Taita Taveta University, Voi, Kenya

Published Date: February 24, 2026 **Article DOI: 10.65150/EP-jnsrr/V2E2/2026-05**

ABSTRACT: In the wake of adverse impact of climate change, renewable energy technologies such as solar power have gained increased attention as sustainable, and low-carbon solutions. However, in Kenya, rural household adoption of solar power remains low, with solar-powered hybrid systems accounting for only 1.07 percent of off-grid electricity generation. This study assessed the determinants of solar power adoption among rural households in Kenya, focusing on awareness of solar power existence, household income, education level of household heads, and availability of substitute energy sources. The study's anchor theory was the Diffusion of Innovation Theory. A descriptive survey design was employed, with self-administered questionnaires being the method used for data collection. Inferential analyses and a logit model were also adopted. Findings revealed that awareness of solar power existence, household income, education level, and availability of fossil fuels and biomass had significant influence on adoption decisions. However, household income emerged as the strongest predictor, underscoring the economic nature of household decision-making. Those findings led to the conclusion that although various aspects exist that determine rural households' willingness to adopt solar power, household income remains the most significant one, which underlines the need for developing solutions focusing on that area to increase rural households' adoption of solar power to achieve United Nations Sustainable Development Goal (SDG) 7 that aims to ensure access to affordable, reliable, sustainable, and modern energy. This led to the recommendation that the Kenyan government should introduce incentives and tax breaks for solar power suppliers to reduce the cost of solar power products.

KEYWORDS: Solar energy, Solar home system, Biomass, Affordable energy

INTRODUCTION

Reliable and affordable energy is a fundamental requirement of socio-economic development but many people in rural areas of sub-Saharan Africa, including in Kenya, are not connected to traditional electricity grids. Kato et al. (2020) highlights that rural Kenya is home to 70 percent of the population, and these areas, energy poverty is a common hindrance to better livelihoods, education, health care, and production. As a decentralized and renewable energy source, solar power is a viable option for addressing the energy deficit in rural Kenya (Khan et al., 2020). It offers the opportunity to provide clean, sustainable, and cost-effective electricity to households without access to electricity or with poor service reliability (Apergi et al., 2024). However, despite these clear benefits there is uneven adoption of solar power among rural households, arising from a complex set of situational factors.

The decision to adopt solar power in rural Kenya is influenced by numerous economic, social, technological, and policy considerations. A financing vehicle in the form of microloans or pay-as-you-go schemes has been shown to lessen the burden of initial capital, but they are not available or accessible to all households (Ouma, 2020). Social factors that also influence household decisions to acquiesce to the adoption of solar energy are an interest in new technology that includes household awareness, education levels, and perceptions of benefits to energy in the marketplace. Limited household knowledge around beneficial aspects of solar systems, limited familiarity with operating systems, and perceptions of reliability can clearly serve as a barrier to adoption (Chemirmir et al., 2023). Additionally, the adoption of household energy is also often subject to the influence of community leaders and the overall local social landscape with community sensitivities and peer behaviours exerted influenced to welcome new technologies.

Kenya has attempted to promote renewable energy through the Kenya National Electrification Strategy and the setting up of the Rural Electrification Authority, however, gaps in implementation and enforcement still exist (Ouma, 2020). Knowing the determinants of rural households' adoption of solar power will help in designing targeted interventions that confront barriers and use enablers. This research looked at various determinants of solar power adoption and to determine the one with the greatest determinant factor or probability.

Khan et al. (2020) notes that advances in photovoltaic (PV) technology in the past two decades have led to increased solar power adoption, as well as declining initial capital, and the global push towards renewable energy as a way of combating climate change. The International Energy Agency (IEA) highlights that solar power is now the cheapest source of electricity in many areas across the globe (Ibegbulam et al., 2023). In 2022, the global installed solar capacity reached over 1,000 GW with the main contributors being China, India, and the United States (Ibegbulam et al., 2023). Nationally Determined Contributions (NDCs) and government policies like tax have also catalysed the trend (Ibegbulam et al., 2023). However, despite the progress, the global adoption of solar continue to experience challenges such as intermittency, financing, and problems with the grid integration. Besides, challenges associated with maintenance, affordability, and product reliability continue to persist in many regions across the globe. Seasonal issues leading to few sunshine hours and long rainy seasons with high cloud cover and increased scattering of clouds and water drops causing back reflection of solar radiation are other challenges hindering global solar adoption.

In Africa, approximately 600 million people lack electricity (Abdelrazik et al., 2022). This has left solar power to be an alternative solution for rural electrification. African continent has an abundance of solar resources, which is a factor that has spurred the growth of the solar market (Adenle, 2020). The declining costs of PV technology has also been a contributing factor to the growth of those markets (Abdelrazik et al., 2022). The advancements of the off-grid solar solutions have allowed rural households to replace kerosene lamps and diesel or petrol generators with cleaner alternatives (Abdelrazik et al., 2022). Companies such as d.light, BBOXX, and Fenix International have been leading in solar innovations in Africa, as they offer households pay-as-you-go (PAYG) financing models that eases the financial stress for those with low disposable income (Kato et al., 2020). Regional initiatives such as the African Development Bank's (AfDB) and Desert to Power program aim at expanding solar infrastructure in the continent (Sankoh et al., 2021). However, the continent's solar power adoption continues to face challenges such as weak regulatory frameworks that hinder broader adoption. For instance, Uganda's grid connectivity rate stands at 28% and although the connectivity to solar power is higher at 43%, the figure highlights that African households continue to face different challenges in adopting solar power in their homes (Muthoka, 2025). Although the initial capital of solar installation has reduced over the years, it remains a challenge in the continent's adoption of solar power. For instance, Mali reports a 49% solar power adoption compared to 37% grid electricity access while Sierra Leon has a 57% solar power adoption rate among its households against only 17% grid electricity access (Muthoka, 2025). The solar adoption rates, although higher than many African countries, is significantly impacted by the cost of purchasing solar power products and their installation (Muthoka, 2025).

In Kenya, the government's commitment to increasing energy access and reducing fossil fuel reliance has made the country a regional leader in solar power adoption (Apergi et al., 2024). Currently, about 75 percent of Kenyan households have access to electricity, with solar being common for off-grid rural areas (IEA, 2024). Kenya's Energy Act (2019) gives a legal framework for renewable energy promotion, including solar, and innovative companies such as M-KOPA, Azuri technologies, and Sun King have pioneered PAYG home systems that have allowed solar to be more affordable for low-income households (Ouma, 2020). Further, Kenya has demonstrated a strong commitment to solar energy through investing in large-scale solar projects such as the 50 MW Garissa Solar Plant and with the help of the World Bank through the Kenya Off-Grid Solar Access Project (KOSAP) aims at making more of such investments to increase solar adoption in the underserved counties (REREC, 2020). However, although those successes are commendable, various challenges continue to affect the nation's adoption of solar energy with financial constraints and grid infrastructure limitations acting as the main hindrances.

From its inception in 2019 to present, the Rural Electrification and Renewable Energy Corporation (REREC) has overseen a growth in households across the country in the rural areas that have access to the national grid, with the number rising from 4 percent to 32 (International Trade Administration, 2024). Despite the progress, a big percentage of rural households in the country continue to rely on off-grid alternatives for electricity access, with solar power being the most popular. The demand for electricity in rural households is growing as development is increasing in those rural areas. However, unstable electricity access continues to cripple the progress, with the adoption of alternatives such as solar remaining low because of the various existing barriers.

There are a few studies focusing on energy issues and rural household's adoption of green energy. However, a large proportion of the studies carried out in Kenya have focused on biomass, fossil fuel, and green energy technologies as well as cook stove solutions and energy mix. For instance, Namaswa et al. (2022) focused their study on biomass, looking at their utilisation trends and strategies for sustainability while using systematic review as their methodology. The study sought to effectively achieve this by collecting raw data augmented by records from government agencies from households located in Bondo Sub-County to examine the key determinants of solar power adoption by rural households.

The objectives of the study included:

1. To determine influence of awareness of solar power existence among rural households in Bondo Sub-County.
2. To evaluate the influence of household income as a determinant of solar power adoption by rural households in Bondo Sub-County.
3. To assess household head's education level as a determinant of solar power adoption by rural households in Bondo Sub-County.
4. To analyse the impact of availability of fossil fuels and biomass as a determinant of adoption of solar power by rural households in Bondo Sub-County.

LITERATURE REVIEW

Theoretical Framework

The anchor theory for this study was Diffusion of Innovation Theory (DIT) by Rogers (1995). The theory helps in understanding how individuals or groups adopt new ideas, products, or technologies and why some technologies succeed as others fail (Khanam & Daim, 2020). The theory's key argument is that different groups adopt innovation at different rates over time in what characterises an S-shaped curve (Barnes, Krishen, & Chan, 2022). Some of the critics of the theory highlight that it assumes innovation is beneficial and should be adopted by all members of society, framing non-adoption as a problem to be solved rather than a rational decision (Ho, 2022). Despite the criticism, the theory helped in comprehending that people's decision to adopt technology is influenced by their perceptions on the technology's relevant advantage, compatibility, flexibility, and observability (Barnes, Krishen, & Chan, 2022). Those constructs related to the variables that were studied in this research considering that they related to attitudes towards adopting solar power and helped understand household income and awareness of solar power existence as determinants of rural households' decision to adopt solar power.

The study also utilised two other theories: The Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975) and Resource-based theory (RBT) that is credited to Penrose (1959) and Barney (1991). The main argument by TRA's proponents was that attitudes and subjective norms predict people's behavioural intention (Rossmann, 2021). On the other hand, RBT's main argument is that a firm achieves and sustain superior performance through developing and leveraging unique resources and capabilities (Barney, Ketchen Jr, & Wright, 2021). TRA was applicable to the study since it helped explain how awareness of solar power existence determined rural households' decision to adopt solar power. Particularly, the theory helped explain how normative beliefs on solar power influenced the households' behaviour and attitudes towards its adoption. On the other hand, RBT was useful in explaining how households' level of income influenced their decision to adopt solar power energy. It further supported the finding that when households have enough resources such as funds and access to solar power products, they are in a position to easily adopt solar power in their homes (Kishara, Obulinji, & Ondimu, 2024).

Review of Previous Studies

A few studies have been done on how the perception of solar power influences people's adoption of solar power energy. In one of those studies, the researchers focused on the perception and knowledge of solar photovoltaic technology in Embu County, Kenya, and found that awareness of solar power existence positively correlates with solar energy adoption (Njeru & Ndunda, 2024). The researchers used mixed-methods research design with questionnaires and interviews being the data collection tools (Njeru & Ndunda, 2024). Contextual research gap was identified and addressed in this study. While the study provides important findings on how the perception of solar power can influence people's adoption of solar power, the findings may differ from rural households in Bondo County. Thus, this study improved on how perception on solar power existence determines solar power adoption.

In the study by Etongo and Naidu (2022) done in Seychelles, the researchers looked at how solar power technology was adopted by households in the country and found that although they have 100% access to electricity, fossil fuels account for a greater percentage. The researchers employed the survey research design and their main finding was that access to credit and monthly household income had a significant influence on households' decision to adopt solar photovoltaic system (Etongo & Naidu, 2022). The research gap identified in this study was contextual since the study was set in Seychelles, a country with 100 percent electricity penetration, which presents a different characteristic to rural households in Kenya.

Vinya and Kohsuwan (2022) employed Technology Acceptance Model 3 framework to examine how rooftop solar technology is accepted in Kenya, with the researchers finding that those who understood the usefulness of solar power were more likely to adopt it in their homes. The researchers used the survey research design with the study area being two regions in the Kenyan coast (Vinya & Kohsuwan, 2022). The research gap identified was conceptual. The researchers assessed the education level of the participants by looking at how they perceived the benefits of solar power, which might not clearly bring out how education level influence solar power adoption. The current study addressed the issue by focusing on the level of education completed by the household heads to provide a good understanding of the issue.

Various research done also show that availability of substitutes such as fossil fuels and biomass can influence household's adoption of solar power. A study focusing on the Maasai pastoral community examined the factors influencing the level of alternative sources of energy and found that awareness of alternative energy sources influenced the pastoralists decision to adopt clean energy sources (Kanini, 2022). The researcher used descriptive research design for the study with the study focus being Kajiado West Sub-County, Kenya (Kanini, 2022). The research gap identified in the study was conceptual. Although the researcher found that availability of substitutes can influence adoption of clean energy sources, it is unclear on how alternative sources such as biomass and fossil fuels influence rural households' decision to adopt solar power in particular. This study improved the knowledge by looking at how rural households' decision to adopt solar power can be influenced by the existence of different alternatives such as biomass and fossil fuels.

Studies have been done on the adoption of solar power, particularly in examining the barriers and determinants of people's decision to adopt solar technology. One of such studies looked at the determinants of domestic solar energy adoption in Nairobi County, Kenya. The main finding made from the study was that low adoption of domestic solar energy in Nairobi County was attributed to lack of awareness, high costs of solar equipment, and high preference for alternative energy sources such as grid electricity (Ongeri & Mbataru, 2023). The researchers used descriptive survey research design for their study, with questionnaires and interviews being the data collection tools adopted in a sample size of 384 households (Ongeri & Mbataru, 2023). The research gap identified in this study was contextual since the researchers focused on Nairobi County, which is an urban area. This study addressed the gap by focusing on rural Kenya.

MATERIALS AND METHODS

Research Design

Descriptive research design was adopted. It allows describing, recording, analysing, and reporting conditions already existing and those that existed (Binn et al., 2021). Quantitative approach was also utilised that entailed the augmentation of secondary data with the primary ones collected. The approach provided valuable understanding of the information gathered and improved the generalisability of the findings.

Data Sources

The target population comprised of households in Bondo Sub-County in Kenya, which comprises of a total of fifty thousand four hundred and fifty-four (50,454) conventional households. The suppliers of the solar power systems were not considered for the study as their information were assumed to be irrelevant in attaining the study's objectives.

Sampling

Simple random sampling technique was adopted in this study because it allowed each household to have an equal chance of selection (Mutuota, 2024), thus minimising bias. The study used the same sampling frame from KNBS 2019 population census. A random number generator was then used to select a sample of households from the sampling frame. Slovin's (1960) formula was used to determine the sample size as shown below (Shibairo, Ngaruko, & Wawire, 2023);

$$n = \frac{N}{1+N(e^2)}$$

Where:

n = Required sample size

N = Total target population

e = Margin of error

Assuming a 95% confidence level and a 5% margin of error

$$n = \frac{50,454}{1+50,454(0.05^2)}$$

$$n = \frac{50,454}{1+50,454(0.0025)}$$

$$n = \frac{50,454}{1+126.135}$$

$$n = \frac{50,454}{127.135}$$

n = 396.8

The final sample size used was **397** households

Data Collection Procedure

A self-administered questionnaire attached was used. The questionnaire comprised of closed-ended questions to allow for ease and speed in data analysis (Spangler, 2024). The questionnaire was divided into sections examining the different variables – awareness of solar power existence, household income, household head's education, and availability of fossil fuels and biomass – that assisted in discovering of the key determinants of adoption or lack of adoption of solar power in rural households, particularly in Bondo Sub-County. The questionnaire was designed to use a 5-point Likert Scale measure that the respondents used in responding to the items.

The respondents of the questionnaire were household heads based in Bondo Sub-County. The questionnaire had a total of 31 items with the first section, which focused on the participant's general information, comprising of ten items. The other sections were categorised based on the variables being examined and comprised of the remaining 21 items. The instrument was pilot-tested with a small group of 30 households in Rarieda Sub-County to identify any ambiguities, technical issues, or cultural sensitivities. After the pilot study, data collection was done. Data was collected through household visits to the households identified as the sample size. Participants were informed about the purpose and objectives of the study. The respondents were then asked to respond to the statements in the questionnaires and their responses were recorded by using Kobo Toolbox. Respondents were presented with various statements evaluating their level of agreement using a 5-point Likert where 1-Strongly Disagree (SD), 2-Disagree (D), 3-Neutral (N), 4-Agree (A), 5-Strongly Agree (SA). After collecting the data, the researcher carried out data validation to ensure data accuracy (Spangler, 2024). The data was then cleaned, analysed, and tabulated for presentation.

A pilot study was carried out and it involved a small sample of the households from the target population in Rarieda Sub-County, which is the sub-county bordering Bondo. About 10% of the sample size, which was 30 households was used for the pilot study. Each of the selected households were visited and data collected using the data collection tools mentioned. Feedback from the respondents were used to understand whether they had any issue with the items presented to them. The pilot data was analysed to assess the quality and reliability of the responses. Some of the aspects that were looked at included patterns of missing data, inconsistent responses, or other issues. The findings and feedback from the pilot study helped in adjusting the research instrument.

Analytical Methods

The collected data was cleaned and tabulated to facilitate basic statistical analysis. The validity test was done by utilising Kaiser-Meyer-Olkin (KMO) and Bartlett's Test and the reliability before embarking on the data analysis. Cronbach's Alpha coefficient analysis was done to check the instrument's reliability with a minimum threshold of 0.7 set to determine if the research scale is sufficient.

Quantitative (numerical) method was employed in the analysis. Particularly, inferential and descriptive analyses were carried out using a statistical software – the Statistical Package for the Social Sciences (SPSS v.22) program that is equipped with analytical tools. Pearson Correlation analysis was also carried out as part of the inferential analysis as well as logistic regression or logit model that was used to estimate the probability of the rural households' adoption of solar power. Diagnostic tests, particularly normality, linearity, multicollinearity, and heteroscedasticity were also carried out to ensure the regression model was significant. The rationale for adopting the model was that it provides intuitive and actionable interpretations that can be easily understood by policymakers and other relevant individuals interested in this study's findings.

The logit model function that was applied is;

$$\ln[P / (1 - P)] = \beta_0 + \beta_1X_1 + \beta_2X_2 + ... + \beta_kX_k \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where;

1-P = the probability that the dependent variable is 0

P = the probability of the household adopting solar power

β_0 = the intercept or constant

β_1, β_2, … β_k = the coefficients of each independent variable

X_1, X_2, … X_k = the independent variables

RESULTS

Response Rate

Table 1: outlines the results of the response rate.

: Response rate

Questionnaire Information	Frequency	Percentage (%)
Questionnaires properly filled and submitted	309	77.8
Questionnaires filled but rejected as inadequate	40	10.1
Questionnaires not filled or returned	48	12.1
Total	397	100

Source: (Author, 2025)

After five weeks of the questionnaire's deployment, a total of 349 questionnaires were filled and returned while 48 were not returned as highlighted in Table 1. Out of the 349 filled and returned questionnaires, 309 were acceptable while forty responses were rejected since they were inadequately filled and could not be used for the analysis. The satisfactorily filled questionnaires represented a response rate of 77.8%, which was considered sufficient for this study.

Awareness of Solar Power Existence

The first objective was to assess the awareness of solar power existence among rural households in Kenya. Respondents were presented with various statements evaluating their level of awareness of solar power existence and were requested to rate their level of agreement using a scale of 1-5 where 1-Strongly Disagree (SD), 2-Disagree (D), 3-Neutral (N), 4-Agree (A), 5-Strongly Agree (SA). The results are presented in Table 2.

Table 2: Measures of awareness of solar power existence

N=309	SD	D	N	A	SA	Mean
	%	%	%	%	%	
I am aware that solar power is a technology that converts sunlight into electricity.	1.9	2.9	26.2	53.7	15.3	3.78
I can recognise common products or systems that can be powered by solar energy such as solar panels on homes.	5.2	6.8	15.2	45.3	27.5	3.83
I am familiar with the basic visual appearance of a solar panel.	2.2	3.9	14.6	47.2	32.1	4.03
I know that solar power is a form of renewable energy, distinct from fossil fuels like coal or natural gas.	3.5	10.4	16.2	40.8	29.1	3.81
I am aware that solar power can be used for both large-scale power plants and small-scale, personal applications.	3.9	18.4	26.5	30.1	21.0	3.46
I am aware that solar power can be generated even on cloudy or overcast days, though at a reduced efficiency.	2.3	14.9	21.0	30.7	31.1	3.73
Average level of awareness of solar power existence	Mean	Std. Dev.	Std. Error of Mean	Min	Max	
	3.77332	.97345	.02540	1.00	5.00	

Source: (Author, 2025)

As shown in Table 2, 53.7% of the respondents agreed that they are aware that solar power is a technology that converts sunlight into electricity while 26.2% were neutral in their response to that statement. On the same statement, 15.3% strongly agreed, 2.9% disagreed, and 1.9% strongly disagreed. The overall response mean was 3.78 implying that the respondents leaned more towards agreeing with the statement. The findings supported the study by Njeru and Ndunda (2024) who found that awareness of solar power products positively correlates with solar power adoption. The findings also show that 45.3% agreed that they can recognise common products or systems that can be powered by solar energy such as solar panels on homes while 27.5% strongly agreed as shown in Table 1. On the same statement, 15.2% were neutral, 6.8% disagreed, and 5.2% of the respondents strongly disagreed. The overall response mean was 3.83 implying that the respondents leaned more towards agreeing that they can recognise common products or systems that can be powered by solar energy. This finding was corroborated by the study by Njeru and Ndunda (2024) who found that 51% of their target population had some perspective regarding solar power products.

Regarding the statement that the respondents were familiar with the basic visual appearance of a solar panel, 47.2% agreed while 32.1% strongly agreed with the statement. On the same statement, 14.6% took a neutral stance, 3.9% disagreed, and 2.2% of the respondents strongly disagreed. The overall response mean was 4.03 implying that the respondents agreed with this aspect.

On the statement that they know that solar power is a form of renewable energy, distinct from fossil fuels like coal or natural gas, 40.8% agreed with the statement while 29.1% strongly agreed. Further, 16.2% were neutral, 10.4% disagreed, and 3.5% of the respondents strongly disagreed. The overall response mean was 3.81 implying that the respondents leaned more towards agreeing with the statement. This finding supports the study by Kishara et al. (2024) who found that people's perception of renewable energy has a limited correlation with solar power adoption.

30.1% of the participants agreed that they were aware that solar power can be used for both large-scale power plants and small-scale, personal applications, while 26.5% were neutral. Subsequently, 21.0% strongly agreed, 18.4% disagreed, and 3.9% strongly disagreed. The overall response mean was 3.46 implying that the responses from the participants were mixed and they were largely neutral on the matter.

On the statement that the respondents were aware that solar power can be generated even on cloudy or overcast days, though at a reduced efficiency, 31.1% strongly agreed while 30.7% agreed. 21.0% were neutral on that statement, 14.9% disagreed, while 2.3% strongly disagreed. The overall response mean on the statement was 3.73, which implied that the respondents leaned more towards agreeing with the statement.

Household Income

The influence of household's income on solar power adoption among rural households was recorded based on the responses made by the participants and presented in Table 3. The participants were requested to rate their level of agreement using a scale of 1-5 where 1-Strongly Disagree (SD), 2-Disagree (D), 3-Neutral (N), 4-Agree (A), 5-Strongly Agree (SA).

Table 3: Measures of household income effect on solar power adoption

N=309	SD	D	N	A	SA	Mean
	%	%	%	%	%	
Our decision to install solar power is based on our income.	0.0	1.3	7.1	37.9	53.7	4.44
My household's average yearly income is enough to support solar power installation and maintenance.	32.8	40.6	14.3	10.7	1.6	2.08
Our ability to pay for solar power installation is high.	1.0	2.6	21.0	45.3	30.1	4.01
A reduction in cost would increase our likelihood to adopt solar power.	0.0	1.3	2.6	12.0	84.1	4.79
Financial support from the government or NGOs would increase my likelihood to adopt solar power.	0.0	1.3	2.6	12.0	84.1	4.79
Average level of household income effect	Mean	Std. Dev.	Std. Error of Mean	Min	Max	
	4.0201	.50275	.02865	1.00	5.00	

Source: (Author, 2025)

As shown in Table 3, 53.7% of the respondents strongly agreed that their decision to install solar power was based on their income while 37.9% agreed. On the same statement, 7.1% were neutral and only 1.3% disagreed. None of the participants, 0.0%, strongly disagreed with the statement.

The overall response mean was 4.4 implying that the respondents generally agreed with the statement. The finding concurred with the argument by Best (2023) that households with better access to stable income are more likely to use solar power technology in their homes.
The findings show that 40.6% of the participants disagreed that their household's average yearly income is enough to support solar power installation and maintenance while 32.8% strongly disagreed as shown in Table 3. On the same statement, 14.3% took a neutral stance, 10.7% disagreed, and only 1.6% of the respondents strongly disagreed. The overall response mean was 2.08 implying that the respondents generally disagreed that their household's average yearly income is enough to support solar power installation and maintenance. This finding was corroborated by the study by Mugisha et al. (2021) who found that most residents of rural households in Kenya do not have enough income to support adoption of off-grid solar power systems.
Regarding the statement that respondents' ability to pay for solar power installation is high, 45.3% agreed while 30.1% strongly agreed with the statement. On the same, 21.0% were neutral, 2.6% disagreed, and only 1.0% strongly disagreed. The overall response mean was 4.01 implying that there was a general agreement among the respondents on this aspect.
On the statement that a reduction in cost would increase their likelihood to adopt solar power, an overwhelming number, 84.1%, strongly agreed with the statement while 12.0% agreed. Further, 2.6% held a neutral position and only 1.3% disagreed. None of the respondents, 0.0%, strongly disagreed with the statement. The overall response mean was 4.76 implying that there was a strong agreement among the respondents that a reduction in cost would increase their likelihood to adopt solar power. This finding was supported by the study by Etongo and Naidu (2022) who noted that access to credit and monthly household income had a significant influence on households' decision to adopt solar photovoltaic system.
84.1% of the participants strongly agreed that financial support from the government or NGOs would increase their likelihood to adopt solar power, while 12.0% agreed. Subsequently, 2.6% held a neutral position and only 1.3% disagreed. None of the respondents, 0.0%, strongly disagreed with the statement. The overall response mean was 4.76, implying that the responses from the participants were strongly positive in regards to the matter.

Household Head's Education Level

The influence of household head's education level on the adoption of solar power among rural households was recorded and presented in Table 4 based on the responses from the participants. The participants were requested to rate their level of agreement using a scale of 1-5 where 1-Strongly Disagree (SD), 2-Disagree (D), 3-Neutral (N), 4-Agree (A), 5-Strongly Agree (SA).

Table 4: Household head's education level on solar power adoption

N=309	SD	D	N	A	SA	Mean
	%	%	%	%	%	
My education has influenced my decision to adopt solar power.	0.6	4.5	23.0	46.9	24.9	3.91
I have great know-how of the benefits of solar energy.	7.4	24.3	29.8	21.7	16.8	3.16
I am able to read about solar technology.	5.2	22.7	15.9	26.2	30.1	3.53
I am able to write about solar technology.	4.5	19.4	21.0	30.7	24.3	3.51
I usually keep myself updated with latest information on solar technology.	5.5	18.4	29.1	35.9	11.0	3.28
Average level of household head's education level	Mean	Std. Dev.	Std. Error of Mean	Min	Max	
	3.4796	.92076	.05238	1.00	5.00	

Source: (Author, 2025)

As presented in Table 4, 46.9% of the respondents agreed that their education has influenced their decision to adopt solar power while 24.9% strongly agreed. On the same statement, 23.0% were neutral, 4.5% disagreed, and 0.6% strongly disagreed. The overall response mean was 3.91 implying that the respondents generally agreed with the statement. The finding concurred with the study by Vinya and Kohsuwan (2022) that found that those who understood the usefulness of solar power were more likely to adopt it in their homes.
The findings show that 29.8% of the participants were neutral on whether they have great know-how of the benefits of solar energy while 24.3% disagreed as shown in Table 4. On the same statement, 21.7% agreed, 16.8% strongly agreed, and 7.4% of the respondents strongly disagreed. The overall response mean was 3.16 implying that the respondents were generally neutral in this regard. The findings corroborated the study by Chidembo, Francis, and Kativhu (2022) who found that rural households in South Africa tend to have less knowledge on the benefits of rooftop solar power, which influences their willingness to adopt solar power.

Regarding the statement on the respondents' ability to read about solar technology, 30.1% strongly agreed while 26.2% agreed that they were able to read about solar technology. On the same, 22.7% disagreed, 15.9% were neutral, and 5.2% strongly disagreed. The overall response mean was 3.53 implying that the participants were leaning more towards agreeing with the statement.

On the statement that the respondents can write about solar technology, 30.7% agreed with the statement while 24.3% agreed. Further, 21.0% held a neutral position and 19.4% disagreed. 4.5% of the respondents strongly disagreed with the statement. The overall response mean was 3.51 implying that the participants leaned more towards agreeing that they can write about solar technology.

35.9% of the participants agreed that they usually keep updated with latest information on solar technology, while 29.1% were neutral. Subsequently, 18.4% disagreed with the statement, 11.0% strongly agreed, and 5.5% strongly disagreed. The overall response mean was 3.28, implying that the responses from the participants were neutral in regards to the matter.

Availability of Fossil Fuels and Biomass

The impact of availability of fossil fuels and biomass on solar power adoption among rural households was recorded based on the respondents' responses and presented in Table 5. The participants were requested to rate their level of agreement using a scale of 1-5 where 1-Strongly Disagree (SD), 2-Disagree (D), 3-Neutral (N), 4-Agree (A), 5-Strongly Agree (SA).

Table 5: Availability of fossil fuels and biomass on solar power adoption

N=309	SD	D	N	A	SA	Mean
	%	%	%	%	%	
The cheap nature of kerosene has made me not adopt solar power.	2.3	5.2	24.3	45.3	23.0	3.82
The readily available biomass has made me not to adopt solar power.	1.6	4.2	21.0	48.5	24.6	3.90
Petrol-run or diesel generators are efficient for me as a power source.	0.6	6.5	23.6	46.6	22.7	3.84
My knowledge of other cheaper alternatives to solar power has made me not adopt it.	0.3	6.5	28.5	41.7	23.0	3.81
Our cooking and lighting needs can be sufficiently met by available biomass and fossil fuels.	1.0	6.5	23.4	46.4	22.7	3.83
Average level of availability of fossil fuel and biomass	Mean	Std. Dev.	Std. Error of Mean	Min	Max	
	3.8401	.80547	.04582	1.00	5.00	

Source: (Author, 2025)

As shown in Table 5, 45.3% of the respondents agreed that the cheap nature of kerosene has made them not adopt solar power while 24.3% were neutral. On the same statement, 23.0% strongly agreed, 5.2% disagreed, and only 2.3% strongly disagreed. The overall response mean was 3.82 implying that the respondents generally agreed with the statement. The finding concurred with the argument by Kanini (2022) that awareness of alternative energy sources influences the decision to adopt clean energy sources.

The findings show that 48.5% of the participants agreed that readily available biomass has made them not adopt solar power while 24.6% strongly agreed as shown in Table 5. On the same statement, 21.0% were neutral, 4.2% disagreed, and only 1.6% of the respondents strongly disagreed. The overall response mean was 3.90 implying that the respondents generally leaned more towards agreeing with the statement. This finding corroborated the study by Ongeri and Mbataru (2023) who found that 87.7% of the respondents in their area of study, Nairobi County, Kenya, preferred other sources of power instead of solar power for home use.

Regarding the statement that petrol-run or diesel generators are efficient for the respondents as a power source, 46.6% agreed while 22.7% strongly agreed. On the same, 23.6% took a neutral stance, 6.5% disagreed, and only 0.6% strongly disagreed. The overall response mean was 3.84 implying that the participants were leaning more towards agreeing with the statement.

On the statement that the knowledge of other cheaper alternatives to solar power has made them not adopt solar power, 41.7% agreed with the statement while 28.5% took a neutral stance. Further, 23.0% strongly agreed and 6.5% disagreed. Only 0.3% of the respondents strongly disagreed with the statement. The overall response mean was 3.81 implying that the participants leaned more towards agreeing that their knowledge of other cheaper alternatives to solar power has made them not adopt solar power. This finding contradicted the study by Kiprono and Kiplagat (2024) that found that the availability of alternative sources of energy influenced reliability of renewable energy sources and made people to be more receptive of those energy sources.

46.4% of the participants agreed that their cooking and lighting needs can be sufficiently met by available biomass and fossil fuels, while 23.4% were neutral. Subsequently, 22.7% strongly agreed with the statement, 6.5% disagreed, and 1.0% strongly disagreed. The overall response mean was 3.83, implying that the participants leaned towards agreeing with the statement.

Correlation Analysis

The researcher moved to carry out a Pearson Correlation analysis as shown in Table 6. The reason was to establish the relationship between the study's variables.

Table 6: Correlation analysis of the study's variables

	Solar Power Adoption	Awareness of Solar Power Existence	Household Income	Household Head Education Level	Availability of Fossil Fuels and Biomass
Solar Power Adoption	1	.387**	.449**	.358**	.216**
		.000	.000	.000	.000
	309	309	309	309	309
Awareness of Solar Power Existence	.387**	1	.634**	.791**	.287**
	.000		.000	.000	.000
	309	309	309	309	309
Household Income	.449**	.634**	1	.642**	.420**
	.000	.000		.000	.000
	309	309	309	309	309
Household Head Education Level	.358**	.791**	.642**	1	.296**
	.000	.000	.000		.000
	309	309	309	309	309
Availability of Fossil Fuels and Biomass	.216**	.287**	.420**	.296**	1
	.000	.000	.000	.000	
	309	309	309	309	309

**. Correlation is significant at the 0.01 level (2-tailed).

Source: (Author, 2025)

Correlation analysis was used to determine the strength and direction of the relationship between solar power adoption and awareness of solar power existence, household income, household head education level, and availability of fossil fuels and biomass.

The results presented in Table 6 indicate that solar power adoption and awareness of solar power existence have a positive and significant relationship but the relationship is weak (r=0.387, p-value = 0.000<0.01). Further, the results show that solar power adoption has a moderately positive and significant relationship with household income (r=0.449, p-value = 0.000<0.01). The findings further show that solar power adoption has a weak but positive and significant relationship with household head's education level (r=0.358, p-value = 0.000<0.01) and also a weak but positive and significant relationship with availability of fossil fuels and biomass (r=0.216, p-value = 0.000<0.01). These findings imply that awareness of solar power existence, household income, household head education level, and availability of fossil fuels and biomass are all valid determinants of solar power adoption. However, household income is a greater determinant of solar power adoption in rural households than awareness of solar power existence, education level, and availability of fossil fuels and biomass. The results are in line with the findings by Best (2023) and Etongo and Naidu (2022) who found household income to be a major determinant of solar power adoption among households.

Regression Analysis

Logit Model

Logistic regression was performed to predict categorical outcome based on the study's dependent variables. The results are presented in Table 7, Table 8, and Table 9.

Table 7: Model summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	152.509a	.294	.516

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Table 8: Classification table

Observed		Predicted: 8. Do you have solar power installed? No	Yes	Percentage Correct
8. Do you have solar power installed?	No	248	9	96.5
	Yes	23	28	54.9
Overall Percentage				89.6

Source: (Author, 2025)

Table 9: Variables in the regression model equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Awareness of Solar Power Existence	.000	.451	.000	1	.999	1.000
	Household Income	2.120	.853	6.18	1	.000	3.647
	Household Head Education Level	-.077	.454	.028	1	.866	.926
	Availability of Fossil Fuels and Biomass	.101	.255	.158	1	.691	1.107
	Constant	-28.135	4.080	47.553	1	.000	.000

a. Variable(s) entered on step 1: Awareness of Solar Power Existence, Household Income, Household Head Education Level, Availability of Fossil Fuels and Biomass.

Source: (Author, 2025)

As shown in Table 7, the value for Nagelkerke R Square is 0.516, meaning that the logit model explains 51.6% of the variance in whether a rural household in Kenya has installed solar power. The value is considered large and substantial enough to highlight that the model has a good fit with the data.

Table 8 shows that the overall accuracy of the model is 89.6% of all cases, which is high enough to justify the model's accuracy. Regarding the specificity, the model is excellent at correctly identifying households that do not have solar power installed (96.5%) as shown in Table 8. On sensitivity, the model is moderately good at correctly identifying households with solar power installed as shown in Table 7 (54.9%). Thus, although the model is highly accurate overall, it is better at predicting the households that are not likely to install solar power than those who are likely to install solar power.

Table 9 highlights that household income is a significant predictor of solar power adoption among rural households in Kenya (B = 2.120, Wald χ^2 (1) = 6.18, p < .001). The model shows that for every unit increase in household income level, the odds of having solar power installed increases by 3.647. The model further highlighted that awareness of solar power existence was not a significant predictor of solar power adoption among rural households in Kenya (B = 0.000, Wald χ^2 (1) = 0.00, p < .999). Similarly, the education level of the household's head was also highlighted as not significant in predicting solar power adoption among rural households in Kenya (B = -0.077, Wald χ^2 (1) = 0.28, p < .866). Availability of fossil fuels and biomass was also identified as not significant in predicting solar power adoption among rural households in Kenya (B = 0.101, Wald χ^2 (1) = 0.158, p < .691). This explains that the decision by rural households in Kenya to adopt solar power is primarily economic since a household's financial capacity is a strong and significant driver of adoption, overshadowing environmental awareness and social factors like education level.

The study's final model is:

$\log\left(\frac{p}{1-p}\right)$ = -28.135 + (0.000 x Awareness) + (2.120 x Income) – (0.077 x Education) + (0.101 x Alternative Fuel Availability)

DISCUSSION

The findings showed that the respondents were generally in agreement with the statements on awareness of solar power existence. The mean response of those statements was 3.77332 and the standard deviation was 0.97345, which showed a variation in the responses that stretched from negative to fairly positive responses. The findings were similar to Njeru and Ndunda (2024) who found that awareness of solar power products positively correlates with solar power adoption.

The findings also showed that the respondents generally agreed with the statements on average household income. The mean response on those statements was 4.0201 with a standard deviation of 0.50275. This showed that the group had a strong convergence in their agreement with those statements. The finding concurred with the argument by Best (2023) that households with better access to stable income are more likely to use solar power technology in their homes. This finding also supported the study by Etongo and Naidu (2022) who noted that access to credit and monthly household income had a significant influence on households' decision to adopt solar photovoltaic system.

On the influence of household head's education level on solar power adoption, the findings showed that the respondents leaned moderately positive with the statements presented to them since the mean response was 3.4796. However, the responses were less consistent considering the standard deviation was 0.92076. The finding collaborated the study by Vinya and Kohsuwan (2022) that found that those who understood the usefulness of solar power were more likely to adopt it in their homes.

Fossil fuels and biomass as a determinant of solar power adoption showed that the respondents generally agreed with the items being measured considering that the mean response for those items was 3.8401. The standard deviation of 0.80547 suggested that the responses were a bit spread with some disagreements existing. The finding concurred with the argument by Kanini (2022) that awareness of alternative energy sources influences the decision to adopt clean energy sources. However, this finding was dissimilar to Kiprono and Kiplagat (2024) that found that the availability of alternative sources of energy influenced reliability of renewable energy sources and made people to be more receptive of those energy sources.

From the logit model run by the study, it was revealed that the decision by rural households in Kenya to adopt solar power is primarily economic since a household's financial capacity is a strong and significant driver of adoption, overshadowing awareness of renewable energy and social factors like education level.

CONCLUSION

The conclusion from the study was that awareness of solar power existence, household income, household head's education level, and availability of fossil fuels and biomass are all valid determinants of solar power adoption among rural households in Kenya. This was supported by the results of the correlation analysis that showed that all those variables had a positive and significant relationship with solar power adoption among rural households in Kenya. However, it was concluded that household income is a greater determinant of solar power adoption among rural households in Kenya compared to the other determinants.

Although the correlation analysis done between the independent and dependent variables revealed a positive and significant relationship between the dependent variable and all the independent variables studied, only household income had a stronger positive relationship with solar power adoption. Besides, the logit model carried out identified household income as the major predictor of solar power adoption among rural households in Kenya. Those findings confirm that although various aspects exist that determine rural households' willingness to adopt solar power, household income remains the most significant one, which underlines the need for developing solutions focusing on that area to increase rural households' adoption of solar power to achieve SDG 7 that aims to ensure access to affordable, reliable, sustainable, and modern energy.

REFERENCES

1) Abdelrazik, M. K., Abdelaziz, S. E., Hassan, M. F., & Hatem, T. M. (2022). Climate action: Prospects of solar energy in Africa. *Energy Reports*, *8*, 11363-11377.
2) Adenle, A. A. (2020). Assessment of solar energy technologies in Africa-opportunities and challenges in meeting the 2030 agenda and sustainable development goals. *Energy Policy*, *137*, 111180.
3) Apergi, M., Eicke, L., Goldthau, A., Kurniawan, J., Schuch, E., & Weko, S. (2024). Pathways to a sustainable electricity sector in Kenya: Challenges and transformational factors. *Utilities Policy*, *91*, 101854.
4) Barnes, J. L., Krishen, A. S., & Chan, A. (2022). Passive and active peer effects in the spatial diffusion of residential solar panels: A case study of the Las Vegas Valley. *Journal of Cleaner Production*, *363*, 132634.
5) Barney, J. B., Ketchen Jr, D. J., & Wright, M. (2021). Resource-based theory and the value creation framework. *Journal of Management*, *47*(7), 1936-1955.
6) Best, R. (2023). Assets power solar and battery uptake in Kenya. *Energy Economics*, *123*, p.106723.
7) Binn, D., Chenoweth, J., & Neel, L. A. (2021). Pulling Together: A Guide for Researchers, Hiłk̓ala.
8) Chemirmir, W., Kibati, P., & Kiprop, S. (2023). Influence of last mile infrastructure maintenance cost on the financial performance of Kenya Power and Lighting Company, Kenya. *Journal of Business and Entrepreneurship (JBE)*, *2*(1), 23-41.
9) Chidembo, R., Francis, J., & Kativhu, S. (2022). Rural households' perceptions of the adoption of rooftop solar photovoltaics in Vhembe District, South Africa. *Energies*, *15*(17), 6157.
10) Etongo, D., & Naidu, H. (2022). Determinants of household adoption of solar energy technology in Seychelles in a context of 100% access to electricity. *Discover Sustainability*, *3*(1), 38.
11) Ho, J. C. (2022). Disruptive innovation from the perspective of innovation diffusion theory. *Technology Analysis & Strategic Management*, *34*(4), 363-376.
12) Ibegbulam, M. C., Adeyemi, O. O., & Fogbonjaiye, O. C. (2023). Adoption of Solar PV in developing countries: challenges and opportunity. *International Journal of Physical Sciences Research*, *7*(1), 36-57.
13) International Trade Administration. (2024). *Kenya - Electrical Power Systems*. ITA. https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems
14) IEA. (2024). Kenya 2024. IEA. https://www.iea.org/reports/kenya-2024/executive-summary
15) Kanini, J. W. (2022). *Factors influencing the level of use of alternative sources of energy among the Maasai pastoral community in Kajiado West, Kajiado County Kenya* (Doctoral dissertation, Africa Nazarene University).
16) Kato, I., Mlay, S., Nantege, Z., Miwanda, A., & Naluwooza, R. (2020). Mobile technologies, digital financing and access to solar energy in Uganda. *International Journal of Technology and Management*, *5*(2), 1-23.
17) Khan, K. A., Kabir, M. A., Mamun, M., Hossain, M. A., & Alim, S. (2020). An observation of solar photovoltaic electricity across the globe. *IJARIIE*, *6*(4), 1487-504.
18) Khanam, M., & Daim, T. (2021). A market diffusion potential (MDP) assessment model for residential energy efficient (EE) technologies in the US. *Renewable and Sustainable Energy Reviews*, *144*, 110968.
19) Kiprono, K. A., & Kiplagat, H. (2024). The Reliability and Availability of Renewable Energy Sources in Kenya: A Review. Africa Journal of Technical and Vocational Education and Training, 9(1), 28-35.
20) Kishara, K. K., Obulinji, H. W., & Ondimu, K. N. (2024). Perception Influence on Adoption of Solar Energy Technologies at Household Level in Konoin Sub-County, Bomet County, Kenya. *Journal of the Kenya National Commission for UNESCO*, *4*(2), 1-18.
21) Mugisha, J., Ratemo, M. A., Keza, B. C. B., & Kahveci, H. (2021). Assessing the opportunities and challenges facing the development of off-grid solar systems in Eastern Africa: The cases of Kenya, Ethiopia, and Rwanda. *Energy Policy*, *150*, 112131.
22) Muthoka, S. (2025). *Energy deficiency in Africa and the rise of solar solutions*. Ipsos. https://www.ipsos.com/en-ke/energy-deficiency-africa-and-rise-solar-solutions
23) Mutuota, R. (2024). Returning home to conduct research: reflections of research work in Kenya. *International Journal of Social Research Methodology*, *27*(3), 301-311.
24) Namaswa, T., Githiomi, J., Oduor, N., & Kitheka, E. (2022). Sustainable biomass energy production and utilization in sub-Saharan Africa: A case study of Kenya. *Journal of Horticulture and Forestry*, *14*(4), 56-67.
25) Njeru, P. C., & Ndunda, E. (2024). Perception and Knowledge of Solar Photovoltaic Technology in Climate Change Mitigation by Households in Embu County, Kenya. *Journal of Geography, Environment and Earth Science International*, *28*(4), 27-40.

26) Ongeri, G., & Mbataru, P. (2023). Determinants of adoption of solar energy for home use in Nairobi City County, Kenya. *International Academic Journal of Arts and Humanities*, *1*(3), 167-183.
27) Ouma, K. N. (2020). *Perceived Factors Influencing Sustainability of Last Mile Connectivity Project at Kenya Power-a Case of Nairobi Region, Kenya* (Doctoral dissertation, University of Nairobi).
28) REREC. (2020). The 50 MW Garissa Solar Power Plant. Rerec. https://www.rerec.co.ke/garissa-solar-power-plant.php
29) Rossmann, C. (2021). *Theory of reasoned action-theory of planned behavior*. Nomos Verlagsgesellschaft mbH & Co. KG.
30) Sankoh, M., Muregasan, S., & Samikannu, R. (2021, October). Renewable Energy Financing in Africa-A review. In *2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA)* (pp. 1-6). IEEE.
31) Shibairo, P. M., Ngaruko, D. D., & Wawire, N. H. W. (2023). Analysis of Devolved Social Safety Funds on Household Welfare in Kenya. *Journal of Poverty, Investment and Development*, *8*(2), 65-79.
32) Spangler, V. (2024). Doing research with international students: methodological considerations for participatory research designs. *Compare: A journal of comparative and international education*, 1-18.
33) Vinya, E. F., & Kohsuwan, P. (2022). Acceptance of Rooftop Solar Technology in Kenya: A Solar Adoption Model for the Main Electricity Grid. *Human Behavior, Development & Society*, *23*(2).