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# Impact of Solar Energy Technology Adoption Participation on Household Welfare: A Case of Ameya District in South West Showa Zone, Oromia

**[1]Milkisa Terefe and [2]Derebe Terefe**

[1]Ambo University Woliso Campus School of Graduate Studies Department of Economics
[2]Ethiopian Biodiversity Institute Mettu Biodiversity Center
Email address: direlove6@gmail.com (Derebe Terefe Gemechu)

**Abstract:**

Energy is a key requirement for human life. It greatly influences all aspects of human welfare. Thus, access to sustainable, affordable, and modern sources of energy is decisively important to addressing many of the current global development challenges such as poverty, climate change, food insecurity, and inaccessibility to health care and education. Solar energy, which is abundant and accessible with low price and minimum ecological and environmental hazard, is a significant one to bring a desired human's life improvement. Because of limitation of using this opportunity, the majority of the rural population of Ethiopia is still suffering with lack of electricity access. This study investigates the major factors influencing households' adoption of solar energy and its impact on household welfare in Ameya district South west shewa. Based on cross-sectional data collected from a sample of 359 households consists of both solar energy Technology adopter and non-adopter was selected using two stage random sampling. Logit regression was used to estimate the factors that influence participation in solar energy Technology while propensity score matching (PSM) was used to estimate its impact on rural household's welfare. From logit result, the factor that influences adoption of solar energy Technology positively are; access to credit service, education, number of livestock, land size, access to information, training and off farm income Subsequently, the PSM results show that adoption of solar energy technology has a positive significant impact on the household's income, household expenditure and wealth of household. Last but not least, distance from main market and age of household head, dependent ratio and alternative fuel price decreases the likelihood of adopting the Technology.

Keywords: Impact, Propensity score, solar energy technology, adoption, welfar

## 1. INTRODUCTION

Access to energy for human beings is a precondition requirement for development and welfare as well as successful economic development and job opportunity (UNEP, 2017). Solar energy is among the cleanest energy resources that do not contribute to the rise of global warming. This is often represented as "alternative energy" to those fossil energy sources such as coal and oil. Its accessibility with a low price and abundant sources of energy with minimum ecological and environmental hazard is significant to bring a desired human life improvement. The rise of fossil fuel scarcity has created the opportunity to increase the global approach towards solar energy (IEA, 2014).

Globally, the share of renewable energy in the production of power capacity grew to over 33% in 2018. rom which
hydropower accounted for about 60% of the production of renewelectricity. city?It is followed by wind power, solar energy, and biogas, which account for 21%, 9%, and 8%, respectively (REN21, 2019). Even though hydropower is still the main source of renewable energy, solar energy has become the largest market for current new investment due to its unsubsidenergy-generatedla energy electricity, which leads to rapidly declining costs that compete with fossil fuels in numerous nations of the world (Joseph, 2015).

In the case of Africa, about 48% of the population did not have electricity access stilwhich the2. Of wwhich the largest share is sub-Saharan African inhabitants, where 57% or about 602 million people still live in the dark (REN21, 2019). Whatever the energy accessibility is like this, the continent's great resource base is exploited only in case of gas, oil, & coal, largely untouched in renewable. Solar energy only accounts for about 1% of the demand (IEAenergy2014). ndThe st conducted by Joseph (2015) also states that the African continent is endowed with a variety of both nonrenewable and renewable energy resources, the diversity of which is unequally distributed across the continent. The main energy resources include gas, oil, and coal, which account for 7.5 percent, 7.6 percent, and 3.6 percent of the world total, respectively. The hydropower potential of the continent also accounts for about 12% of the world's total. The continent also has a huge and abundant source of renewable energy. The capacity of the continent's annual solar radiation range (2010), which is 5 to 7 kWh/m² (Brüderle, 2010), indicates a huge potential of the continent with clean solar energy and could be taken as a bright hope for the future to solve the current energy crisis observed in the continent.

In the case of Ethiopia, there is huge demshowed, more elericity. As evidence showed, half showed, more thantal population of the country (56%), almost the same as that of sub-Saharan Africa (57%), still lacks electricity (MoWIEve access 2019). electricity, 2019)Thus, addressing energy poverty and enhancing the welfare of its people through modern energy provision pose th2019). llenges (Abera, 2019)The country has great potential for solar energy as it receives a solar radiation of 5,000-7,000 Wh/m² depending on the local area and the season. The solar radiation averages 5.2 kWh/m²/day. The values vary with the seasons, ranging from 4.55 to 5.55 kWh/m2/day, and over space, ranging from 4.25 kWh/m2/day in the extreme western lowlands to 6.25 kWareas (REEEP/day in high land area, 2014), and it has a total solar energy reserve potential of 2.199 million TWh per annum (Deribew, 2013). In our country, off-grid solar PV is a highly attractive energy source for rural populations due to the scattered rural settlement and abundant solar energy resources (Alemshet, 2010). For those living without national grid connection, an off-grid solar energy system can provide electricity to remotely located households and villages that are not c2004).ted to the main grid Nieuwenhout, 2004).

The action plan of the National Electrification Program for "achieving universal eleclaunched inaccess nationwide by025 is launched an efficient and transparent manner as well as in a strategic and comprehensive way for the benefit of all citizens of the country. By 2025, 65% of access provision is targeted with grid solutions and 35% with off-grid technologies (solar off-grid and mini-grids) (MoWIE, 2019). Most of the households in the study area rely predominantly on kerosene and spend much of their total household consumption expenditure on lighting. While waiting for grid expansion, or even a permanent one where appropriate, such as in very remote areas where grid access will remain too costly and logistically challenging even in the long term.

Thus, the main purpose of conducting this study is to investigate the impact of solar energy technology adoption on households' welfare, specifically used as a source of energy for lighting and communication purposes such as radio, TV, and mobile charging. A logistic regression model was used to estimate factors influencing households' decisions to adopt solar and propensity score matching to compute the impact of solar on household welfare. The result of this study will help to inform policymakers in the energy sector by providing timely information about the current situation of solar energy technology adoption and its impact on the household's welfare in rural areas, particularly the study area.

## 1.1 Statement of the Problem

Ethiopia has plentiful and diverse renewable resources and available electricity-generating technologies that can give the country the opportunity to shift away from the current energy system. These resources and technologies include energy-efficient biomass cook stoves, solar thermal and photovoltaic, biogas, large- and small-scale hydropower, wind, and geothermal. However, the country is dependent on traditional biomass fuels to meet its energy needs (Howell, 2011) due to the country still not having fully exploited the resource. In addition to poor accessibility of electricity, the energy sector of the country is too dependent on hydropower. This in turn increases its vulnerability due to the increasing risk of drought caused by climate change (Guta, 2018).

The problem is highly experienced in deep-rural areas, where 5% of people have been accessed with electricity. As noted by TERI (2014), such a problem is mainly caused by the difficulty and expensiveness of connecting the rural population living in isolated villages to a centralised electric grid. Due to this reason, most of the households in the rural villages depend on kerosene lamps for lighting and wood and charcoal for cooking. This high dependence of rural households on biomass resources causes adverse effects on the environment as it emits a lot of carbon and also damages the health of the people using it (Makuria, 2016). The adoption of solar energy technology has encountered challenges that make it impossible to utilise the technology in a successful way on any extensive scale. Not only can solar energy be used for lighting and powering low-voltage appliances, but the cost of installation is extremely expensive, especially for low-income rural populations in Ethiopia (Howell J2011).1).

In the review of the above literature, numerous factors determining household adoption of solar energy are investigated. However, there is no research conducted on the impact of solar energy adoption on household welfare to the best knowledge of the researcher. Not only is the welfare impact unique, but the methodology applied also makes this research unique, i.e., none of them apply the propensity score matching model, which is the potential model to evaluate the impact of solar energy on the welfare of households. Therefore, this paper is mainly focused on filling the observed gap by examining the impact of solar energy adoption on households' welfare in the study area.

### 1.2 General Objective

To evaluate the determinants of solar energy Technology adoption and its impact on the household welfare

#### 1.2.1 Specific Objective

-  To identify factors influencing households' decision to participation in solar energy technology adoption.
-  To analyze the impact of solar energy technology adoption on household income, consumption expenditure and wealth.

## 2. METHODOLOGY

### 2.1 Description of Study Area

The study was conducted in Ameya district, South West Shewa Zone Oromia National Regional State. It is located at 144 kmSouth West of Addis Ababa, the capital city of Ethiopia. The district is bordered on the South by Abeshge woreda, on the West by Nono Woreda,on the East by Wonchi, Goro and Woliso woreda and on the North by Toke Kutaye Woreda. The capital city of Ameya is Gindo. The total area of the district is about 93,279 hectare and its altitude ranges from 1500 to 2300 meters above sea level. The district has 36 rural and 4 urban kebeles with the total population of 170,387. Of which the number of men and women accounts 47.4% and 52.6% respectively. Out of the total population of the district, only 7.9% of the population is urban resident and the majority (92.1%) is rural settler. The three largest ethnic groups in Amaya are the Oromo (85.4%), the Amhara (12.71%), and Gurage (0.93%); all other ethnic groups made up 0.96% of the population. Afan oromo is speaking as a first language by 87.56%, 11.37% spoke Amharic, and 0.59% Gurage; the remaining 0.48% speak all other primary languages. The majority of the inhabitants professed Ethiopian Christianity, with 77.17% of the population, while 18.12% of the population said they are Muslim, and 4.29% are traditional beliefs

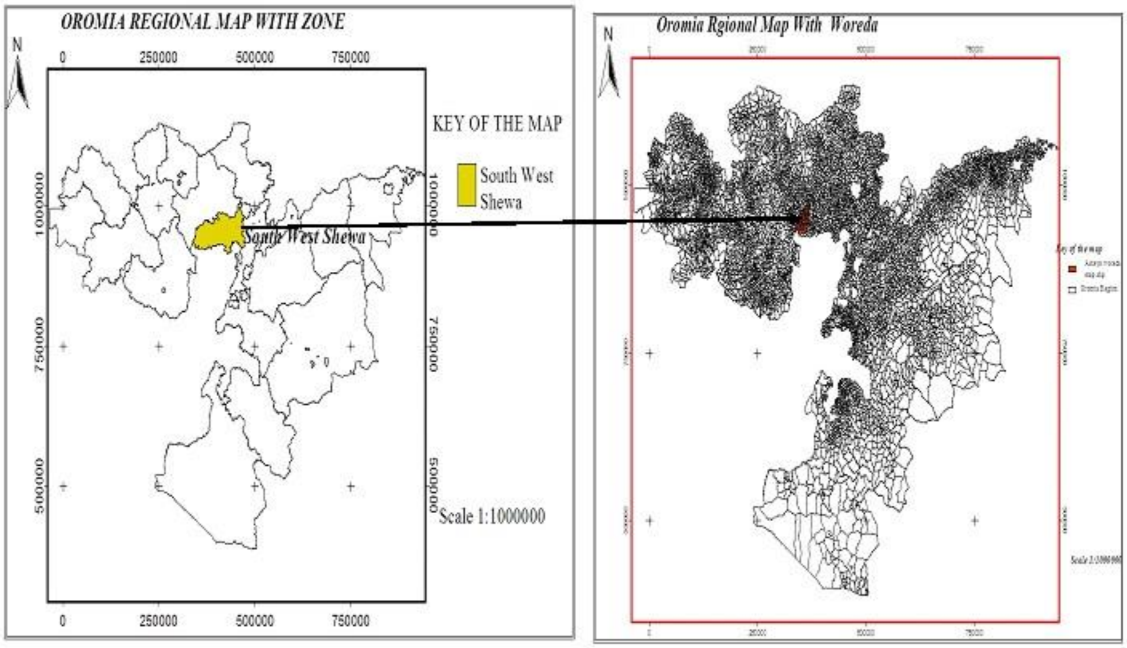


**Figure 2.1:** Map of the Study Area.

**2.2. Types and source of data**

Both qualitative and quantitative data were collected from primary sources (sample respondents) using structured and semi-structured questionnaire. Quantitative data was collected from the sample respondents with close-ended questions, and some qualitative data was also collected using open-ended questionnaire interview on a wide range of important welfare indicators (variables) such as income, expenditure, and wealth accumulation , due to the adoption of solar energy technologies.

In addition to interview schedule, key informants interview was employed to collect the required primary data that guide discussion with the concerned bodies to obtain in-depth information about different issues related to the study objectives. Primary data was collected through personal interviews by trained enumerators using a semi-structured survey questionnaire from respondents. With regard to secondary sources; data was collected from review of different documents that included research reports, books, office documents, journals, articles, etc. that has been written by different scholars on the related issues. The research study data was collected by using household survey, FGDs, field observation, and key informant interview. To collect the information, tools such as guidelines and checklist were applied to guide the household survey

**2.3 Data collection method**

The qualitative and quantitative data collection methods were used to investigate the issue in detail. The main reason behind of using qualitative method of data collection is that it helps to gain an understanding of underlying opinions, reasons, and also provides insights into the problem. Whereas the reason of using quantitative method is that it allows for meaningful comparison of responses across participants and study sites (Gill et al 2008). The study is based on primary data collected from Ameya woredas of the South west shewa zone. A structured questionnaire is used to collect the required data. Purposive sampling will be applied in selecting interviewees, such as development agent, experts, local elders and potential adopters.

**2.4 Sampling Techniques and Sample Size**

The target population for this study was all rural households of Ameya districts. According to the (Ameya district socio economic profile, 2023), the total population of the farm households exists in the districts were 156,756 and the district has 40 kebeles. From these kebeles, the researcher selects fiver kebeles. The study adopted a multi stage sampling technique of purposively selecting the Ameya district due to its huge potential for solar energy generation and adoption experience of the technology in the zone and five kebeles out of 36 kebeles were randomly selected followed by a two-stage random sampling. In the first stage, the sampling frame was identified and then it was stratified into two strata. The first stratum consist households that participate in adoption of solar energy referred as the treatment group and the second one consists households that do not participate in adoption of the technology referred as the comparison group. In the second stage, total samples of 359 households were selected applying probability proportional to size sampling technique in each stratum. A total of 175 households from the treatment group and 184 households from the control group were surveyed in the study. The selected kebeles will be namely, Bero Sallan, Gulti Bolaa, Dhankaka, Dire Aroge and Tummi Sombo Bino. The total household for each kebeles are, Bero Sallan has total household of 5550, Gulti Bola has total household of 4010; Dhankaka has total household of 5024, Dire Aroge 5026 has total household of and Tumi Sombo Bino has total household of 4948. In addition to this, the researcher used proportionate sampling that enable in taking samples from each sub strata' which are to be selected from the target population.

N = 5550+4010+5024+5026+4948 =24,558 where, N = the total number of rural households

To get adequate number of matches that enabled to give generation on research objectives, the sample of the respondent households was selected representative way of selection with±5% precision level and 95% confidence interval. The respondents sample size was determined following the formula suggested by Kothari (2004).

The details were presented below:

$$n = \frac{z^2 \times Npq}{(N-1)e^2 + z^2pq} = \frac{1.96^2 \times 5584 \times 0.5 \times 0.5}{(5584-1)0.05^2 + 1.96^2 0.5^2} = 359$$

Where, $p = 1 - q$, $n$ is required sample size, $N$ is Population size, $z =$ Confidence interval at 95% which is 1.96, $e$ =5%, $p$ =0.5, and $q$ =0.5. Here, $e$ is acceptable error term, $p$ and $q$ are estimates of the proportion of population to be sampled. Distribution of sample respondent size proportional to each Kebele was shown by table below

## 2.5 METHOD OF DATA ANALYSIS

In order to accomplish the objective of the study both descriptive statistics and econometric modeling were employed. The descriptive analysis was performed using averages and mean difference tests to compare socio economic characteristics of treated and control households. To estimate the impact of solar energy technology adoption participation on rural household Welfare, the logit and propensity score matching (PSM) econometric model was applied. Descriptive statistics is one of the techniques used to summarize information (data) collected from sample respondents. It was employed to explain the demographic and socioeconomic and institutional behavior of household characteristics that are linked with households' welfare in the study area. By applying descriptive statistics such as mean, standard deviation, frequency of appearance, percentage, maximum and minimum value etc. Moreover, the statistical significances of the dummy variables were tested using Chi-square test.

## 2.6 Definition of variables and their expected signs

### 2.6.1. Dependent variable

In estimating propensity score, only variables that influence the participation decision and the outcome variable simultaneously should be included in the model (Caliendo & Kopeinig, 2005). In the subsequent sections, the variables selected in the logit model are discussed in detail.

### 2.6.2. Outcome variables

Outcome variables were selected to determine the impact of solar energy technology adoption on the rural households' welfare in the study area. It can be a variable that represents the probability of the household whether they can be benefited from solar energy or not. The impact indicators that are examined include impacts on households' welfare indicators are income, consumption expenditure, and wealth measured in terms of Ethiopian birr Independent variable: - Age of the Household Head (AGHH): It is a continuous variable and measured in years. The young household heads are likely to be more flexible and liable to accept new technologies. But at the same time, they are likely to have less capital accumulations and have lower economic status than the old household. Hence, the age of the household head was expected to having either positive or negative influence on adoption of solar energy technology.

Gender of the household head (GEND): It is a dummy variable. The use and management of household energy is primarily the duty of women in Ethiopia (EREDPC and

SNV, 2008). But men dominantly control the household resources (Lim et al., 2007) and often make final decisions both at household and community levels in the country. Thus, sex of the household head will be expected to have either positive or negative influence on adoption of solar technology.

Marital status (MERSTU): It is a dummy variable. Being married is expected to have a positive influence on solar energy adoption. Previous evidences stated that married household heads are more likely to adopt solar energy technology than either single or divorced household heads (Anteneh, 2019)

Education level of the household head (EDUC): It is a continuous variable, the year of education in grade maintained by the respondents. The studies revealed that education level of household heads have a positive effect on solar energy technology adoption (Abera, 2019; Guta, 2018 and Anteneh, 2019). This is because of the reason that education enhances individuals' health and environmental awareness that helps them to choose clean and modern energy sources. Thus, in this study educational status of household heads is expected to positively influence the adoption of solar energy technology.

Household size (HHSIZE): It is a continuous variable. Household size is expected to have either positive of negative influence on solar energy adoption. Literatures indicated that household has a negative effect on solar energy technology adoption (Gitone, 2014; Anteneh, 2019 and Abera, 2019). This is because households with large household size spend more resources in upholding of their children rather than investing on solar energy technology. The other study also revealed that household size has a positive effect on solar energy technology adoption ((Guta, 2018).

Land size (LANDSIZE): It is a continuous variable: - The size of land positively affects solar energy adoption since it is still the main source of households' income in rural areas. Therefore, land holding size is expected to positively influence households' willingness to adopt solar energy technology. Total livestock unit (TLU): It is a continuous variable. In most cases, it has positive contribution to household's adoption of solar energy technology. Thus, Livestock is also an important income sources which enables household to invest on adoption of solar energy technology. It was a continuous variable and measured in Tropical Livestock Unit. It was expected that livestock ownership and adoption have positive relation.

Income from off-farm activity of households (OFFFARM):- It is a dummy variable. Off-farm activity was expected to affect solar energy adoption. A household head farmer who has an access to off-farm employment has a positive effect on adoption of solar energy technologies. This entails that increased access to off-farm employment could lead to increased adoption of solar energy. Access to information (ACCINF): - Information or knowledge of the households about solar energy technology is considered as one driving factor of solar energy adoption. A study found that there is a positive relationship between the adoption of solar technology and awareness and knowledge about the technology (Naomi, 2014). Therefore, it is proposed to influence solar energy adoption positively in the model estimation.

Access to Credit services (ACS):- It is a continuous variable and measured in ETB: - credit accessibility is the other institutional factor to be estimated in the model. One literature stated that an increase in accessibility of credit enhances household adoption of new technologies (Khushbu et al, 2015). This is because it can assist rural households to purchase technological products the needed. Therefore, access to credit is expected to positively affect solar energy adoption

Distance to Market Center (MRKDIS):-These variables also considered as key factors expected to affect solar energy technology adoption. Legesse (2016), distance from home to surrounding market negatively affects solar energy technology adoption. That means since solar products are found in market areas, households who are close market are more adopters. Therefore, distance from home to market is expected to negatively influence solar energy adoption.

Training: -It is one of the institutional factors considered as a key driving factor of solar energy technology adoption at household level. Training given for households about solar energy technology has a positive effect on their decision to adopt (Keriri, 2013). Alternative fuel price(ALFPRICE):-This variable is also one of key driving factors of solar energy technology adoption at household level and it is expected to have negative influence on solar energy adoption since as the price of alternative fuel like kerosene increase, the probability to adopt solar energy simultaneously increased.

## 3. RESULTS AND DISCUSSION

### 3.1. Descriptive analysis

In this section the respondents' demographic, institutional and socio-economic factors of the two groups (adopter and non-adopter households) of sample respondents were compared and contrasted with respect to independent variables by using descriptive statistics such as mean, mean difference, percentage and standard deviation and inferential statistics such as chi-square for categorical and t-tests for continuous variables.

### 3.1.1. Age of respondent household heads

The survey result in table 3.1 showed the mean age of the household head in the study area was approximately 39.64 years. While the mean age of adopter and non-adopters were 38.26 and 40.95 years respectively. This result showed there was a mean age difference between adopter and non-adopter that indicated adopter households were on average younger than their counterpart in the study area. The t-value also indicated the mean age difference between respondent solar energy technology adopters and non-adopters was statistically significant at 5% significance level. Thus, younger household tends to adopt solar energy than the older one.

**Table 3.1:** Respondents age distribution

| Variable | Adopter (N=175) | Non-adopter (N=184) | Total (N=359) | t-value |
|---|---|---|---|---|
| | Mean (Std. Dev.) | Mean (Std. Dev.) | Mean (Std. Dev.) | |
| Age | 38.26 (6.22) | 40.95 (6.74) | 39.64 (6.62) | 3.9167 * |

Source: Own survey result (2024)      * indicates significant at 5% significance level

### 3.1.2. Marital status of respondent's household heads

The results in table 3.2 pointed out from the sampled 359 household's heads, 82.73% of them were married and 17.27% not married household. From adopters household 86.29% were married and 17.71% not married. Similarly from non-adopter households, 79.34% of them were married and 20.66% females headed. The percentage of married householdadopter's was larger than not married

**Table 3.2:** Respondents marital status distribution

| Variable | Category | Adopter (N=175) | | Non-adopter (N=184) | | Total (N=359) | | $Chi^2$ –value |
|---|---|---|---|---|---|---|---|---|
| | | Count | % | Count | % | Count | % | |
| Marital status | Married | 15186.29 | | 14679.34 | | 29782.73 | | |
| | Not married | 2413.71 | | 38 20.66 | | 6217.27 | | 3.0217 |

**Source:** Own survey result (2024)

### 3.1.3. Educational level of respondent household heads

The surveyed data showed the education level of respondent households in the study area was 2.62 years on average. While education level of adopter households was 2.75 years and for that of non-adopter respondents 2.5 years. This result reported adopter households had more mean education level than non-adopters. In other word there was mean difference of education level between adopters and non-adopters. This difference was statistically significant at 5% significance level. Thus, it could be concluded that households that have more education level tends than their counter parts.

**Table 3.3:** Respondents educational level distribution

| Variable | Adopter (N=175) | Non-adopter (N=184) | Total (N=359) | T-value |
|---|---|---|---|---|
| | Mean (Std. Dev.) | Mean (Std. Dev.) | Mean (Std. Dev.)) | |
| Education level | 2.75 (0.967) | 2.5 (0.986) | 2.62 (0.985) | -2.6200 ** |

Source: Own survey result (2024) ** indicates significant at 5 % significance level

### 3.1.4. Household size of the sampled households

The result of collected data from table 3.4 indicated the household size of respondent household was 5.62.While the household size of adopter households was 6.13 and 5.18 for that of non-adopter households. This result implied there was a significance mean difference of household size between adopter and non-adopter of solar energy technology. Supporting this result, the t-value reported there was a significant mean difference of family size between the two groups which was significant at 1% significance level. Thus, adopter households possessed more household size than non-adopter dairy technology.

**Table 3.4:** Respondents household size distribution

| Variable | Adopter (N=175) | Non-adopter (N=184) | Total (N=359) | T-value |
|---|---|---|---|---|
| | Mean (Std. Dev.) | Mean (Std. Dev.) | Mean (Std. Dev.) | |
| Household size | 2.93 (1.165) | 2.70 (1.21) | 2.81 (1.19) | -1.8301 *** |

Source: Own survey result (2024) *** indicates significant at 5% significance level

### 3.1.5. Land size of respondent households

As presented in table 3.5 average household land holding of respondents household was 1.75 hectares. Solar energy technology adopters possessed on the average about 1.83 hectares and that of non-adopters owned on the average 1.70 hectares of land. The resulted data revealed there is a mean difference of land holding between the two groups. Solar energy technology adopter households hold more land size than non-adopters. The tabulated value of t-test also showed farm land holding was statistically significant at 5% significance level. Thus, farmer households having more farm land tend to adopt solar energy technology than their counter parts.

**Table 3.5:** Respondents land holding distribution

| Variable | Adopter (N=175) | Non-adopter (N=184) | Total (N=359) | T-value |
|---|---|---|---|---|
| | Mean (Std. Dev.) | Mean (Std. Dev.) | Mean (Std. Dev.) | |
| Land size | 1.83 (0.52) | 1.7 (0.42) | 1.75 (0.479) | -2.6792*** |

Source: Own survey result (2024) *** indicates significant at 5% significance level

### 3.1.6. Livestock ownership of respondent households

The total number of Livestock found in the study area Cow, Heifer, Calf, Sheep, Goat, Bull, Ox, Chicken, Horse, Mule and Donkey were converted into singe number per household by using "Tropical Livestock converting Unit". From the results of surveyed data table 3.6 below the overall livestock average number found in the study were 3.45. Adopter households hold on average 3.65 live stocks per household while non-adopter households hold 3.27 per household. This result showed there was a significant mean difference of livestock holding in the study area between solar energy technology adopters and non-adopters. The t-test result also indicated mean difference of livestock owned between the two groups was statistically significant at 1% significance level. Thus, adopter households hold more live stocks than non-adopter.

**Table 3.6:** Respondents Livestock distribution

| Variable | Adopter (N=175) Mean (Std. Dev.) | Non-adopter (N=184) Mean (Std. Dev.) | Total (N=359) Mean (Std. Dev.) | T-value |
|---|---|---|---|---|
| TLU | 3.65<br>(1.15) | 3.27<br>(1.065) | 3.45<br>(1.12) | -3.2809*** |

Source: Own survey result (2024)   *** indicates significant at 5% significance level

### 3.1.7 Respondent's participation on off-farm income

The resulted data in table 3.7 presented 84.96% of respondents participated on off-farm income activities. While 91.42% of adopters and 78.80% of non-adopters participated on off-farm activities according to the surveyed data. Only 8.58% of adopters and 21.2% of non-adopters participated on off-farm activities. This result showed percentage of participation of solar energy technology adopters on off-farm activities was larger than non-adopters in the study area

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**Table 3.7:** Respondents participation on off-farm income

| Variable | Category | Adopter (N=175) | | Non-adopter (N=184) | | Total (N=359) | | Chi² - value |
|---|---|---|---|---|---|---|---|---|
| | | Count | % | Count | % | Count | % | |
| Participation on off-farm income | Yes | 16091.42 | | 145 78.80 | | 30584.96 | | |
| | No | 15 8.58 | | 3921.2 | | 5415.04 | | 11.1858 |

Source: Own survey result (2024)

### 3.1.8 Main market distance from respondents farming site

In this study area as shown in table 3.8, the average distance of respondent households from main market was 3.70km. The average distance of solar energy technology adopters from market center was 3.53 kilometers and for non-adopters 3.86 kilometers. This result revealed there was a mean difference distance from main market between adopters and non-adopters. The calculated t-value also indicated as there was significant mean difference of distance from main market between the two groups which was statistically significant at 5% significance level

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**Table 3.8:** Respondents Main market distance from farming site

| Variable | Adopter (N=175) | Non-adopter (N=184) | Total (N=359) | T-value |
|---|---|---|---|---|
| | Mean (Std.) | Mean (Std.) | Mean (Std.) | |
| Distance from market center | 3.53 (1.32) | 3.86 (1.30) | 3.70 (1.32) | 2.3527*** |

**Source:** Own survey result (2024) *** indicates significant at 5% significance level

### 3.1.9 Respondents access of credit services

The result of collected data in table 3.9 revealed 47.91% of respondents got access of credit service and 52.09% of them didn't. Among adopter respondents, 61.14% of them got access of credit service and 38.86% didn't get it. Regarding non-adopters, 35.32% of them got access of credit while 64.68% of them didn't. This result
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showed there was a percentage difference of access of credit service to purchase solar technology between adopters and non-adopters in the study area. In percentage, adopter households got more credit service than non-adopters. The chi$^2$-value also showed there was a positive percentage difference of access of information between adopters and non-adopters which was statistically significant at 5% significance level

**Table 3.9:** Respondents participation on access to credit service

| Variable | Category | Adopter (N=175) | | Non-adopter (N=184) | | Total (N=359) | | Chi$^2$ – value |
|---|---|---|---|---|---|---|---|---|
| | | Count | % | Count | % | Count | % | |
| Access to credit service | Yes | 10761.14 | | 6535.32 | | 17247.91 | | |
| | No | 6838.86 | | 11964.68 | | 18752.09 | | 23.954 |

**Source:** Own survey result (2024) * indicates significant at 5% significance level

### 3.1.10 Respondents access to information

The result of collected data in table 3.10 revealed 49.86% of respondents got access of information about solar energy technology and50.14% of them didn't. Among adopter respondents, 60% of them got access of information about solar energy technology and 40% didn't get it. Regarding non-adopters, 42.21% of them got access of information while 59.79% of them didn't. This result showed there was a percentage difference of access of information about solar energy technology between adopters and non-adopters in the study area. In percentage, adopter households got more information than non-adopters. The chi$^2$-value also showed there was a positive percentage difference of access of information between adopters and non-adopters which was statistically significant at 5% significance level. Thus, reliable, consistent and accurate information tends to increase adoption of solar energy technology.

**Table 3.10:** Percentage distribution of respondents' access to information

| Variable | Category | Adopter (N=175) | | Non-adopter (N=184) | | Total (N=359) | | Chi$^2$- value |
|---|---|---|---|---|---|---|---|---|
| | | Count | % | Count | % | Count | % | |
| Access to information | Yes | 105 | 60 | 74 | 42.21 | 17949.86 | | |
| | No | 70 | 40 | 11059.79 | | 17050.14 | | 14.0408 *** |

**Source:** Own survey result (2024) *** indicates significant at 5% significance level

### 3
### .1.11 Respondents access to Training

The result of collected data in table 3.11 revealed 50.7% of respondents got access of training about solar energy technology and49.3% of them didn't. Among adopter respondents, 57.71% of them got access of training about solar energy technology and 42.23% didn't get it.Regarding non-adopters, 44.02% of them got access of training while 55.98% of them didn't. This result showed there was a percentage difference of access of information about solar energy technology between adopters and non-adopters in the study area. In percentage, adopter households got more information than non-adopters. The chi$^2$-value also showed there was a positive percentage difference of access of information between adopters and non-adopters which was statistically significant at 5% significance level.

**Table 3.11:** Percentage distribution of respondents' access of Training

| Variable | Category | Adopter (N=175) | | Non-adopter (N=184) | | Total (N=359) | | Chi$^2$- value |
|---|---|---|---|---|---|---|---|---|
| | | Count | % | Count | % | Count | % | |
| Access to Training | Yes | 101 | 57.71 | 81 | 44.02 | 18250.7 | | |
| | No | 7442.23 | | 10355.98 | | 17749.30 | | 6.7278 *** |

**Source:** Own survey result (2024) *** indicates significant at 5% significance level

### 3.1.12 Respondents alternative fuel price

In the study area the resulted data in table 3.12 showed respondent households got on average ETB 320.22. On the side solar energy adopter households got ETB 245.7 while non-adopters access of credit ETB was 391.087. The result reported non-adopter of solar energy technology adopters expend for other fuel than adopters. The mean difference of alternative fuel price was also statistically significant at 10% significance level
.

**Table 3.12:** Respondents' alternative fuel price distribution

| Variable | Adopter (N=175) | Non-adopter (N=184) | Total (N=359) | T-value |
|---|---|---|---|---|
| | Mean (Std. Dev.) | Mean (Std. Dev.) | Mean (Std. Dev.) | |
| Alternative fuel price | 245.7 (324.07) | 391.087 (337.34) | 320.22 (338.39) | -4.1601 * |

Source: Own survey result (2024) * indicates significant at 5% significance level

### 3.1.13 Reasons of adopting solar energy

Households who adopted solar home system replied their reasons about why they had adopted it. As clearly shown in the table 15, 11.43% of the adopted respondents used solar home system in terms of cost effectiveness of the product. 12% of adopted respondents confirmed that they adopted solar home system because of its reliable energy source; 2.29% of respondents adopted the technology in terms of their environmental and health awareness; 21.14% of the adopted respondents replied that they had adopted solar in terms of both its cost effectiveness and reliable energy source; 26.86% of the adopted households confirmed that they had accepted solar energy technology in terms of both its cost effectiveness and their environmental and health awareness; 14.86% of them adopted in terms of its cost effectiveness, reliable energy source and their environmental and health awareness; and the remaining 11.42% of the adopted respondents confirmed that they adopted solar energy in terms of reliable energy source and their environmental and health awareness. The result revealed that most of the respondents adopted in terms of cost effectiveness and environmental and health awareness they acquired. Today, the costs of kerosene and battery/dry cell used for sources of lighting in most rural area of Ethiopia, particularly in the study area are getting higher and become beyond their financial capacity to afford the day to day expense for it. But those adopted households have no more expense regarding their home light after once they invest on solar in addition to its positive environmental and health impact.

**Table 3.13:** Respondents' reason to adopt solar energy

| Households' Reason | Frequency | Percentage |
|---|---|---|
| Cost effectiveness | 20 | 11.43 |
| Reliable Energy source | 21 | 12.0 |
| Environmental and health awareness | 4 | 2.29 |
| Cost effectiveness and reliable energy source | 37 | 21.14 |
| Cost effectiveness ,Environmental and health awareness | 47 | 26.86 |
| Cost effectiveness ,reliable energy source, Environmental and health awareness | 26 | 14.86 |
| Reliable energy source ,Environmental and health awareness | 20 | 11.42 |
| Total | 175 | 100 |

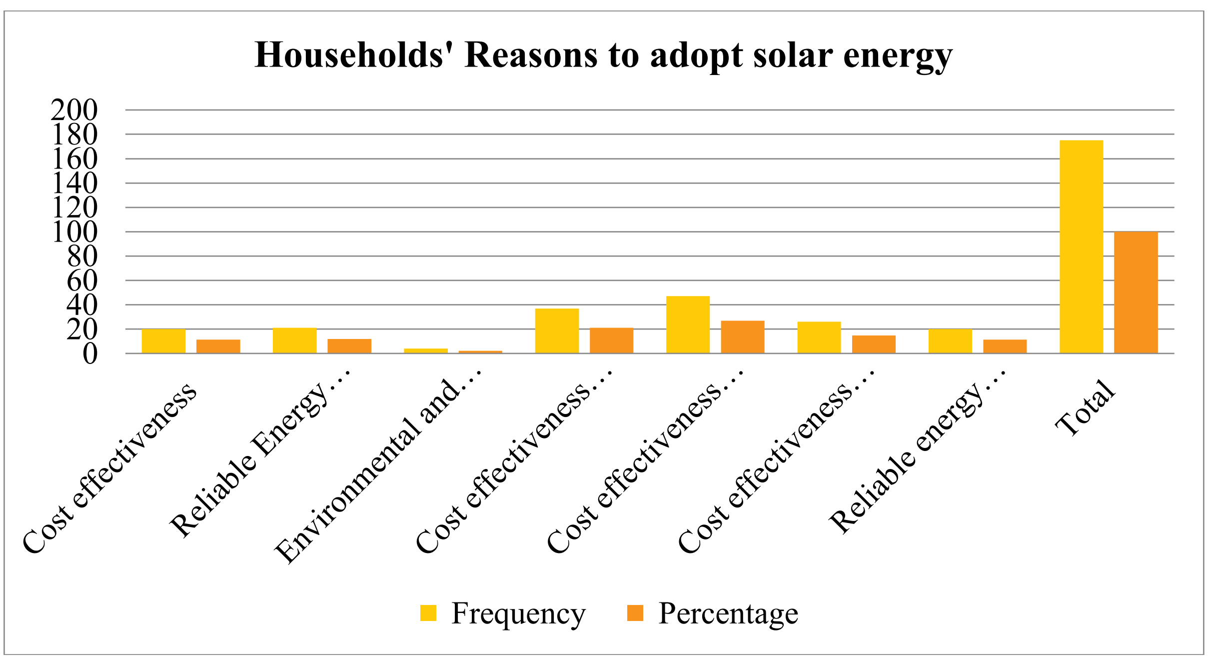


**Figure 3.1** Reasons for adopting solar energy technology

### 3.1.14 Reasons of non -adopters and sources of energy for their home light

Non- adopter households of solar home system responded their reason why they didn't adopt still. As clearly shown in the table below, 22.28% of non-adopters were because of lack of awareness about solar energy technology, 19.02% were because of their low financial capacity to afford the cost, 11.41% were due to high degree failure of solar energy technology products they observed and heard from other users, 10.33% were due to other alternative energy that substitutes solar, 10.87% were because of both lack of awareness and unable to afford the cost of solar products, 2.72% (one respondent) was due to lack of credit accessibility, 11.96% were due to both failure of the product and lack of attention of solar product distributers to implement the guarantee signed, and the remaining 11.41% were due to lack of solar product supply that the households could afford. Therefore, the result indicated that as compared to other factors, lack of awareness about solar energy technology and unable to afford the cost were the major problem of most of households to adopt solar energy technology This result somewhat corresponds with Anteneh (2019), who revealed that most of the problem of rural Ethiopia are poverty and backwardness to adopt new technologies. The third most important problem was failure of the product and lack of attention to implement guarantee signed between households and solar product distributors when the product fail to function. This situation leads households to reject the adoption or discontinuation with the technology.

**Table 4.14:** Reasons of not adopting solar home system

| Households' Reason | Frequency | Percentage |
|---|---|---|
| Lack of awareness about solar energy technology | 41 | 22.28 |
| Lack of credit accessibility | 5 | 2.72 |
| Unable to afford the cost | 35 | 19.02 |
| High degree failure of solar products | 21 | 11.41 |
| Because of another alternative | 19 | 10.33 |
| Lack of awareness & unable to afford the cost | 20 | 10.87 |
| Failure of the product & lack of attention to implement guarantee | 22 | 11.96 |
| Lack of solar product supply that the household need | 21 | 11.41 |
| Total | 184 | 100 |

**Source:** own survey data (2021)

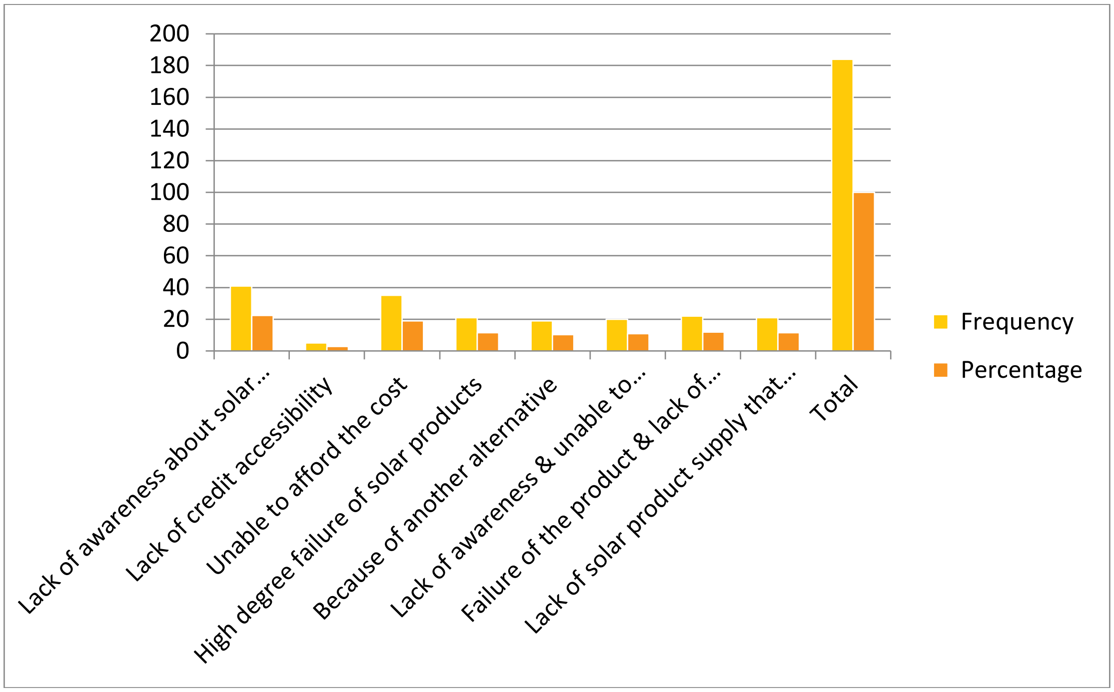


**Figure 3.2** Reasons for adopting solar energy technology

Most of non- adopter households of solar energy technology (49.46%) use battery/dry cell as source of energy for their home light. 17.39% of non- adopters use battery and kerosene alternatively as sources of energy for their home light. 4.89%, 24.86% and other 3.8% of non -adopters use electricity, kerosene, and biogas as source of energy for their home light respectively. The result of this study indicated that most of the rural households who didn't adopt solar energy technology are dependent on battery/dry cell for their home light. This finding doesn't correspond to that of Anteneh (2019), the study conducted in Gurage, who proposed that most of none-adopted households (97%) use kerosene. As clearly shown in the table below, there were also households who use both battery and kerosene as light source. This corresponds to Abera (2019), who revealed that "unlike cooking energy, households' lighting energy choice involves more diverse and competing alternatives ”

**Table 4.15:** Lighting energy sources of non -adopters of solar home system

| Types of energy source for lightening | Frequency | Percentage |
|---|---|---|
| Battery/dry Cell | 91 | 49.46 |
| Battery &kerosene | 32 | 17.39 |
| Electricity | 9 | 4.89 |
| Kerosene | 45 | 24.46 |
| Biogas | 7 | 3.80 |
| Total | 184 | 100 |

## 4. CONCLUSION AND RECOMMENDATION

### 4.1. Conclusion

Using clean and renewable energy sources have paramount importance to reduce adverse health and environmental impacts of using detrimental energy sources as well as keep households from extra cost especially for citizens from low income countries like Ethiopia. This study was conducted to investigate impact of solar energy adoption participation on household welfare in fiver kebeles of Ameya district, south west shewa zone. In the study area, almost all of households in the rural area are not connected with grid electricity.

The overall motive of this study was to evaluate the impact of solar energy technology on the welfare of rural households. To this end, a household income, consumption and wealth survey was undertaken on 359 rural households (175 treated and 184 controls) in village Ameya district in south west shewa zone. The study had implicit evidence that access to solar energy has a positive impact on household welfare. In this regard, income consumption expenditure and wealthy were used as a proxy for measuring household welfare. To analyze the impact of solar energy technology on household welfare, descriptive and econometric analyses were employed. Generally speaking, this study has concluded access to solar energy technology has a profound impact on the welfare of households in the study area.

The specific conclusions drawn from the study are presented below. From the descriptive analysis no significance difference observed between the two groups in relation to the variables gender of household head and number of dependent individual in the households (dependent ratio). The main reasons for adoption of solar energy technology as reported by the household is due to, reliability energy source, cost effective, healthy and environmental friendliness. In the same way the main reason for not adopting solar energy as reported by the household is due to lack of awareness about the technology, high degree failure of solar product and lack of solar product supply that the household need. From econometric analysis the major findings of the study reveal that age of the household head, marital status of the household head, education level of the household head, household size, land size, total livestock unit, distance to the market, off farm income, access to information, access to credit, other fuel price and training influence farmer's decision to participate in solar energy technology.

### 4.2 Recommendation

Based on the above findings the researcher recommends that the government, NGOs, and concerned stakeholders should plan training, workshops, and seminars with the purpose of dissemination, and information related to solar energy technology thus raising knowledge and awareness among the rural dwellers. The government should encourage investors to invest in solar power technology to investment, installation, and implementation. We need to find a way to reduce the cost of implementing solar energy technology and providing for the needs of the low-income earners (the poor household). The household should be encouraged to harness solar technology since it is easily accessible compared to other sources of energy given that the household comes from a remote area where the sun is abundant.

Diversification of income sources of rural households through creating different opportunities of off farm income generating activities is better to enhance their economic level, indirectly increases their tendency to adopt solar home system technology. If the income level of rural households grows, not only enhance their willingness to adopt solar, but also the overall wellbeing of the family become improved.

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