

Factors Influencing the Use of Solar Energy Technology in a Local Township of Blantyre City, Malawi

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Abstract

Challenges with access to electricity are global but becoming increasingly high in Malawi where more than 96% of the electricity is produced from hydro generation. Energy sources for electricity production can be renewable or non-renewable. Due to many challenges facing hydropower production such as water levels, debris in the inlet ponds, etc., renewable energy sources that produce clean energy such as solar power are becoming common. However, despite such opportunities, access to electricity whether renewable (solar) or non-renewable (hydro production) to many people in urban areas in Malawi is still a challenge. A household survey was carried out involving 100 households aimed to establish factors that influence the use of solar energy technology in Machinjiri, one of the townships in the city of Blantyre, in southern Malawi. Only 32% of the households have access to solar energy. Results indicated that the level of education attained has an influence on the peoples' choices to use solar technology. In this regard, respondents with basic primary school certificate reported 8% while those with college education reported 32% and those with higher education, Malawi School Certificate of Education (MSCE) reported 52% use of solar energy for lighting. Some of the reasons for not using solar energy include: low production during winter (55%), not durable (23%), no knowledge (18%) and others mention combined reasons (4%). Only a few people use solar energy for lighting. Therefore, there is a need for the government and non-governmental organizations to continue sensitizing people on the importance of using renewable energy such as solar energy. Furthermore, the government should create deliberate conditions to make solar energy equipment affordable to many Malawians with low incomes.

Keywords

Electricity, Solar Energy, Renewable Energy, Non-Renewable Energy, Lighting

1. Introduction

Energy management has become an important area of study due to the increasing significance of conservation of energy resources and fossil fuels [1] [2] [3] [4]. There is a need in the modern world to assess the sustainability in energy systems in order to meet the requirements of energy with an improved economic, ecological, and social performance for the benefit of all [4] [5] [6] [7]. Studies show that renewable energy such as solar decreases the threat of energy uncertainty [8] [9]. Solar energy systems are an easy and cheaper solution to the global energy crisis [8] [9]. Some of the factors influencing the adoption of solar energy technology include the landscape of an area, availability of funds, lack of knowledge and technical know-how [8] [9] [10]. Reference [11] defined solar power as electrical power generated through the conversion of sunlight into electricity, either directly using Photovoltaic (PV) arrays, or indirectly using Concentrated Solar Power (CSP) systems. Solar power is an important and relatively inexpensive source of electrical energy where grid power is problematic, expensive to connect, or unavailable [12] [13] [14] [15]. Solar power energy is important since it supports safer and cleaner development in addition to the promotion of environmental protection and human health [16] [17].

In Malawi, southern Africa, the energy sector is largely dominated by petroleum and electricity, with wood fuel providing the basic energy needs of the rural communities, urban poor, and the informal sectors [18] [19]. Electricity access in Malawi is low despite the government's ambitious target to increase electricity connectivity from the current 2.4% to at least 25% by the year 2020 [20]. Due to low access to hydroelectricity, most people in Malawi use improved cookstove for cooking and generators, battery torch and solar devices for lighting [21] [22].

This study aimed to establish factors that influence the adoption of solar energy technology with the aim of increasing solar energy uptake for lighting in Machinjiri and Chinseu Townships, Blantyre district, southern Malawi.

Malawi is currently facing problems in providing electricity to its people [21] [23] [24]. The energy problems range from persistent blackouts to an alarming fuel supply shortage posing a threat to the country's economic recovery path and also frustrating foreign investors to establish their businesses in the country.

Most rural populations in Malawi use paraffin (kerosene) for lighting and firewood for cooking [25] [26]. According to reference [27], solar energy plays a big role in combating climate change as well as helping in easing the burden on the Electricity Supply Commission of Malawi (ESCOM) Company, the only provider of hydropower in the country. Firewood and kerosene have caused many health problems because of the smoke emitted into the environment. Despite studies indicating the benefits of solar energy technology as compared to other sources of energy, not many households adopt and use solar power technology. Most households are still using candles for lighting which causes a fire resulting in the burning of houses, property and even loss of life if not well taken care of. Despite the availability of solar energy technology on the market, only a few households are using solar energy for lighting. There is, therefore, a need to understand some

of the factors that influence the use of solar power in Malawi. This study investigated factors influencing the use of solar energy technology by determining the number of households using solar energy for lighting, analyzing the level of education of household heads using solar energy for lighting and lastly, investigating the level of socio-economic status of household heads using solar technology for lighting.

2. Materials and Methods

A structured survey questionnaire was administered to 100 households randomly chosen out of 1336 households in Chimseu and Machinjiri Townships in Blantyre district, southern Malawi. Qualitative data was analyzed using content analysis while quantitative data was analyzed using inferential statistics in Microsoft Excel.

3. Results and Discussion

3.1. Households Using Solar Energy

Results show that only 32% of the respondents use solar energy for lighting (**Figure 1**) agreeing with earlier studies conducted in Ethiopia, Tanzania and Malawi [18] [20] [21] [28]. These studies observed that most people in rural households largely depend on kerosene and batteries for lighting their houses, while electricity and batteries is a major source of lighting energy for urban households. Most Malawians rely on Biomass as their main source of energy. This is in agreement with a study conducted by [29]. The results in their study revealed that 97% of Malawians total relies on primary energy supply, out of which 59% is used in its primary form as firewood (52%) and residues (7%), while the remaining 41% are transformed into charcoal [29]. The results show that some Malawians still use firewood for lightning [29]. Reference [30] argued that Malawians have improved a lot in terms of usage of solar power. The study which was conducted in 2020 showed that farmers are able to use solar system to power the milking machine, water supply system and for household lighting [30].

The results also showed that only 12% and 84% of single headed and married households use solar energy for lighting respectively while and only 4% of the divorced women use solar energy (**Figure 2**). Results also indicated than none of the widows use solar energy in the area (**Figure 2**).

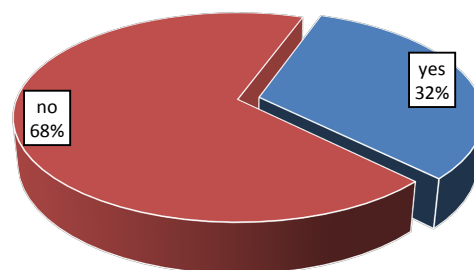


Figure 1. Households using solar energy in Machinjiri and Chinseu Townships, Blantyre City, Malawi.

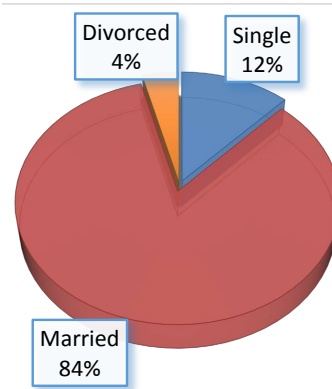


Figure 2. Marital status of respondents.

Widows mentioned the high cost of solar appliances as the major reason for not being able to use them. Overall, results showed that 67% of both married and single households are not using solar energy. Further probing revealed that people largely dependent on hydroelectricity and resort to using candles in times of blackouts. These results agree with a study which was conducted in Malawi showing the relationship between use of candles for lightening and malaria illnesses [31]. Results showed that most Malawians in rural areas use candles for lightening other than electricity and most of them do not sure from Malaria than those in urban areas who often use electricity. This is another area of research to find out if this might be one of the reasons why most people in rural areas use candles other than electricity (hydro or solar).

3.2. Level of Education of Households

Over half of the respondents using solar energy have basic primary school education suggesting that they are able to read and write (Figure 3). Lack of use of solar appliances may simply be due to financial challenges.

Households with basic primary school certificate reported 8% on use of solar energy (Figure 3) while those with college education reported 32% use of solar energy for lighting (Figure 3). Those with Malawi School Certificate of Education (MSCE) reported 52% use solar of energy (Figure 3). This is similar to those with no and other education, where results showed that 8% use solar energy for lighting (Figure 3). These results agreed with the results obtained from a study which was conducted in the sub-Saharan countries. The results showed that level of education plays a greater role in choosing type of energy to use for lightening [28]. This might be the reason why there is higher percentage (52%) of people with MSCE who use solar energy for lightening.

3.3. Source of Income

Most of the respondents are employed (72%) while 16% are self-employed and students represented 8% while 4% were respondents who do nothing but survive on casual labor and remittances from relatives (Figure 4).

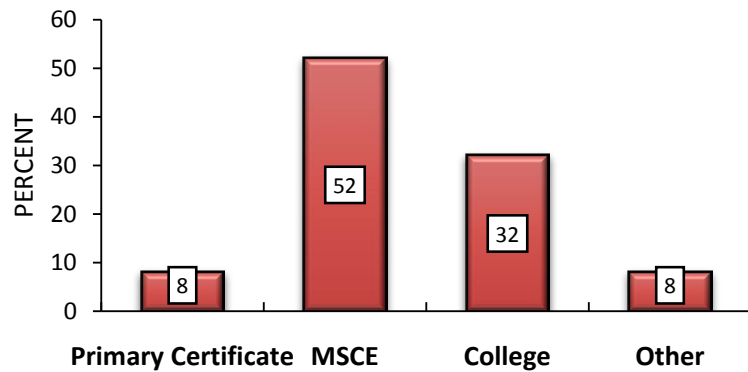


Figure 3. Level of education of households.



Figure 4. Respondents' source of income.

Out of the 72 % of those employed only 28% use solar while 72% do not use solar for lighting. For the 16% self-employed respondents 75% use solar energy and indicated small businesses such as hawkers as the source of money (Figure 4). None of the students or piecework respondents use solar energy agreeing with earlier studies that most poor people prefer using candles, paraffin and other sources of energy other than solar energy [26] [32] [33].

3.4. Perception on Importance of Solar Energy

The respondents were asked on their perceptions regarding the advantages of using solar energy technology for lighting. The following 4 parameters: 1) cheap; 2) locally available; 3) accident free; 4) pollution-free were mentioned. Results indicated that 56%, 24%, 12% and 8% of respondents said it is cheap, locally available for example in shops in the neighborhood, accident free for example it cannot cause fire as candles and pollution free, respectively (Figure 5).

More than half (56%) of the population are aware that these technologies are cheaper compared to other sources of energy (Figure 5). These results are in agreement with the results which was obtained in one of the studies conducted in Malawi in 2020 which proved that poverty contribute in the choice of type of energy to use [21]. It has been observed that it is very expensive for poor people to obtain hydroelectricity or solar energy because of its higher costs.

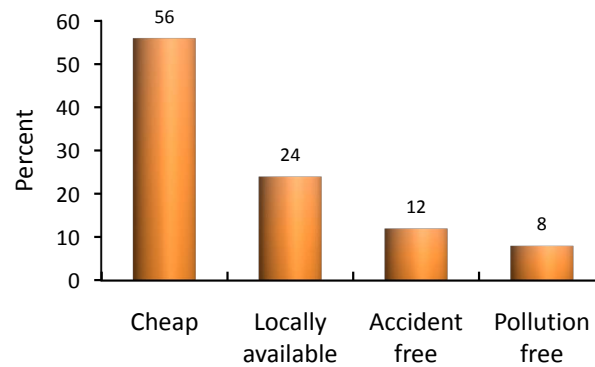


Figure 5. Advantages of using solar energy.

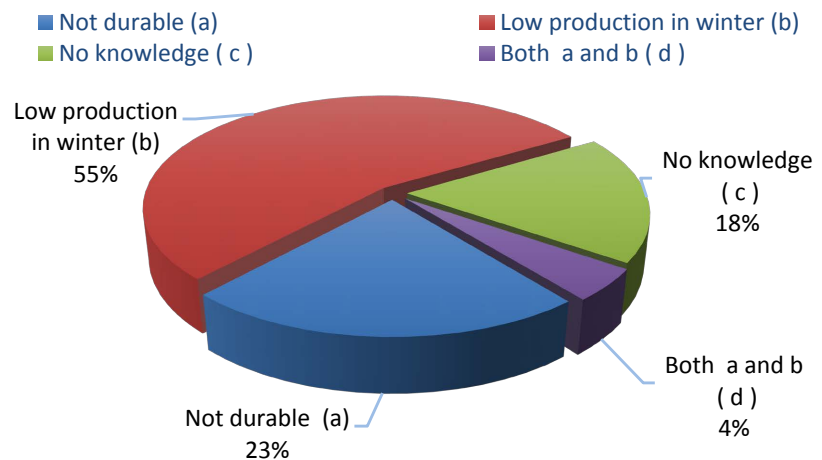


Figure 6. Why not using solar energy.

3.5. Reasons for Not Using Solar Energy

Another equally important question which was asked was why many households are not using solar energy technology for lighting and the following disadvantages were mentioned; low production during winter (55%), not durable (23%), no knowledge (18%) and others mention both a and b (d) (4%) (**Figure 6**). Most solar gadgets do not take long to be broken also reported by [34] [35]. Respondents believed that solar gadgets are not long lasting and hence frequent replacements are costly. Opting to using a candle in times blackout. About 48% of the respondents mentioned low production during winter as a reason for not using the solar gadgets (**Figure 6**). Solar panels do not charge perfectly due to low incoming solar radiation in times of more cloud cover. It is interesting to note that about 18% of the respondents indicated not being aware of solar technology other than lamps (**Figure 6**). Another 4% yet mentioned both durability and low production as the reasons for not using solar technology (**Figure 6**).

4. Conclusions

The study concludes that solar energy is still not widely used despite that it is environmentally friendly and a reliable renewable source of energy. High costs

for solar appliances appear to be the main reason for their lack of use although other reasons such as durability play a role.

It is interesting to note that education has no bearing on the use of solar energy technology for lighting suggesting that financial unavailability still remains the core reason. The media mainly radio has successfully helped in promoting the use of solar energy technology.

The study also established that small-scale business owners and those not yet connected to the hydro-electricity grid use solar energy technology.

Recommendations

There is a need to continue with mass media communication on the benefits of using solar energy technology for people. It is also recommended that government should create deliberate conditions to make solar energy equipment affordable to many Malawians with low incomes and manufacturing companies should strive to produce durable appliances.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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