

Factors Influencing Adoption of Solar Technology in Tanzania: A Case Study of Arumeru District

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Abstract: *The study analyzes factors affecting adoption of solar energy technology in Tanzania, basing on the following objectives: to analyze the extent to which awareness of solar technology affects its adoption, to determine the influence of household income on adoption of solar technology, to analyze to what extent does reliability of solar technology affects its adoption and to analyze the role of government policy on adoption of domestic solar technology using Arumeru District as the case study. This study applied the cross-sectional research design by applying both qualitative and quantitative research approach. The population of the study was Arumeru, District, Tanzania. The determined sample size was 97 from the population of 2,978 for quantitative data and only 90 questionnaires were returned. Data were collected on random sampling. The qualitative data used a sample of 10 respondents who were interviewed. Thus, data were collected using structured closed questionnaire and unstructured interviews. Data were analyzed using descriptive and content analysis. Quantitative data were analyzed using descriptive statistics and qualitative data were analyzed using content analysis. The study findings are as follows: With regards to awareness and its influence on the adoption of the solar technology respondents agreed. This indicates that, awareness influences adoption of solar technology to the people of Arumeru district. With respect to weather income affects adaptation of solar technology, 90% of respondents agreed that income affects the adoption of technology. On other hand solar energy reliability affects its adoption an average. With respect to whether the government supports affects solar technology the respondents agreed. This implies that, the government policy is supportive on solar energy adoption. This study recommends that the government and other service providers ensure the delivery of the lighting services to the users, providing loan for the purchase of the lighting system, creating awareness over the solar technology to the users. Finding the proper linkage of the solar services to the national grid so as to overcome the doubling cost of the installation to the users of the services at large. It is suggested that study should be carried on the challenges emanating from the adoption of the solar technology and also the impact for the adoption of the solar technology to the services users at Arumeru district and country at large.*

Keywords: Solar energy, Solar power, Photovoltaics (PV), Adoption, Utilization

1. Introduction

In Tanzania, electricity supply is low compared to its demand; there for the country is forced to continue expanding its power generation capacity to meet the growing demand, but it has to be in a sustainable and diverse manner. Generally, there are different methods of supplying electricity to both rural and urban areas in this country; grid extension and the use of isolated diesel generators. Both options are not sustainable for rural areas since grid connections are costly and isolated diesel generators necessitate continued reliance on expensive diesel fuel (Plainly et al., 2005). For instance, the World Bank estimates that grid extension prices vary from USD 6,340/km in densely populated regions to USD 19,070/km in regions with dispersed population, therefore, there is a need to utilize sustainably the available substantial indigenous energy resources such as solar, hydro, biomass, wind, and geothermal in Tanzania, which can reduce the country's dependency on fossil fuels (Damian, 2009; Bauner et al., 2012; Kimambo, 2012; GreenMax-Capital-Advisors, 2013)

In this regard, solar energy is perhaps one of the hopeful sources of renewable energy as Tanzania where solar systems range from the smallest pico-applications, such as solar lanterns and small mobile-phone chargers, solar home systems (SHS) which are the normal systems installed in private households and mini-grids at village level to utility-scale and grid-connected plants, stand-alone systems which are used for institutions like schools, hospitals and other middle consumer communities and Backup systems which are used for production areas and big industrial consumers

like running the machines and other equipment which should run throughout the day.

Purpose

The purpose of the study was to analyze factors affecting adoption of solar energy technology in Tanzania. Specifically the study sought to analyze the extent to which awareness of solar technology affects its adoption, to determine the influence of household income on adoption of solar technology, to analyze to what extent does reliability of solar technology affects its adoption and to analyze the role of government policy on adoption of domestic solar technology in Tanzania.

2. Methodology

The study adopted the cross-sectional research design. The defining features of a cross – sectional study is that, it can compare different population groups at a single point in a time, without repetition from sample selected. (Yin, 2014)Probability sampling technique was used to obtain the required sample size from the study area where this technique is very useful for a large and diverse population (Saguti, 2012). Purposive Sampling technique was used to select head of households and sales agents because they are the relevant source of information while Random Sampling technique was applied in this study since it minimizes the possibility of biasness when selecting respondents. This study covers the sample of 47 households and 20 sales agents. Data was collected through questionnaires and interview. The analysis was done using descriptive statistical tools.

3. Results and Analysis

The study achieved 100% of response rate, wherewith regards to the age of the respondents, 47(70.1%) were males, 20 (29.9%) were female. This had an implication of households heads (men) are the ones in charge of the system installation at the level of the family and possessed rich information compared to female. Despite of gender variation among respondents the data obtained were not distorted by gender differences. The marital status of the respondents, 38(56.7%) of the respondents were married, 15(22.4%) of the respondents were single, 6(8.9%) of the respondents were separated, 8(11.9%) of the respondents were widower. This is a likely indication that, most solar technology users are individuals with families. The analysis show that, there are numbers of factors affecting adoption of solar technology in Tanzania.

Awareness on Solar Technology

The results revealed from the findings show that there is wider awareness of the solar technology and thus it has also

influenced the adoption of the solar technology and the next alternative source of energy to the community members. However some of the users of solar technologies have limited awareness with solar accessories they need in order to meet their required needs, where to purchase extra appliances as well as maintenance cases. This implies that, some of the solar technology users are struggling to understand the technology before they fully adopt it.

The study investigated the awareness of ownership of the solar home system as soon after paying for it, the data revealed that the respondents strongly agreed of the awareness of ownership of the solar home system and they agreed on the awareness of ownership of the solar home system after paying for the systems. Similarly, Rogers (2003) theorizes that the process of adoption commences with an individual driven by precedent conditions such as a felt need to adopt an innovative product or service. The individual will pass along an innovation decision process at a pace that is influenced by their own level of innovativeness and by the perceived characteristics of the innovation.

Table 1: Awareness on Solar Technology

<i>Response Rate</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
I am aware of solar technology	0	0	0	7	60
I have played a role on bringing awareness on solar technology to people in my community	0	0	45	17	5
I know how I can get solar energy whenever I need	19	37	11	0	0
I know the kind of solar accessories I need to meet my needs	51	9	7		0
I am aware of maintenance of the solar appliances	20	34	13	0	0
Was I given a basic trouble shooting of the system during handover	41	26	0		0
I can assist someone in getting a general understanding of solar technology	64	3	0	0	0
I am aware of the suppliers sales points in case I need a spare part or a new solar appliance	0	11	22	30	4
People in my community have enough knowledge and awareness on solar technology	53	5	9	0	0
I am aware of ownership of the solar home system as soon as I am done paying for it	0	0	0	51	16

Influence of income of households on adoption of solar technology

Result from the respondents showed that their source of income relied on the monthly salary while fifty percent of the respondents their source of income relied on the own business. Investigation into the adoption of energy efficiency and renewable energy technologies confirmed much of what has been documented in that the barriers to adoption of renewable technologies are mostly financial, as well as some practical issues regarding installation and general levels of knowledge. However, it is not clear that even if the costs were reduced and information made more available that adoption levels would increase. Neither is it clear that if an increase in adoption were to occur that it would lead to reductions in carbon emissions due to the effect known as the 'Rebound' effect.

Respondents showed that respondents access loan from a SACCOSS for the purpose of paying for a solar home system while others rejected over the access to loan from a SACCOSS for the purpose of paying for a solar home system. This has an indication that the financial institutions are still reluctant in granting loans for the lighting services at the level of the households at Arumeru district and Tanzania in general, respondents have shown that sometimes access solar system borrowing from service providers and are scheduled paying for the installment.

Mode of payment

The study revealed that in most cases, the payment mode used by the users of solar technology at Arumeru district, where else, ninety five percent of the respondents pay through up front system and three percent of the respondents pay through loan access. The result show that majority of the respondents pay for the system through up front systems through own income sources. Similarly, respondents use this means of payment due to lack of awareness of other options that could be used alternatively.

The results showed that ninety two percent of the respondents said that one of the reasons opting for solar home system is the affordability nature of the services while the rest concur that one of the reasons for the adoption of solar system at home is regarded nature of the best source of energy. In the same vein majority of the respondents took about 1-3 months to decide on the use of the specific source of energy while shortly period for the adoption of the solar system was attributed by the availability of cash money at households.

Reliability of solar technology

The study found that 17(25.4%) of the respondents agreed that solar home system is reliable and 50(74.6%) of the respondents strongly agreed that solar home system is reliable technology. The study examined on whether there is no regular/unknown black out unlike the previous source of

energy used and it was found that some extent agree with solar system at home there is no regular/unknown black out unlike the previous source of energy used, 14(20.9%) of the respondents agreed that there is no regular/unknown black out unlike the previous source of energy used and 49(73.1%) of the respondents strongly agreed that there is no regular/unknown black out unlike the previous source of energy used.

However the study investigated whether there is trust of solar system than any other source of energy and it was revealed that that nineteen percent of the respondents to some extent agreed over the trust of solar system than any other source of energy, twenty percent of the respondents

agreed of trusting of Solar system than any other source of energy and fifty percent of the respondents strongly agreed of trusting of solar system than any other source of energy.

Cost of connection

The results showed 48(71.6%) of the respondents strongly disagreed of being awareness of cost to connect the national grid compared to solar home system, 13(19.4%) of the respondents disagreed of the awareness of cost to connect the national grid compared to solar home system and 6(8.9%) of the respondents to some extent agreed of the awareness of cost to connect the national grid compared to solar home system. The presented data show that Arumeru users of solar system trust it than any other source of energy.

Table 2: Reliability of solar technology

Response	1	2	3	4	5
The technology is reliable in Arumeru District	0	0	0	17	50
There is no regular/unknown black out un like the previous source of energy used	0	0	4	14	49
I have solar system and not any other source of energy because It is reliable compared to national grid	0	0	13	20	34
I have never slept in the dark unless I have not paid for the system otherwise I have access to clean and reliable source of energy	0	0	0	12	55
I am also using other source of energy apart from solar home system for lighting	44	23	0	0	0
Solar home system suppliers are way closer and available than the national grid	0	0	17	20	30
It takes longer to install a solar home system that to be connected with the national grid	50	12	5	0	0
I know how much it will cost to connect the national grid compared to solar home system	48	13	6	0	0

Role of government policy on adoption of domestic solar technology

The study shows that, the government has reduced the time, paperwork and unnecessary inconvenience associated with building and electrical permit applications for solar installations and the findings showed that 23(34.3%) of the respondents agreed that government has reduced the time, paperwork and unnecessary inconvenience associated with building and electrical permit applications for solar installations and 49(65.7%) of the respondents strongly agreed that government has reduced the time, paperwork and unnecessary inconvenience associated with building and electrical permit applications for solar installations.

Relationship between the government and solar technology providers

Moreover, there is a good relationship between the government and solar technology providers this was proved

by ninety five percent of the respondents who strongly agreed that there is a good relationship between the government and solar technology providers. The analysis of the data shows that there has been fully relationship between the government and solar technology providers. The results showed that ninety nine percent of the respondents strongly agreed that the government has free the main part of solar system from tax example solar battery and panel.

On the other hand, the study presented relationship between the national grid connection and solar technology where as the result shows, there is no any interference in the power connecting a client from TANESCO could also have solar technology I parallel with grid connection. This improves the power availabl to all community members even with low income who wishes to use sola technology and connect with TANESCO later.

Table 3: Role of government policy on adoption of domestic solar technology

Respondents Response	1	2	3	4	5
The government has reduced the time, paperwork and unnecessary inconvenience associated with building and electrical permit applications for solar installations	0	0	0	23	44
There is a good relationship between the government and solar technology providers	0	0	0	3	64
The government has free the main part of solar system from tax example solar battery and panel	0	0	0	0	67
There is no interference between national grid (TANESCO) providers with solar providers	0	0	0	10	57

4. Conclusion and recommendation

The major findings have shown that 70% of the respondents were males however gender disparity did not compromise the revealed findings of the study. 56% of the respondents were married and thus the users of the solar system were found to be more couples making a family. Majority (47.6%) of the respondents were between the ages of 39 to 49 years old. Similarly (38.8%) were with primary education and their users of the solar technology and it's this category

which dominated many respondents than other levels of education.

The study findings have shown that there is great awareness of the solar technology to the users and it prompts to the adoption as the lighting systems, also the awareness of solar accessories has remained limited to the users of the solar technology, on other hand the adoption of solar technology to the users brings awareness to the people at community level, also the findings show that solar technology.

Nevertheless, the users of solar system at home have little awareness of the place to get accessories and with little knowledge of the maintenance of the system.

In line with research objective two it is observed that purchasing of the solar technology depends on the users own income sources, also the financial institutions have mainly remained reluctant to support the purchase of the solar technology at households level. And also the users of the services have been obliged to pay the whole lump sum for the purchase of the solar systems at home.

Similarly to the objective three of the study, solar home technology noted at reliable lighting system at household level and the system is free from regular/unknown black out unlike the previous source of energy used, as the results the much trusting of solar system than any other source of energy, there is also, much dependence of solar systems compared to the national grid service and the services freely users from the darkness, the respondents strongly agreed that solar home system suppliers are closer and available than the national grid. The services does not takes longer to install a solar home system that to be connected with the national grid and also there is much unawareness of cost to connect the national grid compared to solar home system.

The government has also remained in fully commitment to Support solar technology. And the Government has reduced the time, paperwork and unnecessary inconvenience associated with building and electrical permit applications for solar installations. There has been fully relationship between the government and solar technology providers. The revealed major findings remain the benchmark factors influencing the adoption of solar system at home.

4.1 Conclusions

Following the major findings from the study, it is concluded that there various factors that influences the adoption of the solar technology in Tanzania, specifically at Arumeru district. Though there also issues that remains not known to the users of solar technology which undermine the adoption of solar technology at households levels.

From the findings presented and discussed, it can be concluded that the awareness of solar technology at Arumeru among the users it core part that influences the adoption of the solar technology, the findings therefore, suggests that in order the ensure effective adoption of the solar technology it important for the users to aware of what the technology entails in areas related to solar accessories, solar appliances, complication during trouble shooting and the like.

The study also finds that income has the role in fueling the adoptions of solar technology as well as it decreases the adoption if it's low to the users. On other hand the findings suggests that the users of solar technology should be supported by financial institutions as findings show that own sources of income finances the purchase and installation of solar technology at Arumeru. Furthermore, the reliability based on the trust of the system, solar lighting availability;

own dependent lighting system ensures the adoption of the solar technology at Arumeru district.

The study also finds little of the government commitment in ensuring the availability of solar technology as an impending factor for the adoption of solar technology. However, little has been done by government to ensure adoption of solar technology to the users such as reduction the time, paperwork and unnecessary inconvenience associated with building and electrical permit applications for solar installations and controlled interference with the national grid during the installation.

4.2 Recommendation

It is recommended that the government and other service providers ensure the delivery of the lighting services to the users, providing loan for the purchase of the lighting system, creating awareness over the solar technology to the users. Finding the proper linkage of the solar services to the national grid so as to overcome the doubling cost of the installation to the users of the services at large.

4.3 Areas for further studies

The study based on the factors influencing adoption of solar technology in Tanzania. It is suggested that study should be carried on the challenges emanating from the adoption of the solar technology system and also the impact for the adoption of the solar technology to the services users at Arumeru district and country at large.

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