International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online)
Vol. 8, Issue 1, pp: (43-63), Month: April 2020 - September 2020, Available at: www.researchpublish.com

The Contribution of Solar Power in Expansion of Sustainable Power Generation in Tanzania: A Case Study of Kagera and Mwanza Regions

[1]Focus C. TAIRO, [2]Dr David A.O Aunga

[1]Manager, Customer Engagement & Communications at PowerGen Renewable Energy Ltd.

[2]Lecturer in Accounting and Taxation faculty of Business at University of Arusha

Abstract: **The general objective of this research was to examine the contributions of solar power projects in the expansion of sustainable power generation in Tanzania. Target population of the study are customers of PowerGen Renewable Energy living in Mwanza and Kagea and specifically the Ukerewe in Mwanza and Bihalamulo in Kagera. Random sampling was conducted in a relatively straightforward way, by taking a customer list and generating a random sample on excel. A total of 119 micro-grid clients were sampled from the population. The study used questionnaire and document review as data collection instrument. Both Primary and Secondary data was collected for the study. The quantitative data was converted into statistical package for social sciences (SPSS) whereas Qualitative data was thematically analysed not only to assess the contribution of solar projects that are none quantifiable but also to assess mechanism and process, relevance, efficiency with which was undertaken, effectiveness towards yielding intended outcomes as well as sustainability of outcomes of the project. A correlation analysis was performed on the adoption variables revealed there was a positive correlation between awareness and affordability which was significant whereas it showed a strong positive significance between efficiency improvements factors and social economic factors and a negative significance between social economic factors and environmental factors. Majority of the respondents said PowerGen improves their quality of life and feeling of safety and security. The negative correlation between environmental factors and socioeconomic acceptability reveal that when socioeconomic factors increase, Environmental factors decrease. It's necessary for the government to give incentives of some kind that will inspire the people to get connected**

Keywords: **solar power projects, PowerGen Renewable Energy, Environmental factors decrease.**

1. INTRODUCTION

The past five years has seen an explosion of private sector approaches to connecting the over 500m people in Africa who lack access to electric power. Most of these approaches cleverly capitalize on the reducing costs of down-scalable technologies like solar, and the ubiquity of mobile money payment platforms on the continent which greatly ease revenue collection. Leading solar home system companies like M-Kopa, Off-Grid Electric, and Mobisol have raised hundreds of millions of dollars over the past few years. Meanwhile an ascendant micro-grid sector has had some early fundraising successes with Powerhive, Husk, and PowerGen raising multimillion-dollar equity rounds in the past few years (Ishengoma, 2011).

The global accepted objectives cover a range of issues from poverty and hunger eradication, climate action, life on land and underwater, peace and justice as a result of strong institutions, gender equality and reducing inequalities, quality education, decent work and economic growth, industry, innovation and infrastructure, sustainable cities and communities, responsible consumption and production, clean water and sanitation and above all, affordable and clean energy which also mean access to electricity. Electricity is important for cooking, for powering plants and equipment and for making technologies work. Access to reliable power empowers considerable social economic benefits, enabling shops and businesses to stay open longer, giving communities access to better healthcare, and providing children with domestic lighting for after-school study time (Kairuki et al., 2010)

According to World Energy Outlook 2016 report, there are 1.2 billion people who still live without electricity and many others have a poor quality supply of electricity. More than 95% of energy poor take place in Sub-Saharan Africa and developing areas in Asia especially in rural areas where electrification rate is at 73%. In Africa, there are 580 Million people (65% of the continent population) without access to electricity. According to IEA, There are 32 countries in Sub-Saharan Africa which had fewer than 50% electrification rate in 2016. Tanzania Access Energy situation report (2017) mentions there are 37.8 Million un-electrified citizens with 31.4 Million rural Tanzanians with no access to power. (Mbatia, 2005)

Solar in Tanzania

Tanzania is the most populous country in Sub-Saharan Africa; it connects six land-locked countries to the Indian Ocean. The country has abundant and world-class wind and solar resources. The Government of Tanzania (GOT) has committed to reform the operations of TANESCO and meet new demand through low cost solutions. High reliance on expensive thermal and emergency generation sources have helped make the sector financially unviable. Tanzania has made progress in grid expansion, increasing generating capacity with natural gas facilitating and enabling environment for solar home system and publishing of new standard power purchasing agreement for small producers. (Power Africa; 2018).

In 2008, Tanzania adopted a new regulatory framework to encourage low-cost investment in mini-grids, called the small power producers (SPP) framework, which caused the number of mini-grids to double. The financial mechanism created – a feed-in tariff – was technology neutral, which favoured biomass and hydro development with low generation cost (ESI, Africa 2017). However, a 2015 revision to the policy encouraged solar and wind development. In 2017 Tanzania's Energy and Water Utilities Regulatory Authority (EWURA), the national regulator, approved a third generation mini-grid framework (Ibid).

The third-generation rules provide several important improvements to create an enabling regulatory environment. The rules cover the following aspects: allowing mini-grids at multiple locations to acquire a single license (above 1 MW) or registration for mini-grids using the same technology (below 1 MW); exemption from tariff regulation for mini-grids below 100 kW; defining eligible customers that need not have their tariffs reviewed by EWURA; allowing grid-connected mini-grids to operate in islanded mode when power supply is not available from the main grid; and, providing some clarity and credibility on the calculation of the limited compensation for distribution assets when the main grid connects to a previously isolated mini-grid. Although these improvements are steps in the right direction, there are limitations on the grid integration framework creating significant ambiguity in implementation. Additionally, the lack of clarity on grid expansion planning increases the risk to developers and their investors. There is not sufficient security within the existing mini-grid framework for investors and financiers (John Kidenda, 2018)

The Tanzanian solar energy sector has been fast growing in recent years and solar services (electricity) and Products are now a common sight in shops and markets throughout the country. Several factors have contributed to this growth. On the supply side, ever increasing work on research and development have greatly reduced the prices of solar-PV services (electricity) and Products worldwide. The prominence of China in producing solar panels at mass scale has reduced prices even further. On the demand side, frequent power outages and a high cost for connection to the grid have made Tanzanians consider alternatives to TANESCO, like solar energy (Singh, 2009).

As explained on the study background, access to reliable power empowers considerable social economic benefits, enabling shops and businesses to stay open longer, giving communities access to better healthcare, and providing children with domestic lighting for after-school study time. According to the Ministry of Energy and Minerals only 36% of the national population in Tanzania is connected to the grid. While this number is up from 10% in 2010 – access is largely limited to major towns. In rural areas only 11% of the population is connected to the grid. By 2016, Tanzania's total power installed capacity is 1,357.69 MW composed of hydro 566.79 MW (42%), natural gas 607 MW (45%) and liquid fuel 173.40 MW (13%). The traditional dependence on hydropower combined with the droughts that are affecting the country, resulted in power supply shortages (Tanesco, 2013).

According to Tanzania Invest, Tanzania's sunshine hours per year range between 2,800 and 3,500 with global horizontal radiation of 4–7kWh per m2 per day. Solar resources in Tanzania are especially present in the central region, and they are being exploited for both off-grid and grid-connected solutions. By 2016, about 5.3MWp of Photovoltaic (PV) solar energy was installed in Tanzania. The Government supports solar development within the country by removing VAT and import taxes on the main solar components (panels, batteries, inverters and regulators) (Riechel et al., 2017).

Tanzania as it is for Africa is currently at a crossroads in terms of how it will pursue the development of its power infrastructure: on one side, the typical infrastructure lenders and donors like the World Bank are advocating for multi-billion dollar loans and grants to national governments in order to deploy massive generation, transmission, distribution, and connectivity projects. On the other side, an emerging ecosystem of private energy companies is trying to bring power to more people through market-driven approaches (Sam Slaughter, 2018).

Lack of public sector progress in energy access has provided fertile soil for private sector approaches to grow. Still with challenging environments, the mini-grid companies working to solve energy access in Africa faces, the proponents of this approach believes that this could be the future vehicle to spearhead the development of sustainable power generation which is clean, cheaper and smart. Despite these considerable number of challenges which falls into two categories of regulatory and financing, private utility companies such as PowerGen Renewable energy Limited has taken on this exciting mission of transforming Lives through Smarter power with over 50 micro-grids and hundreds of single off-taker systems deployed. (Sam Slaughter, 2028).

PowerGen Renewable Energy Ltd was founded in 2011 to address the challenges of renewable energy and energy access in East Africa. Today the company has built more micro-grids in East Africa than any other company and serve thousands of customers across seven countries with clean, renewable energy. The entry of PowerGen in Tanzania in 2013 was as results of the country's challenges of access to clean, affordable and reliable electricity for the rural based customers (PowerGen, 2018). Although researches has been conducted on solar power projects (mini-grid) development and distribution in Tanzania, little is known on the contributions which these project are adding in spearheading the government's goal of ensuring all villages in Tanzania are electrified by 2021.

PowerGen was founded in Nairobi, Kenya in 2011 on the basis of two simple ideas: 1) All over the world, renewable technologies continue their ascent as the energy sources of the future and 2) Africa is poised for enormous continued growth and innovation in the decades ahead. Over the course of 5 years, PowerGen installed hundreds of renewable energy systems across seven countries in East Africa, and built a team of more than 50 full-time professionals focused on delivering exceptional off-grid power systems to the region. Available information form the PowerGen's website shows that they built their first micro-grid in 2013 in Zambia, and since then have installed dozens more across Kenya and Tanzania.

Thousands of people benefit from the clean energy they sell to them on a pay-as-they-go basis throughout rural areas of East Africa. PowerGen believes that their micro-grid business isn't just about increasing energy access – it's also about leading the charge in implementing the future energy system of Africa. Africa, with its weak incumbent infrastructure, shouldn't be aiming to build an energy system emulating that of the US or Europe today. Instead PowerGen believes we must be focused on building the energy system of the future, converging on where the US and Europe will be decades from now. This future will involve on-grid storage, distributed generation, and smart metering. It will incorporate more intelligent tariffs and billing systems. It will be modular, acting more like a network composed of many semi-autonomous nodes rather than a mono-directional pipeline for commoditized electrons. Customers will be treated as customers for energy and other services, not just as 'ratepayers' that happen to be on the other end of a wire (PowerGen, 2018).

Specific objectives

1. To examine the contributions of PowerGen projects in the efficiency improvements of power generation in Kagera and Mwanza Regions

2. To study how PowerGen projects have contributed to reduce environmental impacts in Kagera and Mwanza Regions.

3. To understand the extent to which PowerGen has improved socioeconomic acceptability in Kagera and Mwanza Regions.

Research questions

1. What are the contributions of PowerGen projects in the efficiency improvements of Power generation in Kagera and Mwanza Regions?

2. How has PowerGen projects contributed to reduced environmental impacts in Kagera and Mwanza Regions?

3. To what extent has PowerGen improved socioeconomic acceptability in Kagera and Mwanza Regions?

2. REVIEW RELATED LITERATURE

Theoretical Literature Review

The Theory of change is a tool or methodology that uses a process of critical evaluation and backward mapping to identify and communicate the conditions and actions that can lead to a desired outcome, thereby resulting in a logical, practical, and actionable theoretical framework detailing the mechanisms of change (Taplin, 2012).

The study used the theory of change that was developed by Kyle M. Karber (2010) using relevant academic and literature on the topic of Micro-grid solar technology contribution in South Africa. This literature alone was not adequate to develop a complete theory of change for solar contributions, so we included tangentially related studies, such as those on cook stove adoption in developing communities or community-scale micro grid electrification. In order to achieve the outcome of contributions of micro grid solar energy access, the study started with the perspective of the potential adopter/customer, as they ultimately drive the contribution process. Thus, the theory of change was developed by identifying the conditions that need to be met for the beneficiary to purchase a solar product, i.e. the “benefits conditions”. This aspect of the theory of change was framed by “the Four A’s”: awareness, attraction (acceptability), affordability, and availability, adapted from (Anderson, 2007), because these categories represent the beneficiary perspective at a fundamental level.

With an initial framework in place, the researcher of the theory of change study began reviewing the publications perceived to be the most relevant - those that applied or developed theories, frameworks, or basic concepts for understanding energy technology adoption in emerging economies (Rogers, 2003; Hirmer, 2014; Ahlborg, 2014). The lead author used qualitative data analysis software, MAXQDA, to organize the review process.

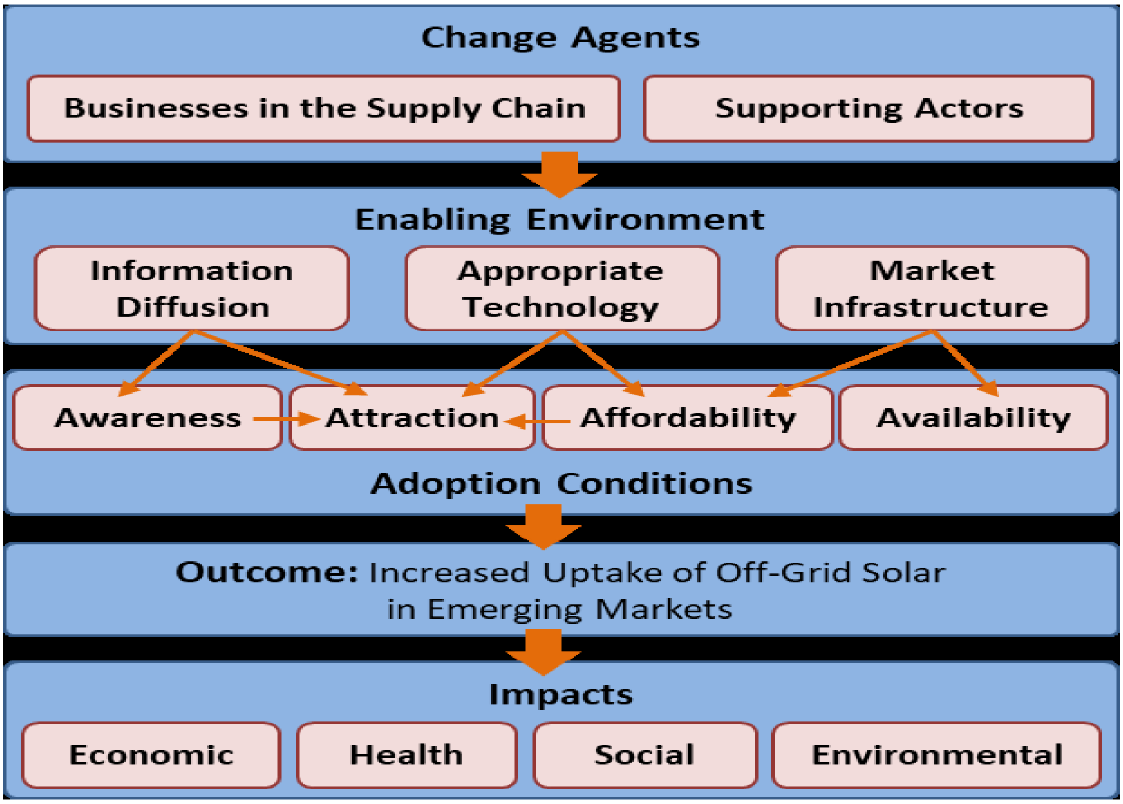

Figure 2. 1: Micro-grid solar theory of change diagram

Source Hirmer (2014)

The theory of change begins by identifying the likely impacts of increased solar benefits, pursue a worthwhile outcome. The most apparent impact of solar is additional lighting hours from a brighter higher-quality light source relative to kerosene and other traditional sources (Scott et al, 2014). Beyond this, solar technology has economic, health, social, and environmental impacts, which are outlined in Figure 2.2 below

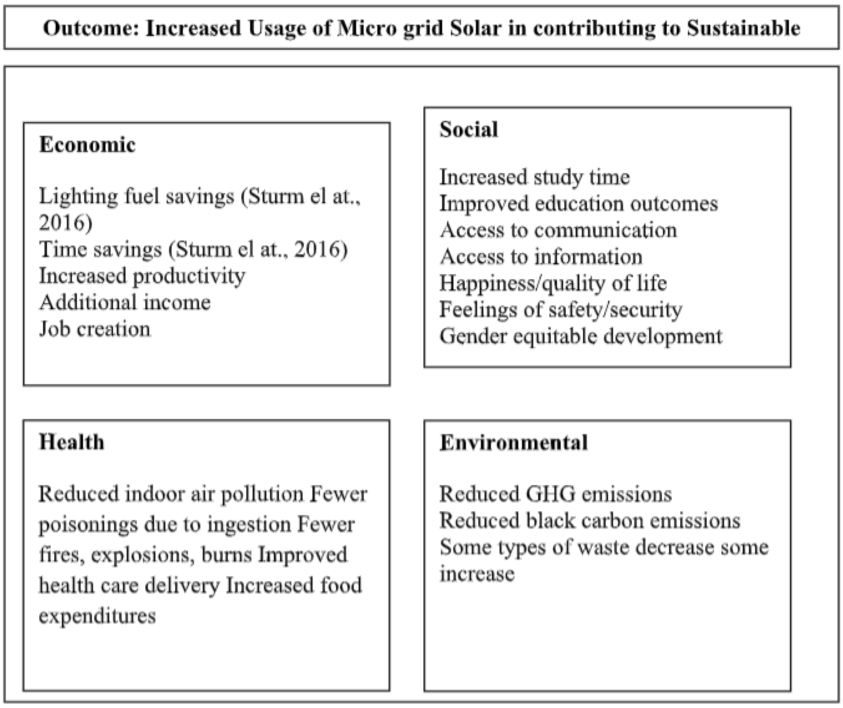

Figure 2. 2: The economic, social, health, and environmental impacts of solar.

For individuals to evaluate the contribution of a phenomena, the reasons to its adoption have to be clear and answering the needs of the individual. The adoption conditions are the four fundamental conditions that must be fulfilled in order for consumers to purchase and use solar services (electricity) and Products. Adopters need to know about solar services (electricity) and Products, have a desire for them, find them economically feasible, and be able to purchase them locally; they must have awareness and attraction for the product, which must be affordable and available (Anderson, 2007). The Four A's are analogous to the 4 P's of marketing (product, promotion, price, and place) (McCarthy, 1960), but from the perspective of potential adopters in emerging economies, rather than the business or marketing perspective.

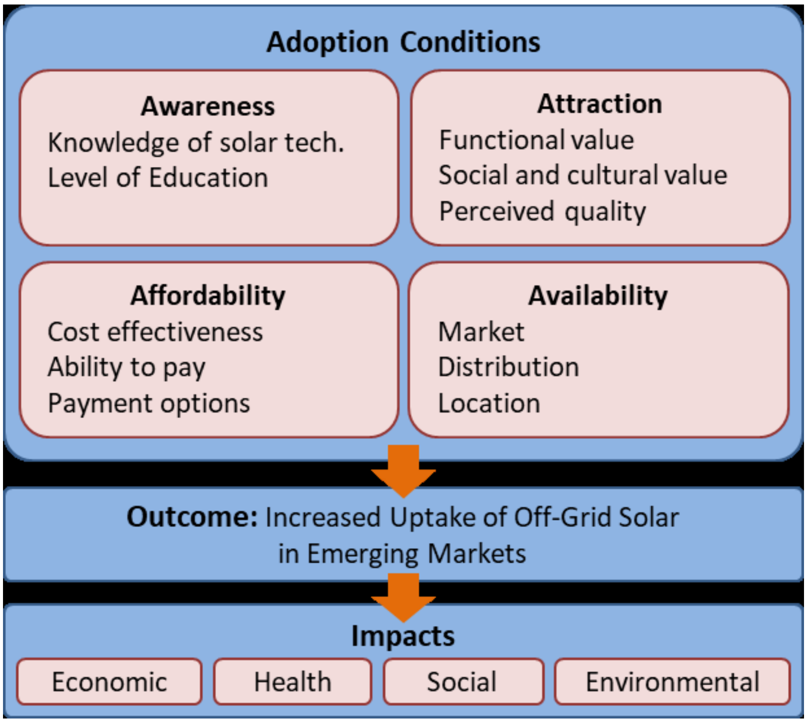

Figure 2. 3: The 4 A's of adopting to Solar energy

Source: Anderson, 2014

Awareness is an indisputable requirement to the diffusion of solar technology in developing communities (Barry et al., 2011). Generally, before awareness reaches 20 to 30 percent of a population there is very little acceptance, but increased in awareness beyond this leads to increased adoption (Rogers, 2003). The two main dimensions of awareness are knowledge of solar technology and its benefits, and the level of education of the adopter.

Further than awareness, potential adopters must find these services (electricity) and Products attractive, thus creating a demand for them. Currently, demand is not coming from the adopter side (market pull), but by businesses who are driving demand (technology push) (Hirmer et al., 2014). For the market to grow and be successful, potential adopters must be motivated to purchase solar technology (Hirmer et al, 2014; Smith et al,. 2014). Though the demand for solar services (electricity) and Products may be lacking, the desire for electricity is evident (Ahlborg, 2014). Increasing demand for electricity may be driven in part by the rapid diffusion of mobile phone technology (Lay et al., 2013). The demand for electricity needs to be more effectively translated into a demand for solar solutions, and a key part of creating that demand is increasing the attractiveness and perceived value of these services (electricity) and Products.

Affordability is one of the primary drivers or barriers of the diffusion of off-grid solar technology in emerging markets (Ondeaczek, 2013). This importance is not only reflected by the focus on this topic in much of the literature, but also by the concentration of donor funding and policies (Haselip et al., 2014). However, in 2013 Bhattacharyya stated that "renewable energies are already cost-competitive in many parts of Sub-Saharan Africa," and that is even truer in 2017 as the cost of solar PV cells continue to drop (Bhattacharyya, 2013). Still, uptake is limited by dimensions of affordability beyond the upfront cost, including cost-effectiveness, ability to pay, payment flexibility, and the availability of financing and subsidies (Smith et al., 2014).

The availability of a product is an obvious prerequisite to its adoption. Availability of solar services (electricity) and Products or the lack thereof is seen as a major impediment in the development of a sustainable market for solar services (electricity) and Products (Hirmer et al., 2014; Ondraczek, 2014). In fact, current efforts are often unable to reach the communities that need solar services (electricity) and Products the most (Smith, 2014). Another issue is the availability of after-sale service, such as installation, maintenance, and spare parts, which can affect consumer confidence when purchasing and lead to systems falling into disrepair (Hirmer, 2014).

Empirical literature

It is understandable that, with the advances in technology, as well as the cost reduction of Renewable Energy Technologies (RETs), the contribution of these renewable energies have led to the expansion of sustainable power generations in developing countries. The work of (Ishaku, 2011) gives a nod to an independent power generating system for use in rural areas that incorporates solar energy in the form of sunlight, wind and running water as primary energy sources. The paper however warns that such proposition may not be necessarily cheap, the primary energy sources (Solar) not withstanding because albeit solar energy is free, its conversion devices and production remain cost intensive. He called on Engineers and Scientists to acquire skills that will enable them to fabricate energy conversion devices in order to meet the needs of millions of Nigerians in their yearning to enjoy the numerous benefits accruing from electrical power generation.

Fagbenle (2012) using meteorological data estimates the total solar energy radiation in Nigeria. The paper observes that total solar radiation In Nigeria generally increases with latitude. The month of August, irrespective of the zone, was seen to witness the least total solar radiation throughout the country. The work is indeed important as it shows the possibility of the development of solar energy in Nigeria. (Akadiri et al., 2012) configured the solar energy scenario for Nigeria from a purely economic perspective. The result of the study reveals that economics just like technology will play a vital role in the success or failure of a solar energy system. The paper advocates an alternative energy sources for the country and earnestly employ the policy makers of the need to channel resources along that direction.

This becomes imperative, the paper noted, because of the increasing cost of fuels, dwindling resources at the disposal of government, despoliation of environmental quality and depletion of fossil fuels. Apart from the theory and prospects of solar energy research in Nigeria, pragmatic efforts have been put to bear in order to construct photo voltaic (PV) modules which provide simple, reliable and independent electrical power source at remote locations(Chen et al., 2014). Most recent work on the use of photovoltaic plants to supply modest amounts of power to efficient end use equipment in areas where a connection to the electricity distribution network is not possible or is prohibitively expensive was carried out by Jenkins (Taplin, 2012). Jenkins (2013) noted that photovoltaic equipment is very robust and costly but has low maintenance requirement. He is of the view that high capital cost can be minimized and the power supply made cost effective if the overall system is carefully designed.

Social impacts of Solar Micro-grids

Whereas power access clearly has a positive influence on education, health, employment and gender equality, there is a need for a healthy means of measuring the extent of any social value and impact derived specifically from mini-grid energy provision. Inside industry literature a considerable lack of information can be found concerning solar mini-grid impact, with few reports containing qualitative analysis of solar mini-grid contribution or effects. Most are intended as progress reviews to notify future investment in the sector and as a result tend as emphasis on technical and financial aspects of installations. These seldom consist of a comprehensive methodology that considers the full range of possible impacts; with societal impact factors being a prominent omission from most. In addition, such techno-economic data on energy systems is often commercially sensitive, much more so than measured social impacts, which could explain the dearth of available literature. Existing mini-grid evaluations have been conducted mostly utilising a mixture of electronic data logged for consumption and associated income patterns, with site visits, household surveys and informal interviews used to set a baseline and conduct regular reviews. Social impacts identified specifically include effects on schools, health, security, and income generating activities. Productive uses of energy are highlighted as key to improving the socio-economic conditions of the recipient community (Rosen, 2009).

Solar micro-grids can have an array of socioeconomic impacts on individuals, households, businesses and communities for previously unserved populations. Lighting can enable children to study during the evenings and remove the harmful effects of kerosene and paraffin. The operation of appliances can enable income-generating and cost-saving activities: for example, water-pumping can eliminate the need for individuals to walk for miles every day to collect water and refrigeration can increase the shelf-life of produce and dairy. Solar micro-grids also enable community uses of energy, providing for instance energy for schools, which can improve the quality of education, or for health clinics, which can reduce mortality rates and help maintain cool chains for vaccines (Ontario, 2006).

Conceptual Framework

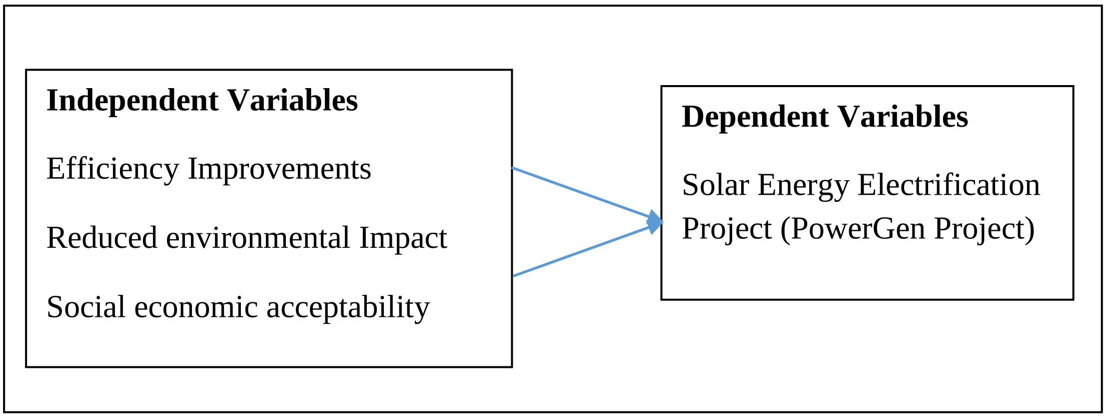

Figure 2.4: Conceptual Framework

3. METHODOLOGY

Research Design

The research problem was studied through the use of a descriptive research design. According to Cooper and Schindler (2003) a descriptive study is concerned with finding out the what, where and how of a phenomenon. This study therefore enabled simplification of the findings from all respondents and identified the contribution of solar power projects in the expansion of sustainable power generations in Tanzania and focuses on the Kagera and Mwanza regions. The study is both qualitative and quantitative in nature.

Population of the Study

The table below shows the population of the study

Table 3.1: Population of the Study

	Customers		PowerGen Staff
	Mwanza	Kagera	Arusha
Population	25	94	3
Total			**122**

Sample Frame

A list of al beneficiaries in the study area was drawn from the Company and the sample frame included the following;

a) Potential customers at potential sites to capture baseline data

b) Customers interested in being connected to the mini-grid to capture baseline data

c) All micro entrepreneurs to Track KPIs related to job creation and skill development

d) Individuals of high standing in the village or someone with an integral stake in the mini-grid, e.g. local mini-grid vendor/agent/technician, village headman, headmaster to capture more qualitative data that isn't necessarily picked up in surveys.

e) PowerGen staff.

Sampling and Sampling Techniques

Random sampling was conducted in a relatively straightforward way, by taking a customer list and generating a random sample on excel. Further sub-sampling was required to ensure adequate gender and other stakeholder group balance. Clients with odd numbers were selected for the study.

Sample Size Calculation

The determination of the sample of respondents was drawn on the weight of the population of beneficiaries currently under the project from PoweGen in the two regions of Mwanza and Kagera. The following formula (Cochran, 1977) was used to determine the number of respondent clients to interview in each category of units in each of the two regions:

$$\mathbf{n} \quad \frac{\mathbf{h(z^2)(1-r)(f)(k)}}{\mathbf{(r)(p)(c)(e^2)}}$$

Where

e is the sampling error term

$\mathbf{n_h}$ is the required sample size, expressed as number of clients

z is the statistic that defines the level of confidence desired (95%)

r is the 90% targeted project effectiveness

f is the sample design effect, *deff*, assumed to be 1.5

k is a multiplier required to account for the anticipated rate of non-response estimated at 1.02 (TDHS, 2010)

p is the targeted population that are using PowerGen Micro Grids (90%)

c is the number of project implementation regions (2)

e is the margin of error to be attained (5%, assuming a 2 tailed normal distribution trend)

h is the number of strata (3 that is consumer, seller and supplier)

Table 3.2: Sample Size Determination estimates

Factors	Estimate
F	1.5
K	1.02
Z	1.96
E	0.05
C	2
H	3
P	0.9
N	5
R	0.9
N	**119**

Using the estimates above in line with the indicate formulae, the total estimated sample was 119 using PowerGen Micro grid in Tanzania. Our weight is based on this classification as indicated in Table 3.2.

Table 3.3: Estimated Sample respondents per Region

Region	Customers (Population)	Weight	Population Proportion	Weighted Proportion	Estimated Sample
Mwanza	858	6	0.75	1	25
Kagera	796	6	0.25	1	94
Total	**1654**				119

A total of 119 micro-grid clients was sampled as indicated in Table 3.2

Instruments

The study uses questionnaire and document review as data collection instrument. The questionnaires were administered by the researcher and translated in the local language (Kiswahili). The items in the questionnaire were structured (closed ended) and developed by the researcher. Data was collected through administration of questionnaires to the respondents by researcher and the research assistants hired by the researcher. The research assistants attained prior training on the data collection exercise by the researcher. Alongside the questionnaire, direct observation was employed during data collection in this study. Information that was sought included; (i) Social demographic background information of each sampled respondent (ii) Location of current residence and distance from Main Grid, time spent in travel and costs of travel to attain power needs (iii) Date of enrolment into the project (if in already in the project or almost joining) (iv) The 4 A's of the project (v) Recommendations.

Reliability test

For reliability, the study relied on Cronbach's alpha coefficient test. Coopers and Schindler (2009) recommended the test and supported Kothari's threshold of 0.70 as the most appropriate alpha coefficient to use as a reliable instrument. A study with results in table 3.4 indicate that all the three variables of the study had reliable items on the study questionnaire and hence the instrument was found fit for field study.

Figure 3.4: Reliability Test

Reliability Statistics		
	Cronbach's Alpha	**N of Items**
Adoption of Solar Power	0.750	4
Contribution of Solar Power	0.851	3

Data processing and analysis

The quantitative data was converted into statistical package for social sciences (SPSS). Frequencies will be run, measures of central tendency especially the mean was measured for continuous data and cross tabulations will be run for categorical data. Comparative analysis was undertaken among sites by region and among councils, as well as gender, age groups and other social defining variables such as urban and rural residence of clients. Data was presented in tables and graphs and analysed and explained in text format. Qualitative data was thematically analysed not only to assess the contribution of solar projects that are none quantifiable but also to assess mechanism and process, relevance, efficiency with which was undertaken, effectiveness towards yielding intended outcomes as well as sustainability of outcomes of the project.

4. RESEARCH FINDINGS AND DISCUSSION

Statistical analysis

Respondents were requested to show their awareness to PowerGen Services and services (electricity) and Products. In the table 4.5 below are the results.

Table 4.5: Statistical analysis

	N	Minimum	Maximum	Mean	Std. Dev	Skewness
Awareness	120	22	34	27.99	.921	.607
Affordability	120	11	16	12.02	.526	3.907
Availability	120	9	13	10.09	.565	4.001
Attraction	120	10	14	12.00	.535	.336
Efficiency	120	12	15	12.11	.547	5.082
Social	120	16	19	16.13	.602	4.646
Environment	120	12	13	12.01	.091	10.954

In the table above, the mean of awareness is higher than the rest of the variables. However, awareness has the highest standard deviation as well. Availability has the lowest mean while attraction has the lowest standard deviation. The high standard deviation reflects a large amount of variation in the group that responded to the survey whereas a smaller standard deviation reflects a small variation. The researcher may conclude that the variable that is most significant is attraction since it has a lower standard deviation. By taking the standard deviation of a variable for attraction that contributes to solar power projects in the expansion of sustainable power generations, PowerGen can better measure the consistency with which revenues are generated. Higher standard deviations show higher amounts of risk (Investopedia, 2015).

In regard to the contributions of PowerGen solar energy, environmental benefit has the lowest standard deviation meaning that it is most significant. Social economic factors also are most significant because it has the highest mean, meaning that the most significant contribution of PowerGen solar Micro-grid is Social economic factors and environmental factors.

Adaption of Solar services (electricity) and Products

Respondents in table 4.7 below were asked whether they would get other solar services (electricity) and Products soon. This was meant to understand the attraction of the solar services (electricity) and Products. 7 (5.8%) of the respondents said they strongly disagree, while 78 (65%) said they agree. This means that 65% of the respondents agreed they would get another solar product as they are attracted to it. The respondents were further asked whether the operation of PowerGen product is easy and the mechanics are friendly. 85 (70.8%) said they agree and 35 (29%) said they strongly agree. This shows the attraction of PowerGen services (electricity) and Products to the respondents. More so, the respondents were asked whether it is a privilege to own PowerGen product in their village. 85 (70%) of the respondents agree and 28 (23.3%) of the respondents strongly agreed which concludes that the attraction is positive.

Efficiency Improvements

Table 4.7: Attraction

I will get another PowerGen product/service soon		
	Frequency	***Percent***
Strongly disagree	7	5.8
Neutral	35	29.2
Agree	78	65.0
Total	**120**	**100.0**
Operation of PowerGen is easy and the mechanics are friendly		
Agree	85	70.8
Strongly agree	35	29.2
Total	120	100.0
It's a privilege to own PowerGen in my village		
Neutral	7	5.8
Agree	85	70.8
Strongly agree	28	23.3
Total	**120**	**100.0**

Table 4. 8: Affordability

The cost for PowerGen electricity service and product is reasonable		
	Frequency	***Percent***
Neutral	50	41.7
Agree	56	46.7
Strongly agree	14	11.7
Total	120	100.0
The payment options only favors the rich people		
Disagree	85	70.8
Neutral	28	23.3
Strongly agree	7	5.8
Total	120	100.0
I would rather use Kerosene or diesel (Generator) because of the cost		
Disagree	120	100.0

Table above shows the response to the question as to whether the respondents think the cost of PowerGen product reasonable. 56 (46.7%) said they agree while 14 (11.7%) said they strongly agree. This means that the respondents agree to the cost being reasonable. However 20 (41.7%) said they are neutral. More so, the respondents disagreed that the payment options only favor the rich 85 (70.8%). However 28 (23.3%) were neutral and 7 (5.8%) strongly agree which is not a significant amount. All the respondents disagreed to the question that "I would rather use Kerosene or diesel (Generator) than use solar services (electricity) and Products because of the cost. This meant that all the respondents preferred using solar services (electricity) and Products and cost wasn't a problem.

The country director confirmed that buying PowerGen electricity is really expensive. However, he pointed out that the difference between PowerGen and the local utility that PowerGen was not subsided. PowerGen operates in remote areas, they have high operation costs and obviously their system is capex is quite high. So the company is expensive that is the difference and setback for them. He added that;

"We could go lower in terms of our tariffs if we are getting subsides on CAPEX, on tariffs as well as operational costs. We are trying inventing ourselves over time to reduce operational coast and the CAPEX. So from the CAPEX we are looking for venders who are little bit economical to our systems". (Country Director PowerGen, 2019)

The country director also said they supply electricity by giving loans to the customers. When customers are not able to pay for the electricity, PowerGen provides them with loans and they understand the terms and conditions of the loan which favor both the client and the business. PoweGen has a good support and customer core-line which gives them training and continues to retrain the customers on the payment methods and mechanical issues.

Table 4. 9: Availability

I can find PowerGen services at the nearest point in my village		
	Frequency	***Percent***
Agree	92	76.7
Strongly agree	28	23.3
Total	120	100.0
I access electricity every time I need it		
Agree	92	76.7
Strongly agree	28	23.3
Total	120	100.0
Don’t get solar electricity and Products because of poor infrastructure		
Disagree	99	82.5
Neutral	14	11.7
Agree	7	5.8
Total	120	100.0

Respondents agreed 92 (76.7%) that they can find PowerGen services (electricity) and Products at the nearest point in their village and 28 (23.3%) respondents strongly agree. Further, respondents were asked if they access electricity any time they need it. 92 (76.7%) of the respondents said they access electricity every time they need it. Respondents were further asked whether they don’t get solar services (electricity) and Products because of poor infrastructure. 99 (82.5%) of the respondents disagreed. Other respondents said they are neutral (11.7%) and others agreed (5.8%) which is insignificant number of respondents.

Contribution of solar services (electricity) and Products

Table 4. 10: Efficiency improvements

Reduced indoor pollution		
	Frequency	***Percent***
Agree	85	70.8
Strongly agree	35	29.2
Total	120	100.0
Fewer fires explosions, burns		
Agree	92	76.7
Strongly agree	28	23.3
Total	120	100.0
Improves health care		
Agree	92	76.7
Strongly agree	28	23.3
Total	120	100.0

Out of the 120 respondents, 58 (70.8%) said they agree that solar power reduces indoor pollution and 35 (29.2%) strongly agreed. More so, 92 (76.6%) said solar power has fewer fires explosions and burns and 28 (23.3%) strongly agree to that. 92 (76.6%) of the respondents said solar power improves health care while 28 (23.3%) strongly agree.

Social economic acceptability

Table 4. 11: Social Economic Acceptability

Increased Study time thus better performance for students		
	Frequency	***Percent***
Agree	99	82.5
Strongly agree	21	17.5
Total	120	100.0
Provides access to communication		
Agree	85	70.8
Strongly agree	35	29.2
Total	120	100.0
Provides access to information		
Agree	85	70.8
Strongly agree	35	29.2
Total	120	100.0
Improved quality of life and feeling of safety and security		
Agree	106	88.3
Strongly agree	14	11.7
Total	120	100.0

99 (82.5%) of the respondents said it increases study time thus better performance for students. 85 (70.8%) of the respondents said solar power provides access to communication. In the table above, 85 (70.8%) of the respondents said they agree that solar power enables them access information while 35 (29.2%) said they strongly agree. More so, 106 (88.3%) of the respondents said solar power improves their quality of life and feeling of safety and security while 14 (11.7%) said they strongly agree.

Adding to the above; the country director of PowerGen said they facilitate clean water in some of the villages by working with other NGOs to drill wells and power those pumps that bring water on the surface. It has been clean water. PowerGen has also facilitated heavy power in schools, clinics, public offices and generally in communities. Some of these communities have been able to do businesses no matter what skills they are. They have been able to start welding, carpentry, to sell cold drinks using a fridge which is something we consider very minor in urban communities.

"*Other social economic advantages include providing clean energy from solar, which is already an advantage that is on a higher level, it is sustainable because we know over time the sources of water will diminish but solar is more sustainable than other sources of power. We do also provide other advantages compared to a local utility. So one of them is to link communities with businesses*." (Country director, PoweGen)

The country director added that they are now looking for funding for community water wells. He said they their activities are pumping clean water to the community and providing electricity. They would also like to connect businesses, for example, one of the sites in Comoro they had linked with another honey producing NGO in Loliondo called Maasai Honey.They produce honey but they never had a way of cleaning it properly and distributing it. So PoweGen linked them together with EFTA which is a financing organization and those are kinds of things that they do even though PowerGen is a utility company. In a way it benefits the company when those producers use electricity and in any way it actually meets or connects business to these communities.

The results have been in direct agreement with Giddens (1976) structuration theory and Sen (1999). The growth witnessed is a true sign of people getting the freedom to be self-reliant and hence developing themselves following the improvement power connection as key production factor. In this case, the central new input was clearly grid power installation. Other scholars who have found similar results were Singh (2009) and Leegwater and Shaw (2008) in their support for action/individual agency theory (Layder, 2010). Here the results have suggested that with the introduction of grid power, more people were taking the businesses they could not previously handle as well as reducing staff for those that required too much labour. The theories have been proved relevant as more business have sprung up and more individuals taken charge of those businesses on their own without involving a second party or agent.

Environmental impact

Table 4. 12: Environmental impacts

Reduced GHG emissions		
	Frequency	Percent
Agree	120	100.0
Reduced black carbon		
Agree	113	94.2
Strongly agree	7	5.8
Total	120	100.0
Decrease waste		
Agree	120	100.0

In the table above, 120 (100%) said Solar power reduces GHG emission. 113 (94.2%) of the respondents said they agree that solar power reduces black carbon. All the respondents (100%) agree that solar power decreases waste.

Recommending PowerGen services (electricity) and Products

The respondents were asked whether they would recommend PowerGen services (electricity) and Products. 63 (52.5%) said they would recommend while 50 (41.5%) said they would highly recommend.

Table 4. 13: Recommendation of PowerGen Services (electricity) and Products

How to recommend PowerGen Services (electricity) and Products		
	Frequency	***Percent***
Neutral	7	5.8
Recommend	63	52.5
Highly Recommend	50	41.7
Total	**120**	**100.0**

However some of the challenges the president of PowerGen noted were that there is customer perception of what services should be provided - customers sometimes believe this should act exactly the same as the subsidized main grid, which is not always the case. More so, the costs to build and to serve customers can be very high. Unlike the main grid, which receives its grid extension costs fully subsidized, these projects are only partially funded by grants. There are high upfront costs to provide 24/7 AC power (the equivalent power as what a TANESCO customer would use in Dar es Salaam) and also to do so with 98%+ uptime. And the revenue collected from customers is quite low, making the revenue-to-cost ratio challenging. Receiving more government and donor support and redirecting the subsidies that go into the main grid into more efficient mini-grids, would help the viability and also the communities.

Analysis of Variance (Anova) test

The ANOVA test was performed to compare the means of two or more independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. The results are shown as table 4.14 below.

The Means is a visual representation of what is seen in the Compare Means output. The points on the table are the average of each group. It is seen in the table above that the mean squares of environmental is the lowest while the mean squares for social had the highest mean. Efficiency improvements and Social economic are more significant at p∠ 0.005. We conclude that the mean square of health variable and socioeconomic variable is significantly different for at least one of the contribution of solar variables of PowerGen services (electricity) and Products (F 3, 836 = 1.522, $p < 0.000$).

According to Ontario, 2006 in the literature review in chapter two of this study; efficiency improvements factors are more significant in the contribution of solar power projects in that Solar micro-grids also enable community uses of energy, providing for instance energy for schools, which can improve the quality of education, or for health clinics, which can reduce mortality rates and help maintain cool chains for vaccines.

Table 4. 14: ANOVA Test

		Sum of Squares	df	Mean Square	F	Sig.
Efficiency improvements	Between Groups	8.358	3	2.786	9.672	.000
	Within Groups	240.784	836	.288		
	Total	249.142	839			
Social	Between Groups	63.955	3	21.318	74.907	.000
	Within Groups	237.920	836	.285		
	Total	301.875	839			
Environment	Between Groups	.015	3	.005	.587	.624
	Within Groups	6.927	836	.008		
	Total	6.942	839			

Correlation

The table below shows correlation for the contributions of solar variables.

Table 4. 15: Correlations – Contribution of solar projects

		Health	Social	Environment
Efficiency improvements	Pearson Correlation	1	.837**	-.150
	Sig. (1-tailed)		.000	.051
	N	120	120	120
Social	Pearson Correlation	.837**	1	-.160*
	Sig. (1-tailed)	.000		.041
	N	120	120	120
Environment	Pearson Correlation	-.150	-.160*	1
	Sig. (1-tailed)	.051	.041	
	N	120	120	120

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

In the table 4.15 above, correlation analysis was performed on the contributions of solar power.

Data showed a positive correlation between, efficiency improvements factors and social economic acceptability that was statistically significant ($r = 0.837$, $p = 0.000$). This means that, as efficiency improvements factors increases social economic factors increase too.

Moeso, there is a negative correlation between social factors and environmental factors that were statistically significant. Meaning that, as social economic factors increase, environmental factors decrease.

Below the adoption of solar power was also analysed using the correlation analysis. The results were as below.

Table 4. 16: Correlations - Adaption of Solar Power projects

Correlations		Awareness	Affordability	Availability	Attraction
Awareness	Pearson Correlation	1	.243**	.050	.478**
	Sig. (1-tailed)		.000	.074	.000
	N	840	840	840	840
Affordability	Pearson Correlation	.243**	1	.727**	.090**
	Sig. (1-tailed)	.000		.000	.005
	N	840	840	840	840
Availability	Pearson Correlation	.050	.727**	1	.028
	Sig. (1-tailed)	.074	.000		.210
	N	840	840	840	840
Attraction	Pearson Correlation	.478**	.090**	.028	1
	Sig. (1-tailed)	.000	.005	.210	
	N	840	840	840	840

**. Correlation is significant at the 0.01 level (1-tailed).

The table 4.16 above shows the Pearson correlation coefficient, where by the objective's level of significance and the sample size that the computation is based.

There existed a, positive correlation between, awareness and affordability that was statistically significant (r = 0.243, p = 0.000). This means that, as awareness increases affordability increase too. There existed a, positive correlation between, awareness and availability that was statistically not significant (r = 0. 050, p = 0. 074). This means that, as awareness increases availability increase too.

There existed a, positive correlation between, awareness and attraction that was statistically significant (r = 0. 478, p = 0.000). This means that, as awareness increases attraction increase too. There existed a, positive correlation between, affordability and availability that was statistically significant (r = 0.727, p = 0.000). This means that, as affordability increases availability increase too. There existed a, positive correlation between, affordability and attraction that was statistically significant (r = 0. 090, p = 0.005). This means that, as affordability increases attraction increase too. There existed a, positive correlation between, availability and attraction that was statistically significant (r = 0. 090, p = 0.005). This means that, as availability increases attraction increase too. In the above results, it is seen that only the correlation between awareness and availability are not significant. The rest of the variables are significant.

Regression

Regression analysis was performed on the results as below. Table 4. Shows the model summary.

Fitness model

The table below shows if the model was a fit. The results are as below.

Table 4. 17: Model Summary

Model Summary[b]										
					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.172[a]	.030	.025	.215	.030	6.389	4	835	.000	.298

The F-ratio tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, F (4, 835) = 6.389, p < .000 (i.e., the regression model is a good fit of the data).

Regression Coefficient

The table below shows the regression analysis of the data.

Table 4. 18: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	*Std. Error*	*Beta*		
1	(Constant)	5.427	1.897		2.861	.004
	Efficiency improvements	.338	.054	.424	6.297	.000
	Social	.480	.049	.664	9.858	.000
	Environment	.170	.154	.036	1.100	.272

The above table shows the regression analysis.

It is seen that Efficiency improvements has a coefficient of 0.338. This means that, for every single unit rise in the Efficiency improvements variables, there is a 0.338 unit increase in the contribution of solar power projects in the expansion of sustainable power generation, keeping all other variables constant. Data shows that social economic acceptability has a coefficient of 0.480. This means that, for every single unit rise in the social economic acceptability, there is a 0.480 unit increase in the contribution of solar power projects in the expansion of sustainable power generation, keeping all other variables constant.

Furthermore data shows that environmental impact has a coefficient of 0.17. This means that, for every single unit rise in the environmental impact, there is a 0.17 unit increase in the contribution of solar power projects in the expansion of sustainable power generation, keeping all other variables constant. Thus, for the subsequent expansion of sustainable power generations though solar power projects, the company may perhaps resolve to use the model and create a contribution strategy estimate. This would assist them refining a further strategic plan and budget for the yet to come (Sweeney, 2014).

5. SUMMARY AND CONCLUSION OF FINDINGS

The main objective of the study was to explore the contributions of solar power projects in the expansion of sustainable power generation in Tanzania. Accordingly, the study used interviews from the respondents in Ukerewe and Bihalamulo villages and its localities to come up with data that was cleaned and summarised before being carefully analysed to enable the conclusions and recommendations for this study.

Findings of the Study

The initial analysis showed that there is a wide consensus by the people of these villages on their acceptance and willingness to use electricity from PowerGen Renewable energy Ltd Company. The results were tested for reliability and they were all found reliable. The project is widely spread in Bihalamulo than in Mwanza as most of the respondents (79.2%) came from Bihalamulo. Almost all the interviewed clients were active (93.3%) and majority (44.2%) aged between 31 – 35 years. Most of these were male (65%) and had a household between 6-10 people. The materials used for house wall were bricks. PowerGen was among the first companies getting support from government and funds from REA. It has built and operating several Min-grids in villages in Bihalamulo, Ukerewe and some other locations where this research didn’t focus intensively on. Majority of the people use PoweGen electricity for lighting and charging phones. However it’s seen that people have emerged in using PowerGen power for business which has boosted their economic situation.

Adopting Solar Power Projects

On adoption of mini-grids, majority of the respondents were attracted to them and agreed that they would get another connection besides the one they have. Majority also agreed they mechanics are friendly and the electricity service & product is easy to use and said it is a privilege to own PowerGen in their village. When asked about affordability, the respondents agreed that PowerGen product and services was of reasonable cost (46.7) though some said it was neutral. They (70.8%) said the payment option was okay and doesn’t favour the rich and they agreed (100%) that they would rather use PowerGen than other sources of power. The respondents agreed that the on the other side of availability, they agreed that PowerGen services (electricity) and Products are available and that they access electricity whenever they need it. The respondents said that PowerGen reaches them despite the poor infrastructure.

More so, a correlation analysis that was performed on the adoption variables revealed there was a positive correlation between awareness and affordability which was significant. Awareness and traction also had a positive correlation significant and well as the rest of the variables. Awareness and availability didn't have a significant correlation.

Efficiency Improvement

In regard to the contribution of PowerGen to the sustainability of power generation, majority (70.8%) said PowerGen reduces indoor pollution. They also agreed to that PowerGen has fewer explosions and burns than other sources of light. It as well improves health care. Here the research looked at basically health improvement. The variables included reducing indoor pollution, having fewer fired explosions and burns and improving healthcare. Majority of the respondents agreed to all these variables. The positive correlation between efficiency improvement and socioeconomic acceptability proved that PowerGen solar, through efficiency improvement, it also improves social economic acceptability. Here the research looked at basically health improvement. The variables included reducing indoor pollution, having fewer fired explosions and burns and improving healthcare. Majority of the respondents agreed to all these variables. The positive correlation between efficiency improvement and socioeconomic acceptability proved that PowerGen solar, through efficiency improvement, it also improves social economic acceptability.

The inferential statistics were performed on the study that included the analysis of variance test, that concluded that health and social-economic factors are the most significant. Whereas the correlation analysis shows a strong positive significance between efficiency improvements factors and social economic factors and a negative significance between social economic factors and environmental factors. With regression, Health and social economic factors were significant.

Socioeconomic acceptability

On social economic factors, PowerGen electricity increases study time thus better performance of the respondents, provides communication as well as information. They agreed that PowerGen electricity also improves quality of life and feeling of safety and security. The study looked at the socioeconomic factors in chapter four. Majority of the respondents said PowerGen improves their quality of life and feeling of safety and security. The country director also mentioned that it has improved people's lives by providing electricity as well as power pumps for safe and clean water. Businesses that have come up as a result of PowerGen solar Micro grid are barbershops, welding, carpentry, selling drinks using fridge and others.

Reduce Environmental impacts

The environmental factors were also looked at whereby the respondents agreed that PowerGen solar reduces GHG emissions, reduces black carbon as well as decrease waste. The respondents concluded by saying they would highly recommend PowerGen services (electricity) and Products to other users. It was seen in the study that majority of the respondents agreed that PowerGen solar reduces GHG emission, reduces black carbon and decrease waste. The negative correlation between environmental factors and socioeconomic acceptability reveal that when socioeconomic factors increase, Environmental factors decrease. This could be the reason that when people are living a happy life,

Recommendations

A major recommendation of the study was that the government should link with the donors like World Bank who have already recognised through their own studies the need for enormous injection of capitals to support the rural electrification programme. In other words, it's necessary for the government to give incentives of some kind that will inspire the people to get connected.

Additional recommendation is that PowerGen should increase their maintenance services that are very necessary especially given that grid power cannot be controlled by any other technical person apart from the capable staff. Likewise, there should be a longer grace period for the rural people terms of repayment period since they are not used to the urban living style where deadlines on payment entice severe action like total disconnection.

REFERENCES

[1] Ahlborg H., L. Hammar, Drivers and barriers to rural electrification in Tanzania and Mozambique – Grid-extension, off-grid, and renewable energy technologies, Renew. Energy. 61 (2014) 117–124. doi:10.1016/j.renene.2012.09.057.

[2] Akadiri, P.O.; Chinyio, E.A.; Olomolaiye, P.O. Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. Buildings 2012, *2*, 126–152.

[3] Akinyele, D.O.; Nair, N.K.C.; Rayudu, R.K.; Chakrabarti, B. Decentralized energy generation for end-use applications: Economic, social and environmental benefits assessment. In Proceedings of the IEEE Innovative Smart Grid Technologies–Asia (ISGT ASIA), Kuala Lumpur, Malaysia, 20–23 May 2014.

[4] Anderson J., C. Markides, Strategic Innovation at the Base of the Pyramid, MIT Sloan Manag. Rev. Camb. 49 (2007) 83–88.

[5] Barry, M.-L.; Steyn, H.; Brent, A. Selection of renewable energy technologies for Africa: Eight case studies in Rwanda, Tanzania and Malawi. Renew. Energy 2011, 36, 2845–2852.

[6] Baurzhan, S. Jenkins, G.P. Off-grid Solar PV: Is it an Affordable or Appropriate Solution for rural Electrification in Sub-Saharan African Countries? Renew. Sustain. Energy Rev. 2016, 60, 1405–1418

[7] Bhattacharyya Electrification Experiences from Sub-Saharan Africa, in: S. Bhattacharyya (Ed.), Rural Electrification Decentralised -Grid Syst. Dev. Ctries., Springer London, 2013: pp. 131–156. http://link.springer.com/chapter/10.1007/978-1-4471-4673- 5_6 (accessed August 17, 2019).

[8] Barry, H. Steyn, A. Brent, Selection of renewable energy technologies for Africa: Eight case studies in Rwanda, Tanzania and Malawi, Renew. Energy. 36 (2011) 2845–2852. doi:10.1016/j.renene.2011.04.016.

[9] Birol, Fatih, World Energy Outlook 2016, Broad transformation in the global energy Landscape. Available Online: https://www.iea.org/newsroom/news/2016/november/world-energy-outlook-2016.html (accessed on 7/3/2019)

[10] Borlase, S. Smart Grids: Infrastructure, Technology, and Solutions; CRC Press: Boca Raton, FL, USA, 2016.

[11] Chen, H.H.; Lee, A.H.I. Comprehensive overview of renewable energy development in Taiwan. Renew. Sustain. Energy Rev. 2014, 37, 215–228.

[12] COCHRAN W. G. 1977, Sampling Techniques 3rd edition, John Wiley & Sons, http://bit.ly/2oKuiJH (Accessed 20/8/2019)

[13] Dinsight, d.light Solar Home System Impact Evaluation, 2015. http://www.dlight.com/files/3314/4666/5533/20151028_d_light_impact_report_FINAL.pdf (accessed August 20, 2019).

[14] ESI Africa, Tanzania: Research uncover the potential of minigrids, available online: https://www.esi-africa.com/regional-news/east-africa/tanzania-study-potential-mini-grids/ (accessed on 15/3/2018)

[15] Gabriel, C.-A. What is challenging renewable energy entrepreneurs in developing countries? Renew. Sustain. Energy Rev. 2016, 64, 362–371.

[16] Gelil, I.A.; El-Ashry, M.; Saab, N. Arab Environment and Sustainable Energy: Prospects, Challenges, and Opportunities. Arab Forum for Environment and Development, 2013. Available online: http://www.idaea.csic.es/sites/default/files/Sustainable-Energy-prospects-challenges-opportunities.pdf (Accessed on 19/08/2019)

[17] Harrison K., A. Scott, R. Hogarth, Accelerating Access to Electricity in Africa with Off-Grid Solar: The Impact of Solar Household Solutions, Overseas Development Institute, London, 2016. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinionfiles/10229.pdf

[18] Haselip, D. Desgain, G. Mackenzie, Non-financial constraints to scaling-up small and medium-sized energy enterprises: Findings from field research in Ghana, Senegal, Tanzania and Zambia, Energy Res. Soc. Sci. (2014). doi:10.1016/j.erss.2014.12.016.

[19] Hansen, U.E.; Pedersen, M.B.; Nygaard, I. Review of Solar PV Market Development in East Africa. UNEP Risø Centre, 2014. Available online: http://pubdocs.worldbank.org/en/600611475093991341/Solar-PVmarket-East-Africa-UNEP-2014.pdf (accessed 18.08.2019).

[20] Hirmer S, H. Cruickshank, Making the deployment of pico-PV more sustainable along the value chain, Renew. Sustain. Energy Rev. 30 (2014) 401–411. doi:10.1016/j.rser.2013.10.018.

[21] Ishengoma, E.K. (2011), Financing Options for Solar Energy Application in Rural Areas of Tanzania: Lessons and Challenges. Discussion Brief No. 16, Financing Solutions for Innovation and Sustainable Development in the Energy Sector. FINE Draft #1 Report, available online at: http://www.gigahamburg.de/content/fsp4/fine/pdf/fine_paper_ishegoma.pdf , accessed on 16th September 2019.

[22] Kariuki, P., Rai, K., Coutinho, F., Mulalo, A., Gore, J., Bekaan, H. and Obara, A. (2010), Market Survey on Possible Co-operation with Finance Institutions for Energy Financing in Kenya, Uganda and Tanzania. GVEP International Report, February 2010.

[23] Knuth, S. "Breakthroughs" for a green economy? Financialization and clean energy transition. Energy Res. Soc. Sci. 2018, 41, 220–229. Available online: www.elsevier.com/locate/erss (accessed on 18/8/2019)

[24] Lay, J. Ondraczek, J. Stoever, Renewables in the energy transition: Evidence on solar home systems and lighting fuel choice in Kenya, Energy Econ. 40 (2013) 350–359. doi:10.1016/j.eneco.2013.07.024.

[25] Mbatia, J. K. (2005). The Socio-Economic Effects of the Rural Electrification Programme: A Case Study of Kandara Location in Maragua District, Central Kenya. Retrieved October 28, 2013, from http://erepository.uonbi.ac.ke:8080/ xmlui/handle/123456789/17147

[26] McCarthy EJ., Basic marketing: a managerial approach, R.D. Irwin, Homewood, Ill, 1960.

[27] Miles, M. B. & Huberman, A. M. (1994). Qualitative Data Analysis (2nd Ed) Thousand Oaks: Sage.

[28] Mohammed, Y.S.; Mustafa, M.W.; Bashir, N. Status of renewable energy consumption and developmental challenges in Sub-Sahara Africa. Renew. Sustain. Energy Rev. 2013, 27, 453–463.

[29] Ontario Power Authority. Ontario's Integrated Power System Plan: Scope and Overview. Report, 29 June 2006.

[30] Ondraczek, The sun rises in the east (of Africa): A comparison of the development and status of solar energy markets in Kenya and Tanzania, Energy Policy. 56 (2013) 407–417. doi:10.1016/j.enpol.2013.01.007.

[31] Power Africa, Tanzania Energy sector Overview fact sheet, Available online: https://www.usaid.gov/sites/default/ files/documents/1860/Tanzania_-_November_2018_Country_Fact_Sheet.pdf (accessed on 7/3/2018)

[32] Price water house Coopers. Developing Renewable Energy Projects—A Guide to Achieving Success in the Middle East. 2016. Available online: https://www.pwc.com/m1/en/publications/documents/evershedspwc-developing-renewable-energy-projects.pdf

[33] Rogers E.M., Diffusion of innovations, 5th ed, Free Press, New York, 2003.

[34] Sergi, B.; Babcock, M.;Williams, N.J.; Thornburg, J.; Loew, A.; Ciez, R.E. Institutional influence on power sector investments: A case study of on- and off-grid energy in Kenya and Tanzania. Energy Res. Soc. Sci. 2018, 41, 59–70. Available online: http://linkinghub.elsevier.com/retrieve/pii/S2214629618303566 (accessed on 18/08/2019).

[35] Smith, J. Urpelainen, Early Adopters of Solar Panels in Developing Countries: Evidence from Tanzania, Rev. Policy Res. 31 (2014) 17–37. doi:10.1111/ropr.12061.

[36] Sopian, K.; Ali, B.; Asim, N. Strategies for renewable energy applications in the organization of Islamic conference (OIC) countries. Renew. Sustain. Energy Rev. 2011, 15, 4706–4725.

[37] Schwaegerl, C.; Tao, L. Quantification of Technical, Economic, Environmental and Social Benefits of Microgrid Operation; Wiley: Hoboken, NJ, USA, 2013.

[38] Scott M.A, J.S. Simonoff, B.D. Marx, The SAGE Handbook of Multilevel Modeling, 1st ed., SAGE Publications Ltd, Thousand Oaks, CA, 2013. http://sk.sagepub.com.colorado.idm.oclc.org/reference/hdbk_multilevelmodel (accessed August 20th, 2019).

[39] Scott, J. Diecker, K. Harrison, C. Miller, R. Hogarth, S. Wheeldon, Accelerating access to electricity in Africa with off-grid solar, Overseas Development Institute, London, 2016. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/10246.pdf (accessed 19.08.2019).

[40] Sturm R., A.I. Njagi, L. Blyth, N. Bruck, A. Slaibi, P. Alstone, A.E. Jacobson, D. Murphy, R. Elahi, J. Hasselsten, M.G. Melnyk, K. Peters, E. Appleyard, I.O. CFA, N. Tyabji, J. Chase, M. Wilshire, B. Vickers, OFF-GRID SOLAR MARKET TRENDS REPORT 2016, Bloomberg New Energy Finance and Lighting Global, 2016. https://www. energynet.co.uk/webfm_send/1690 (accessed August 19, 2019).

[41] Singh, K. (2009). Rural Development: Principles, Policies and Management. New York: Sage Publications Ltd

[42] Suárez Sánchez, A.; Krzemie´ n, A.; Fernández, P.R.; Iglesias Rodríguez, F.J.; Lasheras, F.S.; Javier De Cos Juez, F. Investment in new tungsten mining projects. Resour. Policy 2015, 46, 177–190.

[43] Slaughter, Sam 2018. World Economic Forum: It's time to change how Africa powers itself. 500 Million Depends on it. Available online https://www.weforum.org/agenda/2018/03/its-time-for-the-public-and-private-sectors-to-start-collaborating-on-african-energy-access-500m-people-depend-on-it/

[44] Ton, D.T.; Smith, M.A. The U.S. Department of energy's microgrid initiative. Electr. J. 2012, 25, 84–94.

[45] Taplin, H. Clark, Theory of Change Basics: a primer on theory of change, Acknowledge, New York, 2012. http://www.theoryofchange.org/wpcontent/uploads/toco_library/pdf/ToCBasics.pdf (accessed August 19, 2019).\

[46] Tanzania Energy Access Situation Report 2017 (National Bureau of statistics) available online:https:// www.nbs.go.tz/nbs/takwimu/rea/Energy_Access_ Situation_Report_2016.pdf (accessed on 3/9/2018)

[47] Union of Concerned Scientists. Barriers to Renewable Energy Technologies. 2017. Available online: https://www.ucsusa.org/clean-energy/renewable-energy/barriers-to-renewable-energy#.WxZrfZ8zbIU (accessed 18.8.2019)

[48] Vyas S, L. Kumaranayake, Constructing socio-economic status indices: how to use principal components analysis, Health Policy Plan. 21 (2006) 459–468. doi:10.1093/heapol/czl029.

[49] Wouters, C. Towards a regulatory framework for microgrids—The Singapore experience. Sustain. Cities Soc. 2015, 15, 2