

# **Rural Electricity for Consumers' Socio-Economic Improvement in Kasulu and Uyui Districts, Tanzania**

**By**

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## **Abstract**

The study was moved by the claim that electricity is one of the ingredients of development in rural areas. Through Rural Energy Agency and state energy utility, substantial efforts have been made to improve access to and leading to reduction of electricity poverty. With undeniable reality on improved access to electricity, the status of whether electricity supplied was of quality for consumption and socio-economic improvement remained sluggish. Thus, to shed lights on the existing gaps, the study was conducted to: -

- Examine affordability of electricity among the rural consumers
- Assess reliability of electric system in rural areas
- Determine the influence of electricity on the adoption of ICT among the rural people
- Determine the influence of quality electricity on household income

This study used coherent theories, models and frameworks. They included:

- Energy Justice Theory
- Multi-tier framework for affordability of electricity
- Multi-Tier Framework for reliability of electricity
- Technological acceptance model
- Resource-Based View theory

The study was guided by positivism philosophical stance which is a clear cut of the scientific study of social patterns. Epistemologically, positivism's goal was to describe the phenomena experienced in the social world. Positivism entailed studying observable social realities to make generalised inference. Positivism was also based on large data utilization to maintain objectivity. Preference on positivism was based on the reality that this study made use of the large sample size, employed scientific methods on data analyses such as multi-variate inferential statistics. Likewise, it included observable and quantitatively measurable facts. Further, issues of causal relations and prediction like those based on the influence of electricity on household income and hypotheses testing called for positivism as well.

The study was conducted in two districts, Uyui (Tabora Region) and Kasulu (Kigoma Region). The districts are found in the regions which mainly form part of Western Tanzania. The two districts were entirely off-grid; however, in 2012 they were electrified through different modalities. Kasulu depended on mini-grids while Uyui was served through grid extension, an installation which was done during the first phase of electrification through REA in 2012. Eight villages were selected, four from each district. The villages selected were connected to electricity for phase one program.

Generally, the areas were selected because;

- First, they were earlier beneficiaries of rural electricity through rural electrification program in Western Tanzania. This made it possible to evaluate the effects of electricity based on short and long-term socio-economic indicators.
- Second, the districts were in regions with daunting socio-economic status in terms of assets and income; for example, statistics indicated that the regions have the lowest level of human development with TZS.1,075,268/= GDP per capita (URT, 2016). They have 0.4 localised Human Development Index (HDI) which is lower.
- Similarly, the areas have higher Multidimensional Poverty Index (MPI) of 56% for Kigoma while Tabora was 65%. Lastly, the districts depended on different modes of electrifications; mini-grids and grid extension, thus, it offered an array of factors to compare reliability of electricity from the two modes. In fact, the study areas had salient features which depict if the investment efforts in electricity supply were paying on the ground after being.

The study adopted a Cross-sectional design embedded with descriptive and analytic approaches. The design was based on multiple case studies where data was collected from different participants with variables observed without being influenced. In this study, cases ranging from affordability of electricity to different consumer groups of varying income quintiles were coherently investigated. Moreover, the design was best for the population-based survey which aimed at studying prevailing characteristics in a population with multiple variables. The study used a sample size of 374 households as obtained through Taro Yamane's sample size formula of 1967. It also used a stratified proportionate sampling procedure to obtain the sample representative from each district and villages as well. The study used both primary and secondary data. Qualitative and quantitative data were collected by using various tools: -

- Focus Group Discussion (FGD)
- Key informant interview
- Documentary review
- Questionnaire

The study analysed qualitative data after transcribing and decoding them. The themes in qualitative data included reliability of electricity, causes of electricity outages, planned and unplanned outages. Data from documentary review were assessed and analysed to depict relevant issues which were taken verbatim. To measure affordability of electricity connection and consumption, the study adopted Conventional Affordability Ratio (CAR) (Price Income Ratio) at 10% threshold. Affordability of electricity consumption was measured through CAR at 5% followed by assessment of the basic need electricity of 30 kWh/month. In measuring reliability of electric system, the General Electric System Index (GESRI) was developed as reliable measure followed by ordered logistic regression as a measure of probability of reliability determinants. The study used Poisson regression to execute influence of electricity on ICT adoption while unique Partial Least Square Structural Equation Modelling (PLS-SEM) was used to analyse the influence of electricity on household income.

Succinctly, regarding affordability of electricity, it was found that:

- Affordability of electricity connection was not enhanced to 61.7% of respondents in lowest income quintiles.
- On aggregate respondents spent 33% of household annual income on electricity connection. This was more than a normal threshold of 10%. Only 2.39% of respondents have spent within the threshold, an indication of noticeable affordability.

- On affordability of electricity consumption, the study revealed that respondents of all income quintiles had spent no more than 5% of monthly household income on electricity consumption.
- Equally the amount of electricity consumed was between 40 and 45 kWh for respondents in the lowest quintile. Respondents in lower, medium, high and highest quintiles consumed up to 57.3 kWh per month. This was a proven affordability of consumption
- The amount of electricity consumed was indeed above the basic need electricity of 30 kWh.
- The results on the electrical appliance ownership showed that after electricity connection at the household electrical appliances increased; TV increased from 8.2% to 59%.
- Fanatically, electrical appliance ownership was accentuated by knowledge on how to use it, electricity connection, and desire for social well-being, economic status and affordability of electricity consumption among the consumers.

#### Regarding affordability of electricity

- The study found that rural electric system reliability was enhanced because: first, voltage fluctuation did not affect appliance use at the household
- Second, electricity was available most of the time respondents wanted to use it
- Third, about 74.1% of the respondents indicated that most outages occurred in the morning and afternoon. At that time, the use of electricity was minimal because most respondents had left their homes for farm and off-farm activities.
- Nonetheless, about 25.9% of the respondents reported evening as the common time of the outages occurs. This offers veracity in the inference that electricity was reliable.
- Fourth, the duration of evening supply was 4-5 hours. According to the Multi-Tier Framework, a reliable electric system had to provide more than 4 and 5 hours for evening supply.
- On System Average Interruption Duration (SAID), the results showed that the system was reliable because for the year 2018 respondents in Kasulu had unplanned outages of 154.27 hours equals to 6 days.
- In Uyui respondents had 361 outage hours equals to 15 days confirming prevalence of reliability
- On System Average Interruption Frequency (SAIF); the results showed that Kasulu had SAIF of 130 incidences of unplanned outages. On the same, Uyui had experienced 260 incidences.
- On index measures, electricity reliability was enhanced as indicated by high reliability scores in term of means.
- The reliability of electricity system was determined by pole decay, weather, fire, and lightning as well as vegetation contacts.
- On monthly basis, outage incidences exacerbated unplanned expenditure on backup fuels where respondents had spent up to TZS 1100/= on other sources of energy.
- The outages incidences did not hike domestic expenditure on lighting fuels because the cost on lighting fuel before electricity connection did not differ significantly with cost on electricity and backup fuels combined

#### Regarding the influence of electricity on ICT adoption

- Descriptively, due to electricity availability, adoption of ICT gadgets like mobile phone and TV was high. About 59.8 % of the respondents owned TV, while 68% owned a mobile

phone. But before electricity connection, 85% of the respondents owned mobile phone of which 22% of them supported internet compared to 82% after electricity connection.

- Computer does not form itself as rural ICT. There was a paradigm shift, before electricity connection, 78% of the respondents owned a radio, 38% purchased new radios after electricity connection, the radios were operated through electricity at this time. These were considered as improvement in widening information access among rural people.
- On ICT preference by gender of the households; female headed households preferred mobile phone than TV.
- On determinants for ICT adoption; electricity connection strongly predicted adoption of ICT at the household. Electricity availability played key parts in ICT especially in reducing the upkeep cost.
- More determinants of ICT adoption were income of the household, age of the household head, affordability of electricity consumption, and information need and wattage capacity of the appliance.
- In rural areas, the adopted ICT were commonly used to search for information, mostly on politics, economic, weather and social issues

On electricity household income nexus, it was found that:

- Coherently, with all key resources being available to the household; quality electricity has very strong significant power to predict household income than other competing resources.
- Electricity increases household financial income saving as the results of a reduced service cost on lighting fuels, milling and mobile phone charging; these are short term effects that come quickly along with electricity connection.
- With quality electricity, respondents saved up to 70% of the costs which were incurred on milling service. Convincingly, electricity stimulates emergency of small firms like kioski, salon and food vending leading to increased employment.
- Moreover, development assets such as land, ICT and networking, upon being mediated poses significant prediction power of household income.
- Individual motivation coupled with a desire for a better living has a significant influence on household income. They do so through the intermediate effect of household strength.
- Education is an important complementary factor that significantly moderates the effects of quality electricity on household income.
- The owner dwelling unit as a valuable asset has seen its value increasing after being connected to electricity as well, thus becoming an indicator of income growth among the rural household.
- Electricity has high performance in predicting household income by 81.66% and importance by -0.4.70 leaving behind land, ICT, networking and individual motivation.

The study concluded that, affordability of electricity connection was not ensured to consumers in rural areas. Although electricity alone is not enough to bring all development dimensions on stage but remains to be an important ingredient of development especially on income acquisition and ICT adoption

The study recommended; first, to the state energy utility (TANESCO) and Energy and Water Utility Regulatory Authority (EWURA) to device instalment payment modality for electricity connection to ease economic burden to rural consumers. Second, the state energy utility should

strive to provide free inspection services for wiring installation at the household level. Third, EWURA should register more independent power producers and distributors in rural areas to increase service competition. Lastly, because electricity was affordable on consumption, consumers were argued to avail themselves with more income generation activities in their localities.

#### Contribution of the study on analytical methods

- ✓ The methods of analysis used in studying electricity versus socio-economic issues sufficiently determine the validity of the inferences to be drawn. The first-generation models such as Regression, Difference in difference, Propensity score matching and case studies for qualitative approach have been popular methods in carrying out analysis.
- ✓ With some analytical models, the study argued that it could be challenging to uphold the confounding factors (Tertium Quid) and unobservable factors. It would also be challenging to handle the complex variables in estimating complex theoretical models.
- ✓ Analytical methods have received less consideration in energy studies. The current study apart from using first generation models, has contributed to analytical debates by delving into the second-generation model through the unique Partial Least Square Structural Equation Model (PLS-SEM)
- ✓ The model upholds both moderators and mediators in a go. It has strong predictive power, making it one of the most reliable models for dependable results because it offers a series of confirmatory advanced analytical options.