



ENHANCING ENERGY SECURITY IN RURAL AREAS IN NIGERIA: TVET IMPERATIVES

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Abstract

Energy security is a fundamental concern for sustainable development, and rural communities in Nigeria confront major obstacles in accessing dependable and affordable energy sources. Consequently, this study assesses the potential of Technical and Vocational Educational Training (TVET) in enhancing energy security in rural areas in Nigeria. The study adopts a Systematic Literature Review (SLR) to assess the potential of TVET in enhancing energy security in rural areas in Nigeria. It examines the present energy situations in rural areas and highlights the primary barriers to energy availability. The study concluded that TVET can greatly help to improving energy security and boosting socioeconomic development in Nigeria's rural areas by concentrating on capacity building, skill development, and local empowerment.

Keywords: Energy Security, Rural areas, Sustainable Development, TVET

Introduction

Energy security is a fundamental concern for sustainable development. It is critical for every society's economic, social, and environmental well-being. Rural communities in developing countries confront major obstacles in accessing dependable and affordable energy sources. For instance, International Energy Agency's (IEA) (2013) reported that in 2011, only 65.1 percent of developing country rural communities had access to electricity. Similarly, in 2020, the rate of electricity availability in Nigeria was 55.4per cent, however, with a significant disparity between urban (83.9per cent) and rural regions (24.6per cent). This is significantly low when compare to other African country like South Africa where more than 80 per cent of the rural population are connected to electricity (Ningi, *et al.*, 2020). Many rural communities in the Nigeria mainly rely on conventional biomass fuels like firewood and charcoal for heating and cooking, which contributes to deforestation and indoor air pollution (Famewo & Uwala, 2022; Sodiya & Uwala, 2022; Remteng, *et al.*, 2021). Similarly, Oyedepo (2012) reported that over 70 percent of Nigerians who live in rural areas use fuel wood, and over 50 million tonnes are used each year, a pace that surpasses the rate at which it is replenished via different afforestation programmes, making the nation vulnerable to desert encroachment. Their lack of access to electricity worsens their energy shortage, impeding economic activities, healthcare services, and educational prospects among other sector.

It must however be stated that there had been various governments interventions in the past that aimed at tackling the problem energy security in the rural areas in Nigeria. These interventions dated back to 1980s with the launching of the Nigerian Rural Electrification Programme (NREP). The Federal Government initiated this programme with the goal of rapidly expanding power accessibility in rural regions and ensuring that energy services are available and cheap in a cost-effective way. Similarly, the Electric Power Sector Reform Act of 2005, section 88 sub-section II established the Rural Electrification Fund (REF) to promote both the on- and off-grid growth so that the energy industry can thrive (Remteng, *et al.*, 2021). Regrettably, the achievement of such interventions has not been very remarkable hence the need to assess the potential of TVET in enhancing energy security in rural areas in Nigeria.

United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Labour Organisation (ILO) (2001) defines TVET "as a broad term that refers to aspects of the educational process that include, in addition to general education, the study of technologies and related sciences, as well as the acquisition of practical skills, attitudes, understanding, and knowledge pertaining to occupations in various sectors of economic and social life". Okwori, *et al.*, (2018) noted that through TVET, developed countries have been able to create new and



productive alternative energy sources for long-term economic development. Similarly, TVET has contributed to the transformation of some undeveloped countries into developed countries with a variety of alternative energy sources that promote growth and long-term economic recovery (Okwori *et al.*, 2018).

The potential of TVET in enhancing energy security in rural areas in Nigeria is largely understudy. Most of the studies focus on the potential of renewable (solar) energy; challenges and prospect of energy security in Nigeria; willingness to pay for energy (Chanchangi, *et al.*, 2023; Abdallah & Odeleke, 2023; Nduka, 2021). This study becomes imperative for policymakers to explore the potential of TVET in enhancing energy security in rural areas in Nigeria in order to pave the path for a brighter, more sustainable future for its rural citizens.

Concept of energy security

Energy security has been variously described by authors and practitioners in different fields. This might not be unconnected with the fact that energy systems range from one location to the next, resulting in various energy security challenges. Also, the phrase 'energy security' is frequently used to refer to other energy policy challenges which include energy poverty and climate change. (Cherp, & Jewell, 2014). International Energy Agency (2014) defines energy security as the constant availability of energy sources at an affordable cost. Similarly, the United Nations in its definition of energy security focuses on the constant availability of energy in diverse forms, in adequate amounts, and at affordable prices (Miller, 2017).

In 2007, Asia Pacific Energy Research Centre (APEREC) identified four dimension of energy security to include; availability, accessibility, affordability and acceptability (4As). Availability implies that adequate energy supplies are available. Accessibility is concerned with ensuring that all residents have access to energy, which includes putting in place reliable infrastructure to provide a steady supply for the end user. In practise, however, this is frequently interpreted as ensuring that energy costs remain low and that energy poverty is kept to a minimal. Affordability goal is to make these resources sufficiently inexpensive for everyone to have access to them while Acceptability is concerned with eliminating energy's negative impacts, which include pollution in order to promote customer acceptance of the energy. (Jones & Dodds 2017). In another study by Cox (2014) suggested similar framework, however, with emphasise on reliability and sustainability. Cox argues that the dependability of energy systems, as well as economic and environmental indices of their functioning, must be paid more attention to in order to assure energy security not just for a while but, must be sustainable (Gitelman *et al.*, 2023). This study adopts the definition of IEA (2014) that recognises the continual availability of energy sources at a reasonable price as energy security.

Methodology

This study adopts a Systematic Literature Review (SLR) to assess the potential of TVET in enhancing energy security in rural areas in Nigeria. Mengist, Soromessa, and Legese (2020) noted that when the technique is followed correctly and with minimum error, the study can give credible information and findings that can assist decision-makers and scientific practitioners act appropriately. The SLR was achieved using the Search, Appraisal, Synthesis, and Analysis (SALSA) framework. The first step (search) was completed on Scopus, IEEE Xplore, ScienceDirect, web of science, and JSTOR Databases using search terms like "energy security" and "rural areas", "energy security" and "challenges", "TVET" and "energy security". At the second stage (appraisal), articles addressing topics related to the subject under consideration were chosen for further analysis and content assessment. Following the extensive study of the chosen academic papers, the primary issues were determined in the Synthesis stage, and the articles were categorised into major areas such as; barriers to energy security in rural areas in Nigeria, TVET and energy security in Nigerian rural communities, and successful TVET programmes on energy security.

Barriers to energy security in rural areas in nigeria

Economic Barrier

Studies have shown that one of the major obstacles to energy security in rural areas is economic barrier (Famewo & Uwala, 2022; Falchetta 2021; Streimikiene, *et al.*, 2021; Ningi *et al.*, 2020). In a recent report by National Bureau of Statistics, more than 70 per cent of rural dwellers in Nigeria live in extreme poverty (National Bureau of Statistics, 2022). The high poverty rate hinder their access to modern energy technologies. According to Ningi, *et al.*, (2020) high-income families are more energy secure than low-income ones. Similarly, the report also revealed that majority of the rural dwellers are deprived of cooking fuel, thus, they cook with dungs, wood and charcoal. In another study,



Falchetta (2021) reported that one of the major barriers of energy security in rural area is the capital-intensive nature of energy supply infrastructure in sparse areas with low demand density and payment uncertainty. Falchetta (2021) opined that while governments have been mostly unable to channel the necessary resources, private companies are frequently hesitant to execute costly and unprofitable residential electrification programmes in rural area.

Technical Limitations

Achieving sustainable energy security requires technical expertise in installation, operation, and maintenance of renewable energy system. However, rural communities often lack access to trained personnel with the necessary skills and knowledge. For instance, Mohammed et al., (2017) aver that the Nigeria rural area lacks people with proper training in solar energy development, installation, and maintenance as well as human capacity building. Similarly, the lack of technical know-how and competence inhibits effective use of numerous available energy resources in the country.

Legal and Regulatory Framework

Inconsistent regulations and weak regulatory frameworks frequently discourage private sector participation in rural energy projects, and the absence of a supportive policy environment creates hurdles to sustainable energy efforts. As noted by Amadi (2019) that lack of political will to adopt effective policy has hampered the expansion of Nigeria's energy industry, resulting in Nigeria overdependence on fossil fuels.

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Technology Transfer and Adoption

TVET institutes may aid in the transfer of technology and the acceptance of renewable energy solutions. Solar panel installation, biogas generation, efficient cooking stoves, and other sustainable energy technology may be included in

Entrepreneurship and Economic Development By encouraging entrepreneurship in supporting small-scale energy businesses

TVET has the potential to boost rural economic growth. Local energy firms can produce jobs and contribute to the community's overall growth.

Policy Advocacy and Implementation

TVET institutions may engage with policymakers to create effective energy policies and regulatory frameworks. They can campaign for incentives and subsidies to encourage the use of renewable energy in rural areas and to create a favourable climate for sustainable energy projects.

Developing the Local Workforce

TVET programmes may play a significant role in empowering rural communities by providing persons with essential technical skills for the creation, operation, and repair of energy infrastructure. Skill development guarantees that a skilled local workforce is available to drive energy initiatives and improve long-term sustainability.

Successful tvet programmes on energy security

Case studies of effective TVET programmes that have improved energy security in rural region are presented in this section

Photovoltaic Training in Tunisia

The relevance of technical skill in enhancing energy security was demonstrated in Tunisia. It was observed that the country lack skilled labour in renewable energy. Consequently, government and other relevant stakeholders developed training system for residents willing to acquire the skills. The association of photovoltaic installer, the industry, and TVET defined the skill needs, developed curricula and standard examinations. With the development of curricula, both public and private vocational training centres were set up where residents were trained and certified after the successful completion of their training. This initiative provides the technical expertise necessary for the nation's adoption of



Rural electrification in Mali and Burkina Faso

The French ADEME, European Development Fund (EDF), and Energy Facility supported a rural electrification vocational training initiative in Africa. Mali and Burkina Faso served as pilot countries for the initiative. The initiative began with a thorough examination and categorization of the required vocations, skills, and qualifications required for energy security in rural areas. In the next stage, in partnership with the Ministries of Education, the training programme, curriculum, and accreditation processes were developed. Six pilot institutions were later chosen in Burkina Faso, where skill acquisition training began. Forty trainers were trained, besides the over 80 operators who were trained through September 2014. Public skill acquisition training institutions are involved in continuing education. Their classes and

Vocational training centres in Tunisia and Djibouti

The German Chamber of Skilled Craft Saar implemented a similar strategy to TVET for promoting renewable energy in Tunisia and Djibouti. The initiative establishes prototype skill acquisition centres by providing training needs such as equipment, producing training material alongside the curriculum. A movable unit that is completely stocked with relevant training and educational tools like solar and photovoltaic systems as well as teaching pieces for environmental and safety protection, is used to deliver supplemental continuing education and training to both the skilled workers and trainers

Conclusion

Improving energy security in rural Nigeria is critical for sustainable development and the well-being of rural communities. TVET offers a viable way for addressing energy access concerns by providing local populations with the required skills, encouraging entrepreneurship, and promoting the use of renewable energy technology. By incorporating TVET approaches into rural energy development programmes, Nigeria has the potential to pave the path for a brighter, more sustainable future for its rural citizens. It is therefore recommended that as demonstrated in some of the successful TVET approaches for energy development discussed in section six. Vocational training institutions with teaching on renewable energy technologies should be set up in rural areas in Nigeria. Approaches to training should be tailored to construction, installation, operation and maintenance of renewable energy system.

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