

Modelling Cooperatives to Combat Energy Poverty in Ondo State in the Context of Renewable Energy Transition

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ABSTRACT

This paper analyzes the possibility to develop solar systems through cooperative business model in optimizing the utilization of local renewable energy for non-grid rural area in southern Ondo State. The proposed model integrates the cooperative renewable energy sources employing photovoltaic solar systems. The study used the Multidimensional Energy Poverty Index (MEPI) to decompose energy poverty into incidence, intensity and inequality in order to ascertain the energy poverty level in Ondo South and how renewable energy cooperatives (RECs) business model could reduce the poverty incidence. The findings of the research were that there exist high energy poverty incidence in Ondo south and weak structures for cooperatives to deploy renewable energy. The research recommended increase in government intervention to cooperatives in setting up mini grids and setting community-based initiatives for home solar systems.

Keywords: energy poverty; renewable energy cooperatives; rural areas, solar systems, electricity grid

INTRODUCTION

Access to clean and affordable energy is a significant global challenge (ILO 2013). This issue particularly impacts the poor, rural inhabitants in villages across less developed nations, causing them to allocate larger proportions of their income to inefficient and dirty energy sources. Energy poverty is a critical global issue in the 21st century. In 2018, only 89.5 percent of the world's population had electricity access, with the rate being only 60 percent in Africa. Nigeria, with an average energy cost of 0.52/kWh and a rural population electricity access rate of 25%, is among the countries with the highest electricity costs and energy poverty globally (World Economic Forum, 2023).

The issue of energy poverty is significant and requires a solution, but the more significant challenge is the trilemma of energy security, equity, and environmental sustainability. Thus, a global transition to sustainable energy sources is necessary (Sovacool et al, 2017). The predominant use of fossil fuel, which accounts for the largest portion of global energy consumption, is not sustainable because of its increasing economic, social, and environmental impacts on human well-being (Aklin & Urpelainen, 2013). Consequently, there is a widespread call for the shift to renewable energy due to growing awareness of the impacts of climate change among different societal groups and key stakeholders (Arlota & Costa, 2021).

The necessity for the transition is based on the fact that fossil fuel would not continue to be available forever and that its usage had exerted great toll on the human and his environment.

Renewable energy sources had been identified as reliable alternative sources of energy to conventional fossil energy sources such as crude oil, coal, and natural gas, stressing that they have some added advantages of being environmental-friendly, readily available, among others (Lawal, 2023). Hence, there

had been strong advocacy for its usage by international organizations such as the 1997 Kyoto Protocol, the 2016 Paris agreement (COP21), the International Energy Agency, and the United Nations, just to mention a few, as it is environmentally friendly and possess the ability to mitigate climate change, produces either no or minimal global warming emissions.

The resolution of energy poverty in Ondo, Nigeria can be addressed by establishing energy cooperatives. By learning from research on renewable energy cooperatives in other African nations, the advantages of community-driven sustainable energy projects become evident. Due to the energy sector's market failure and the insufficient energy supply to Nigerian households, alternative options from the "third sector" need to be explored. Nigeria, with its growing population and various socio-economic challenges, necessitates sustainable energy sources to accommodate the increasing demands across its economy and achieve universal access to modern energy services (International Renewable Energy Agency, 2023). The structure of Cooperatives is such that it facilitates members to make additional investments to create new infrastructure and stable member base allowing cooperatives combat market failure (Fijnanda & Tine, 2024).

The nonprofit sector has seen cooperative societies continue to play a significant role in the global economy (Alessandrini & Messori, 2016). Within the "third sector," cooperatives have been suggested to serve the dual role of addressing market failure and providing an avenue for altruism, ideological entrepreneurship, and the promotion of social values.

Recent global perspectives on utility cooperatives have led to the creation of Renewable Coops (RECs) to engage the "third sector" in electricity generation and promote environmental sustainability. RECs energy models involve generation and transmission at one level, and distribution at another level (Ontario Cooperative Association, 2023). The definition of a renewable energy cooperative varies due to the different organizational forms and financing models they use (Beggio & Kusch-Brandt, 2015). Nonetheless, these cooperatives share common elements that are founded on a set of fundamental principles and values. Membership entails adherence to the principles of the International Co-operative Alliance (ICA) (ICA, 2015; REScoop.eu, 2015; Viardot, 2013).

The foundation of energy cooperatives in Nigeria stems from the Rural Electrification Agency (REA), which was established in 2005 with the goal of providing rural electrification to the Nigerian population. As a result, the promotion of the Rural Electricity Users Cooperative Society model for rural electrification has been a key focus of the REA. This model involves the deployment of renewable energy systems such as solar mini grids, solar home systems, and solar streetlights to rural communities. These communities are expected to take ownership of, operate, and maintain their electricity networks, with support from technical experts who provide training on the effective and efficient operation of such systems (Rural Electrification Agency, 2021). Ondo state suffers from energy poverty, especially in its southern regions where nearly five local government areas have been without access to the national grid for close to 20 years (Adebulu, 2022). Consequently, this research aims to develop a small-scale model for generating, transmitting, and distributing electricity using photovoltaic systems within the framework of owner-user cooperatives in rural communities in the southern part of Ondo State, Nigeria.

CONCEPTUAL CLARIFICATION

Energy cooperatives are usually formed by local communities with the aim of harnessing renewable resources such as solar, wind, or hydroelectric power to generate energy for their members. By pooling resources and expertise, these cooperatives can invest in and maintain renewable energy infrastructure, providing a sustainable solution to the energy needs of underserved areas. Research has shown that cooperatives can significantly lower energy costs for members while promoting environmental sustainability and energy independence. Additionally, they can empower communities by creating local jobs and fostering a sense of ownership over energy production.

An innovative approach to addressing energy poverty is through the establishment of Renewable Energy Cooperatives, which are organized by local communities with the goal of utilizing solar, wind, or hydroelectric power to produce energy for their members. By combining resources and knowledge, these cooperatives can invest in and maintain renewable energy infrastructure, offering a long-term solution to the energy needs of underserved areas. Studies indicate that cooperatives can significantly reduce energy expenses for members while supporting environmental sustainability and energy self-sufficiency. Also, they can strengthen communities by creating local employment opportunities and nurturing a sense of ownership over energy generation. Renewable energy cooperatives have the potential to revolutionize the energy environment in Ondo and lay the groundwork for a fairer and sustainable future.

Renewable energy cooperatives are essential for the shift towards sustainable energy generation and distribution. These community-led projects involve collective ownership and management of renewable energy sources like solar panels and wind turbines for internal use and external supply. By forming energy cooperatives, people intend to cut costs, lower environmental impact, and make energy production more democratic. By pooling resources and expertise, individuals who may lack the funds or knowledge to invest in renewable energy individually can collectively benefit from clean energy production. The establishment of these cooperatives not only promotes energy independence but also helps in decentralizing energy generation and reducing dependence on traditional power providers. Furthermore, energy cooperatives play a crucial role in stimulating community involvement and empowerment, which is in line with the overall objectives of sustainability and achieving climate neutrality in the energy industry.

Renewable energy cooperatives can manifest in various forms, with many producing electricity from renewable sources and being structured as RECs, but there are alternative methods through which cooperatives can engage in community energy initiatives (Ontario Cooperative Association, 2022). Within certain cooperatives, members unite, combine their investments, and collaboratively establish extensive project portfolios independently. In such instances, the cooperative generates income by vending electricity to a third-party distributor and subsequently disperses the proceeds from sales among its members. The modern configuration of RECs comes in different sizes and structures as they adapt to operate as either for-profit or not-for-profit. They may function with or without share capital and oversee a single project or an entire portfolio. Despite their differences, all RECs strive to fulfill the needs and interests of their members. They are democratically controlled and seek to empower communities by allowing them to have some decision-making power regarding energy (Ontario Cooperative Association, 2022).

However, despite the robustness of RECs, there are a number of obstacles in the way of implementing energy cooperatives in Nigeria (Nyarko, et. al., 2023). The primary obstacle is creation of RECs which is hampered by various legal, financial, and social obstacles (Esan, et. al., 2019). The premise that Nigeria has too many obstacles preventing the formation of energy cooperatives or other collective presumption models forms part of the basis for this study. Coupled with these are fundamental factors such as poor economic conditions, weak institutional frameworks and poor cooperative management make cooperatives to be weak in providing the large-scale off grid renewable energy and to maintain sustainable implementation of renewable energy projects (Nyarko, et. al., 2023). Overcoming these barriers require changes in the law, in the energy policy and frameworks guiding RECs formation in Nigeria. Also, these barriers may offer chances for cooperation to collaborate with government agencies and parastatals, private financiers, and educational establishments to obtain resources, draw in specialists, and enhance the ability for sustainable energy projects. Renewable energy cooperatives can overcome challenges and succeed over the long run in reducing energy poverty in Ondo by utilizing these partnerships.

EMPIRICAL REVIEW

In their study, Uzoma et al (2021) observed that the relationship between Renewable Energy Centers

(RECs) and rural electrification had influenced the development of hypotheses regarding the effectiveness of RECs in examining the impact of the centralized electricity grid on rural electrification and the rural economy of Nigeria. They further commented that the connection of rural areas to the centralized grid was significantly lacking, leading them to recommend a decentralized electricity structure as the ideal model for rural electrification, with a focus on mini-grids and an emphasis on localized energy generation.

Esan et al (2019) emphasized the significant risks posed to Nigeria’s citizens, economic development, and overall national growth by the state of the country’s electrical power supply. The authors highlighted the necessity of a more diversified approach to electricity production to incorporate sustainable energy sources, particularly renewables, for meeting the increasing power demand in Nigeria. They also pointed out the significant potential for power generation in Nigeria through the proper integration of renewable energy resources into the centralized electricity grid.

In, Bamisile et al (2017) stated that the solar energy consumption was projected to be 1.26%, 6.92%, and 15.27% by 2015, 2020, and 2030, respectively. They also observed that the potential of solar energy in Nigeria could significantly improve electricity access and enhance the quality of life in rural areas.

Olapegba (2013) observed that the establishment of an electric cooperative requires a strong commitment from community members, as well as the development of business models and securing funding to support microgrids, improve electricity infrastructure, and overall enhance electricity provision to consumers within the electric cooperatives’ service areas. This is because the founding members must put significant effort into handling incorporation, infrastructure, and staffing to initiate operations and gain momentum, while potential members and the founding board of directors may engage in technical, commercial, and legal consultations to gain insights into relevant electricity issues and recognize potential risks and opportunities.

RESULTS AND DISCUSSIONS

Cases were taken from three local government areas in southern part of Ondo State villages where energy poverty were rampant. The study used the Multidimensional Energy Poverty Index (MEPI) to decompose energy poverty into incidence, intensity and inequality following Oihana & Eneritz (2023).

Questionnaires were distributed in different households across towns and villages represented in Table 1 below:

Table 1: Administration of Questionnaire to Households in the Study Area

		Population	Household Population	Households sampled
Local Govt.	Town			
IlajeLGA	Ayetoro	18,146	1720	60
	Awoye	2301	190	45
	Molutehin	597	150	45
EseodoLGA	Arogbo	10,362	1820	60
	Igbekebo	2299	260	45
IreleLGA	Iju-Osun	2383	160	45
Total			3,400	300

Source: Ondo State Demographic Variables Statistics (2020) (Column 1 and 4)

Table 2 shows the socio demographic features of the households sampled. The mean age of members of the households sampled is 53. This shows that majority of the households in the southern part of Ondo State are relatively old. Expectedly, male respondents also constitute 84.6% of the total. The mean household size of seven shows that average household in Ondo South is relatively large. However, this could have a significant effect on the types of energy households could be using. Households with the annual income range of ₦100, 001–₦500, 000 constitute 35% of the total population, while an average household obtain ₦354,334.3as annual income. More than 50% of the total population does not have access to cooperative credit.

Table 2: Socio demographic features of households

VARIABLES	Frequency	Percentage
Age of Head of Household (Years)		
<40	61	20.33
41–60	146	48.66
>60	93	31
Mean	53.11	
Gender		
Male	254	84.6
Female	46	15.4
Household Size		
1–4	171	57
5–8	84	28
>8	45	15
Mean	7	
Income (?)		
0—100,000	143	47.66
100,001—500,000	105	35
500,001—1,000,000	32	10.66
>1,000,000	20	6.67
Mean	354,334.3	
Access Cooperative Credit for Solar Systems		
Yes	102	43.79
No	198	56.21

Source: Author’s Field Survey (2024)

Table 3 shows the distribution households sampled and the sources of energy consumed. There were 20 households that use the electricity from national grid; while the use of renewable energy (solar) was 27%. The households that used nonrenewable energy sources were 73 % in total (Generator 11%; Gas 15% and Other nonrenewable sources 40.3%). This indicates that there is a wide range between the use of renewable and nonrenewable energy sources in South Western Ondo State.

Table 3: Distribution of Households in according to energy source

Energy Source	Frequency	Percentage
Electricity (National Grid)	20	6.7
Generator	33	11
Solar	81	27
Gas	45	15
Others (Firewood, Charcoal etc)	121	40.3

Table 4 shows estimates of determinants of energy poverty in Ondo South. As can be seen from the table, the model is generally robust. All the regressors, on aggregate with the exception of household size, have significant effect on energy poverty of households. The likelihood ratio statistic, which is statistically significant at 1%, indicates that the model fits the data used. Virtually all parameter estimates are statistically significant at 1% having the expected a priori signs. Sex of household head with respect to male headship, age of household head, residing in rural sector and land size are positively associated with energy poverty. They increase the odds in favour of households being energy poor. On the other hand, household income, and access to cooperative credit were negatively related to energy poverty. This implies that the variables reduce the tendency of households to be energy poor. The energy poverty tends to increase among male-headed households relative to the female, implying the predominant use of traditional and/or unsafe energy sources among male-headed households.

Table 4: Determinants of Energy Poverty among Households

Variable	Coefficient	Std. Err.	t-Value
Age	0.002	0.0006	2.05
Household size	0.004	0.005	1.09
Sex	0.117	0.023	5.08
Coop Credit access	0.373	0.017	21.59
Income	7.20e ⁻⁰⁸	9.82 e ⁻⁰⁸	7.33
Constant	0.135	0.052	2.60
Sigma	0.421	0.007	
N			4049
LRX ² (12)			1900.45
Prob> _2			0.000

The positive relationship between rural residents and energy poverty is attributable to low commercial clean energy consumption of rural population in Ondo South due to low population. Households with high levels of income have access to home solar systems, while those with lower socioeconomic profile use traditionally unsafe lighting sources. The finding of the study was that low income contributed to high energy poverty among households especially among households without access to credit. The access to credit variable invested in profitable venture would lead to increased income, which in turn will enhance the ability of households to use clean energy.

FINDINGS AND RECOMMENDATIONS

The sustainable use of clean and safe sources of energy is indeed a global challenge. Traditional and unsafe

forms of energy use is predominant among households in sub-Saharan Africa. This is not only a threat to the environment, but also constitutes health risk to the population. The study examines multidimensional poverty energy index (MPEI) and the factors affecting multidimensional poverty energy index (MPEI) among households in Nigeria. Based on the findings of this study, energy poverty incidence is high in Ondo South.

Therefore, the integration of renewable energy cooperatives presents a promising solution for combating energy poverty in Ondo. The findings underscore the potential of energy cooperatives in significantly reducing the cost of purchasing electricity and expediting the payback period for investments in generation sources. By promoting local energy self-sufficiency and citizen participation in energy management, these cooperatives offer a path towards enhanced energy security and environmental sustainability. The empirical analysis of existing renewable energy cooperatives reveals their capacity to stabilize energy prices, facilitate direct energy transactions, and foster community engagement towards a common goal of decarbonization. Despite challenges such as financial constraints and monitoring limitations, the strategic focus on expanding membership, increasing renewable installations, and addressing energy poverty demonstrates the long-term viability and impact of cooperative energy initiatives in fostering sustainable development and resilience against energy poverty in Ondo South.

Through a combination of community involvement, financial support, and technical assistance, these cooperatives can effectively harness renewable energy sources to provide affordable and sustainable electricity to underserved communities. This study shows that the success of these cooperatives is dependent on strong partnerships with local stakeholders, as well as clear government policies that support renewable energy initiatives. Additionally, it is recommended that further studies be conducted to explore the scalability and replicability of this model in other regions facing similar energy challenges. By adopting a collaborative approach and leveraging the resources available, renewable energy cooperatives have the capacity to transform the energy landscape in Ondo South and beyond.

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