

## Economic Implication of Addressing the Needs of Rural Women through Solar Energy

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### ABSTRACT

*Solar energy will continue to play a progressively significant role in both developing and developed countries in the future. Interestingly, in Nigeria, the economic implications of the wider use of solar energy sources for women and men have hardly been considered, even though women's roles and interests in energy use and production have been well-documented. Nigeria has abundant sunshine throughout the year, which heightens its potential for solar energy generation. Unfortunately, the country's solar energy projects is yet to realize a*

*reasonable result over the years, due to many barriers associated with initiatives implementation; hence, the entire power sector remains incapacitated to generate, transmit and distribute a clean, affordable and sustainable energy to assist economic growth. This paper therefore evaluates the economic implication of rural women's utilization of solar energy. It reviews the literature on rural women's involvement in solar energy and presents a case in point of the results of including women in solar energy development for economic development.*

*Keywords: Rural Women, Solar Energy, Economic Implication, Renewable Energy, Nigeria.*

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### INTRODUCTION

Solar energy make up an insignificant fraction of power generation in Nigeria, although, the country receives maximum sunlight exposure, potential for solar photovoltaic (PV). According to [1,2,3], Nigeria is in the solar belt, which heightens its solar potential; unfortunately, the likelihood for utilizing the renewable energies remains slim compared to the conventional electricity. Generally, solar energy in the country has mostly been used for various activities through the open to the sun method, especially in the rural areas. [4,5] aver that solar electricity generation surfaced about two decades ago and has continued to grow. Nigeria is blessed with the abundance of solar radiation throughout the year, yet the country lacks the appropriate infrastructure to carry out solar radiation measurement [6]. Presently, Nigeria operates about thirty (30) measuring stations which are managed by the Nigerian Meteorological Agency (NMA). These are airport based and the data from these stations are used

to calculate an estimate probability for solar radiation in the country [7,8]. There is a dearth of research activities related to solar energy in Nigeria especially in the area of economic growth. According to surveys carried out by the Energy Commission of Nigeria (ECN) in 1999, there are about 44 companies and research centres in charge of the importation and installation of photovoltaic systems in Nigeria. Of these, only one company (Exide Batteries Nigeria Limited) manufactures batteries that are used for photovoltaic solar systems [9]. There is no doubt that solar energy will continue to play an important role in both developing and developed countries in the future, thus this paper intends to evaluate the economic implications of the wider use of solar energy sources for rural women. The paper reviews the literature on women's involvement in renewable energy and presents some examples of the results of including rural women in solar energy development [10,11].

#### Energy Crisis in Nigeria

Incredibly, 1.1 billion people - 14% of the world's population - still live without access to electricity. In rural, remote communities, many people simply have no light after sunset. That makes being productive at night—such as working and learning—extremely difficult [12]. Limiting useful hours of the day by access to daylight holds back personal and economic development and wastes human potential. Many homes are forced to use kerosene lamps for illumination, which are environmentally dirty, and dangerous. Women are disproportionately at risk of inhaling low-quality kerosene smoke, especially while cooking. In fact, kerosene smoke is now one of the main killers of women in the developing world [13].

Energy plays a very important role in a nation's economic growth, progress and development. It is fundamental for socio-economic and human development as well as for poverty eradication [14]. Notwithstanding the Nigeria's position as the sixth largest petroleum oil exporting nation and a leading gas exporter, the country undergoes huge energy crisis with approximately 40% of the her population connected to the national electricity grid [15]. The grid is plagued

by constant outages that last for as long as 20 hours daily. Presently, Nigeria's electricity generating capacity is about 3920 MW with per capita power capacity of 28.57 W which is not enough for domestic household consumption [16]. At present, 15.3 million households lack access to electricity, per capita electricity consumption has been less than 150 kWh per annum [16]. In the same vein, the growing energy poverty in Nigeria can be strongly linked to the absence of energy law. Although a number of policy initiatives do exist [17], government commitment to effective implementation is lacking. The dearth of energy law has reduced investors' confidence on these policies. The absence of institutions with clear-cut vision and resources to enhance widespread access to both power and energy for the poor, as well as insufficient access to finance are primary limitations; households and Small businesses equally lack financial resources to enable them to acquire pro-poor energy services such as clean biomass cook stoves, LPG and solar lanterns. There are also no clear service delivery models for public support for expanding access to energy services [18].

#### Overview of Solar Energy in Nigeria

Nigeria has a huge potential for solar energy, particularly because the country lies within a high sunshine belt [19].

'annual average of total solar radiation varies from about 3.5 kWhm<sup>-2</sup>day<sup>-1</sup> in the coastal latitudes to about 7kWhm<sup>-2</sup>day<sup>-1</sup> along the semi arid areas in the far North. On the average, the country receives solar radiation at the level of about 19.8 MJm<sup>-2</sup> day<sup>-1</sup>. Average sunshine hours are estimated at 6hrs per day. Solar radiation is fairly well distributed. The minimum average is about 3.55 kWhm<sup>-2</sup>day<sup>-1</sup> in Katsina in January and 3.4 kWhm<sup>-2</sup>day<sup>-1</sup> for Calabar in August and the maximum average is 8.0 kWhm<sup>-2</sup>day<sup>-1</sup> for Nguru in May.

Sambo further adds that;

given an average solar radiation level of about 5.5 kWhm<sup>-2</sup>day<sup>-1</sup>, and the prevailing efficiencies of commercial solar-electric generators, then if solar collectors or modules were used to cover 1% of Nigeria's land area of 923,773km<sup>2</sup>, it is possible to generate 1850x10<sup>3</sup> GWh of solar electricity per year. This is over one hundred times the current grid electricity consumption level in the country [12].

Thus, solar radiation is moderately distributed within the country's 36 states and its capital [20]. According to [20],

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According to [8], the above fact highlights the immense amount of energy which the country can benefit from solar energy, given that presently, solar energy constitute less than one percent of the total power generation. In the opinion of [13], the availability of such massive radiations combined with the developments in the photovoltaic technologies makes it clear that huge amounts of electricity can be generated

[3], investigated the relationship between electricity consumption and real GDP growth in Nigeria during a period of thirty six years (1970-2005). The paper adopted Vector Auto Regressive (VAR) and Error Correction Model (ECM) to test the causality between real GDP and electricity consumption. The order of integration of the two variables was determined using Augmented Dickey Fuller (ADF) test which was followed by co-integration and causality test. The result shows that there is unidirectional causality from real GDP to electricity consumption without a feedback effect. This could be attributed to the low level of electricity consumption, engendered by low level of electricity generation, which is too small to cause economic growth. The paper observed that there is need for government to diversify the energy mix to include all the untapped potentials of renewable power options such as small hydro, wind, solar and biomass among others in all the states and local constituencies. Also, energy wastages should be curtailed through proper efficiency measures and different pricing system. It is also suggested that government should make policies which will create an enabling environment for the private sector to generate electricity from renewable sources in terms of fiscal incentives such as tax rebate, subsidies and low import duties for the imported equipment among others. Furthermore, the study called for the review of the 2003 National Energy Policy so as to come up with a sound, robust and technological energy policy that will be able to solve the challenges of the electricity sector. It

and used to tackle the country's electricity crises that have become an obstacle to economic development. He maintains that the prices of solar PV have continued to reduce, plummeting to about 50% in comparison to when it first surfaced. This development is said to be as a result of the rise in solar PV productions in China as well as the technological breakthroughs experienced in the field [13].

#### Empirical Analysis

added that political commitment through investment in energy infrastructures and capacity building of the citizens in renewable energy technologies was critical towards the improvement of electricity generation, which could then cause electricity consumption to have a significant impact on economic growth in Nigeria. [8], analyzed the energy consumption and economic growth nexus in Nigeria. Using the auto-regressive distributed lag method, the study estimated the effect of energy consumption on economic growth in Nigeria between 1981 and 2017, incorporating financial development, gross fixed capital formation and inflation for enhanced robustness. The result indicated that energy consumption and gross fixed capital formation (proxy for infrastructure) significantly determined growth of economic activities in Nigeria. The study also presented empirical support for delayed response of an endogenous variable to its own shocks as well as shocks to explanatory variables. It therefore asserted that energy consumption is a major determinant of economic growth in Nigeria, and aligned with the energy-led hypothesis. The study advocated for increased government and private sector investment in energy and infrastructural development.

[10], estimated the impact of renewable energy on economic growth in West African countries using panel dynamic ordinary least squares (DOLS) by employing a sample of 15 West African countries covering the 1995-2014 period. The results indicated that renewable energy consumption slows down

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economic growth in these countries. This was attributed to the nature and source of renewable energy used in West Africa, which is majorly wood biomass. The wood biomasses used in West Africa are usually unclean and highly polluting when burnt. On the other hand, the use of clean energy sources like solar, wind and hydropower which does not have a side effect on human health and the environment is less in West Africa. As

#### Women and Solar Energy

Both rural and urban women need adequate energy supplies for their small- and medium-scale enterprises and home industries. Many of these informal sector activities are highly fuel-intensive, and their viability and costs are affected by energy prices and availabilities. Examples of energy-intensive microenterprises usually operated by women include food-processing industries. Thus, there are studies on increasing rural women's knowledge about building, installing, and maintaining solar panels and batteries etc., which show that women could deliver clean energy to their villages [7]. According to Cecelski, rural women are interested in building, operating, and maintaining renewable energy technologies. In most cases, attending workshops and technical trainings are necessary for enhancing these skills [9]. For instance, through these measures, rural women like Habiba Ali, a local entrepreneur funded by the Rockefeller Foundation, has provided off-grid solar solutions such as a 10-kilowatt solar micro-grid (providing electricity to over 800 individuals) as well as solar powered dryers to villages in northern Nigeria [11]. Similarly, in South Africa, rural women have also designed a solar-powered pump that is mobile, easily transported between fields and stored when not in use.

Rural women are interested in consuming energy from solar technologies because it would improve the quality of life in their homes, including lighting [13]. Women also need cooking energy that is less

such, renewable energy use can slow down economic growth by lowering productivity when unclean and inefficient sources are used. The study recommended among others, that the share of other renewable energy components such as solar, wind and geothermal should be increased in the renewable energy mix of the sub-region of West Africa.

labor-using, more convenient, and safer. Furthermore, rural women need solar energy to improve profitability and safety in their energy-intensive microenterprises, and to save labor. For instance, improved commercial-size solar cookers, solar baking ovens, solar fruit and vegetable dryers, improved fish smokers and renewable energy-powered grain grinders and millers are some of the applications that have been made to ease women's food-processing activities. Solar hot water heaters, refrigeration systems and photovoltaic lighting for markets, hotels and restaurants, as well as for entertainment venues are also potential uses. Lighting can also be important for allowing rural women to work in the evening more productively in home industries. An important portion of women's economic contribution is unpaid, unrecognized and undervalued, resulting in less attention to technology development and to investment in improving women's work than men's work; hence, rural women need efficient energy in the modern sector, because they still play the key role in household energy use in modern societies. Solar energy as well as other energy efficiency programs needs to involve women because women influence their households' direct and indirect energy consumption, and educate and shape their children's future energy conservation and consumption habits [20].

#### Benefit of Solar Energy to Women

Women are often assumed to be the principal beneficiaries of improved

technologies, in particular of renewable energy technologies. Labour-saving

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devices are clearly a priority for rural women, given the inordinate amount of time and energy that they expend in necessary household drudgery. Thus, solar technology initiatives have the tendency to improve efficiency of

#### Case in Points of Bringing Clean, Renewable Light to off-grid Communities

##### i. The Solar Mamas program

According to [13], the Solar Mamas program, which has already improved tens of thousands of lives, is a typical example of bringing light - literally and metaphorically - to communities in Africa, Latin America, Asia and the Pacific Islands. The women who join the program are often illiterate or semi-literate mothers and grandmothers, who already play an important role in the development of their communities and are perfectly placed to introduce new ways of doing things. The program is based around the idea that by investing in one woman, we can spread knowledge, skills and inspiration throughout a whole neighborhood. Solar Mamas train women to build, install and maintain solar panels

#### Economic Implication of Women's Utilization of Solar Energy

Solar energy can greatly enhance the ability of children to read and write under clean light, while adults are able to extend their working day, unlocking life-changing development and economic opportunities. Black carbon kerosene emissions are also reduced, helping developing countries reduce their carbon footprint. Solar energy can have a dramatic positive impact on the fortunes of an entire community by addressing the high level poverty, as it provides opportunities for increase business activities, night life,

#### CONCLUSION/RECOMMENDATIONS

This paper concludes that solar energy interventions can empower women from some of the most impoverished communities in Nigeria, while contributing to the economic development of the nation. Training rural women on effective utilization of solar energy will afford them the opportunity to use their knowledge to help their communities. Thus, manufacturers must pay attention to energy needs of women because they constitute a huge potential

production in general, and further reduce the toil in women's activities. Interestingly, increasing the efficiency of energy production processes usually implies larger-scale production.

and batteries, so they can deliver clean energy to their villages. Participants also learn how to build LED lamps, charge controllers, lanterns and home lighting systems, and how to store and repair components. The equipment they construct is then shipped to their villages for installation. The training is entirely practical and requires no previous qualifications. Barefoot has also developed a training program using colors and pictures so that women can learn and work on the solar panels without needing the ability to read and write. After six months training with Barefoot College, Solar Mamas return home as trained solar engineers, able to install lighting and train others.

high level of efficiency, and reduced labour. Research by the World Bank indicates that, women who are working invest around 90% of their earnings into their families and communities - compared to 35% for men. That means money earned by working rural women is likely to be spent locally and stay local - further driving local growth. Accordingly, by 2025, the advancement of women's equality could add \$12 trillion to world GDP - roughly equivalent to the size of the Chinese economy.

market. Similarly, policymakers in Nigeria should ensure that the energy needs of women are incorporated in energy laws being made in country, bearing in mind that women are a powerful force for renewable energy development. In addition, energy researchers should endeavour to include women in their energy research and analysis because women constitute a large part of energy consumption and production.

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