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Renewable Resources usage, Health and Sustainable Living - How Far Has Nigeria Fared? A Review

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***Abstract*:- This paper reviewed what had been happening over some years in Nigeria with respect to renewable energy. It tried to look at the power challenges and the potentials of renewable energy as the possible alternative and solution to the problem. It reviewed some of the advocacy calls for more usage of the renewable resources in Nigeria. Governmental policies, programmes and proposed measures towards the development and improvement of renewable energy were looked at. The interrelationship between renewable energy, health and sustainable living and gender issues of renewable energy were reviewed. The poor attitude to the environment which has a direct bearing on health was pointed out. These situations were linked to the low level of awareness of the benefits of using renewable energy. The inability of Nigerians to identify the relationships between the usage of renewable resources, health and sustainable living was pointed out. The review showed that societal bias played a great role in the acceptance of renewable energy technology and concluded that because energy is fundamental for socioeconomic development and poverty eradication, the solution to this Nigerian problem was as much social as it was technological.**

Keywords: Renewable energy, health, sustainable living, resources, policies

INTRODUCTION

Over the years, it has generally been observed that Nigerians are not so much into the use of their available renewable energy (RE) resources. It is also observed that their lifestyle is largely unsustainable with respect to energy resources. It has also been found that largely, people do not know about their being able to use renewable energy resources. Contrary to this situation, countries like Malawi, Uganda and Kenya have a high level of awareness to this situation and are making use of renewable energy resources more than Nigerians in terms of cooking, heating, water resources management and lighting (Karekezi and Kithyoma, 2003; Mgbemene, 2010; Fashina et al. 2018).

Sources of energy are classified into nonrenewable (conventional) and renewable energy sources. Renewable energy resources refer to the energy resources which are naturally replenished within the human timescale and are largely free in nature. The resources involved include solar energy, wind energy, hydro energy, and biomass. The conventional or nonrenewable energy resources include crude oil, tar sands, natural gas and coal.

Energy is a vital ingredient and actually, a critical factor necessary for the development of any nation. It is also a powerful driver of social and economic change in any country and plays a vital role in poverty eradication and security of any nation. (Oyedepo, 2012a, Eleri et al. 2013, Akorede et al. 2017). The amount of energy that is available and used by a country is a significant factor that is generally recognized as the best indicator of any nation's level of development, industrial strength and wealth (Lloyd, 2017). As shown by Boes and Taylor (2003) and Esen and Bayrak (2017), there is a strong statistical correlation between a country's energy consumption and its economic output. The economic growth of any nation depends crucially on the long-term availability and uninterrupted supply of energy from sources that are affordable, accessible, and environmentally friendly. Thus, the need for energy can never be over-emphasized in the contemporary world. It is indeed fundamental to the fulfillment of basic individual and community needs in our modern society. The indices for measuring the level of a nation's development include the capability to provide energy for lighting and heating a house, running a factory, street lighting, keeping a hospital open and operational, provision of potable water, etc. Consequently, the country's economic and social development depends on the amount of energy consumed by the country at a particular instant of time (Sesan 2008; Akorede et al. 2017).

Renewable energy sources have unique characteristics which influence how and where they are used. Globally in 2012, about 19% of total energy consumption came from renewables, with 9% coming from traditional biomass like fuel wood, and 10% from modern renewables such as biomass for heat production and vehicle fuel, geothermal, biofuel, solar, wind and hydropower. The share of renewables in electricity generation at the end of 2015 was about 23.7 % with 16.6% coming from hydropower, 3.7% from wind and 3.4% from other renewables (Scarlat et al, 2015).

Nigeria lies within latitudes 4.269 N and 13.883 N, and longitude 2.715 E and 14.652 E and is richly blessed with an abundance of both renewable and nonrenewable (conventional) energy resources (Augustine & Nnabuchi, 2009; Shaaban & Petinrin, 2014). The renewable energy resources, which are significant, include large and small hydroelectric power resources, solar energy, biomass, wind, potential for hydrogen utilization and development of geothermal and ocean energy (Nwulu & Agboola, 2011). These resources provide her with great capacity to develop an effective national energy plan. Despite these and as noted by Okoro et al. (2007), about 90% of the country's economy is dependent on crude oil. Nigeria is yet to exploit her huge available renewable energy potentials with less

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environmental and climatic impacts (Igbinovia, 2018). A great challenge facing Nigeria is having access to clean energy services despite the abundant renewable energy resources. In fact, one of the greatest economic and developmental challenges facing Nigeria as a nation is the issue of generating sufficient electricity both for industrial and home usage. According to Proshare Ecosystem (2018), in 2017 Nigeria's installed electricity capacity was 12,522MW, while the demand was 98,000MW. However, the actual output was about 3,800MW, resulting in a huge demand shortfall. As a result of this wide gap between demand and output, only 45% of Nigeria's population has access to electricity. This is as a result of so many reasons one of which is the poor maintenance of most of the power grid facilities. Nigeria's power sector retains high energy losses, between 30% and 35%, from generation to billing. This is significantly high as compared with the US, where power losses across lines usually come to less than 7%, even across long distances (Ikeme & Ebohon, 2006). This has resulted in difficulties in provision of crucial services such as clean water, sanitation and healthcare, reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunications as these are dependent on energy generation and power supply. Iwayemi (2008) and Akinwale et al. (2015), have established that there is a strong relationship between the level of poverty and access to energy. According to Nigeria Bureau of Statistics (2016), in Nigeria, 60% to 70% of the population did not have access to regular supply of electricity, with more than 60% of the Nigerians living below the poverty line.

THE PROBLEM

Sustainable living is a way of living such that the consumption of the earth's natural resources are conserved. It describes a lifestyle that attempts to reduce and properly manage an individual's or a society's usage of the earth's natural resources (which includes renewable energy resources). However, this description does not fit the general attitude of the life of an average Nigerian towards renewable energy resources. This could be due to the abundance of the conventional energy sources and also due to the fact that their supply chains were already well established long before the global emphasis on renewable became ramped up. Also people have come to believe that the fossil fuels will always be there. Consequently, they do not ultimately believe they will finish someday. There is a blind eye to the environmental effects of consumption of these fossil-based resources. Pollution of the environment (air, soil, water, noise pollution, obstruction of vision by smoking vehicles) are rife due to the usage of these 'dirty' energy resources. These lead to poor relationship with the existing infrastructure which in turn affects the lives of the populace. The prevailing situation in Nigeria is characterized by overloaded lines and transformers, poor quality of power supply, polluted air from power generating sets and insufficient reliability of power supply thus contributing to frequent outages (Ferrero, 2018). In response to these reliability concerns, Nigerians have turned to alternative sources for their power supply including the use of simple candles and hurricane lamps for lighting; electric power generators that run on fuels like diesel and petroleum are used for other power requirements. For heating and cooking, firewood and charcoal are popular. Nigerians spend more on self-power generation than what they spend on grid power. The popular thing is to buy expensive diesel generators. In 2009, an estimated 60 million Nigerians owned electricity-producing generating sets (Nwachukwu, 2010). By 2016, this number rose to 100 million based on the data from the Manufacturers Association of Nigeria (Odutola, 2017). Over 50 million homes spent a minimum of N30, 000 a month ($83/month) on fuel for their generators (Ferrero, 2018). In the same year, the Nigerian government ministries spent approximately N55.4 billion ($154 million) on fuel. The majority of the N5.5 trillion ($15.2 billion) spent on fuels in 2016 came from the residential and private sectors (Odutola, 2017; Ferrero, 2018). These values signify a huge quantity of fossil fuel burnt with the exhaust gases pumped into the atmosphere. This rate of fuel combustion has devastating effects on the environment, health of the population and the fossil fuel deposit in the ground. The estimates have it that going by the present rate of extraction, Nigeria's fossil fuels will be depleted to an uneconomical level by the year 2050 (Shaaban and Petinrin, 2014).

Nigeria imports more than 70% of its petroleum product requirements (Augustine & Nnabuchi, 2009; Asu, 2019). Nigeria's heavy dependency on fossil fuel has a far reaching environmental and health implications. For instance, according to Iyayi (2006), a major means through which greenhouse gases (GHGs) are emitted into the atmosphere is the practice of gas flaring by oil companies operating in the country. Nigeria is one of the highest producers of GHG emissions in Africa. Carbon dioxide (CO_2) emissions in the country are among the highest in the world. Some 45.8 billion kW of heat are discharged into the atmosphere of the Niger Delta, Nigeria from flaring 1.8 billion ft^3 of gas every day. Gas flaring has increased the temperature and made some areas to become inconvenient to live in. A total of about 125.5 million m^3 of gas were produced in the Niger Delta between 1970 and 1986, in which 102.3 million m^3 were flared while only 2.6 million m^3 was used as fuel by oil producing companies, and about 14.6 million m^3 were sold to other consumers (Awosika, 1995). The gas flaring is still on as we speak (Giwa et al, 2019). Overdependence on the burning of fossil fuel can be obviated by the use of renewable energy sources. Moreover, the flared gases can be converted to methanol and used as fuel for both industrial and domestic purposes. Environmental degradation, unstable oil prices in the international market, global warming, and the social crisis in the Niger Delta area, (where the bulk of Nigeria's crude oil is extracted), have further made the choice of renewable energy inevitable.

Essentially, the major energy-consuming activities in Nigerian households are cooking, lighting and use of electrical appliances. Based on estimates carried out, cooking accounts for about 91% of household energy consumption, lighting uses up 6% and the remaining 3% goes to the use of basic electrical appliances such as television and pressing iron (Sesan, 2008). Thus, the need for a more steady, healthy and environment friendly

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alternative source of energy such as the renewable energy becomes unavoidably imperative.

The Nigeria's reserve for large hydropower is estimated at 11,250 MW and 3,500 MW for small hydropower. Nigeria has a reserve of 11 million hectares of forest and woodland and 72 million hectares of agricultural and waste land. Based on the available statistics, Nigeria produces about 227,500 tonnes of fresh animal wastes daily. If fully utilized, this quantity is equivalent to 6.8 million m^3 of biogas production every day (Oyedepo, 2012a).

Chineke and Igwiro (2008) noted that Nigeria receives abundant solar energy that can be usefully harnessed with an annual average daily solar radiation of about 5.25 kWh/m^2/day. This varies between 3.5 kWh/m^2/day at the coastal areas and 7 kWh/m^2/day at the northern boundary. The average amount of sunshine hours all over the country is estimated to be about 6.5 h. This gives an average annual solar energy intensity of 1,934.5 kWh/m^2/year. Thus, over the course of a year, an average of 6,372,613 PJ/year (approximately 1,770 TW h/year) of solar energy falls on the entire land area of Nigeria".

With this background established, the question is: what has been happening over these years with respect to renewable energy? Over the years, calls have been made advocating for more usage of the renewable resources (Mgbemene 2010, Proshare Ecosystem 2018). The calls are in agreement with the requirements by the global Sustainable Development Goals (SDG) 7. As outlined by SDG 7 Technical Advisory Group (2019), three of the objectives of the Advancing SDG 7 implementation are to:

i. Close the electricity access gap by establishing detailed plans of action nationally, regionally and globally to create cross-border grid connections, on-grid renewable energy solutions and decentralized options.
ii. Accelerate the pace of transition towards renewable energy.
iii. Harness the potential of decentralized renewable energy solutions.

As it may be, there does not seem to be an appreciable effort towards adopting the usage. There does not seem to be an evaluation of the effects on our health. The aim of this paper therefore is to review the level of usage of renewable resources in Nigeria, its relationship to health and sustainable development in order to understand how the Nigerian populace has fared. This write-up will look at the status of things thus far by reviewing the calls for increased exploitation of the renewables, looking at the suggestions and recommendations made, and then join in advocating for the wide spread use of renewable energy resources.

REVIEW OF LITERATURE ON RENEWABLE ENERGY IN NIGERIA

Over the years, several authors have written on the use of renewable energy in Nigeria. Some of these studies are reviewed below:

Akinbami (2001) as far back as then had analyzed the renewable energy resources and technologies in Nigeria. The analyses revealed and discussed some barriers that exist to the development and penetration of renewable energy resources for electricity production in Nigeria. He then presented some possible strategies to overcome them. He recommended that intensive efforts and realistic approach towards energy supply system in the country should be adopted in order to adequately exploit renewable energy resources and technologies for economic growth and development. Collier, et al (2008) in their own paper noted that Nigeria must plan a response to global shift to clean energy. They went further to say that dependence on oil presents a threat to the national growth. They suggested that Nigeria should make a strong commitment to the development of renewable energy usage.

Ajayi (2009) noted that Nigeria sits in the midst of enormous potential for wind harvest for power generation. The far northern states, the mountainous regions and different places of the central and south-eastern states were identified as good areas for wind harvest together with the offshore areas spanning from Lagos through Ondo, Ogun, Cross Rivers to Rivers states along the Atlantic Ocean in the south. Despite this great potential and huge prospect, the country was found to still suffer from serious energy crises due to her over dependence on hydropower which also is susceptible to seasonal variation in the amount of water levels at dams. There was yet to be a committed wind energy project for power generation on-going in the country. Shaad and Wilson (2009) stated that energy poverty cannot be addressed in isolation from other development challenges, including overall poverty alleviation, clean water, agricultural development, and provision of education and health services. While focusing on Nigeria, they explored some of the ways that international oil and gas companies could tackle energy poverty in the regions in which they operate. They described a number of initiatives relating to both renewable energy and gas utilization in Nigeria, which are implemented by the oil and gas companies and other actors, including donors, government and nongovernmental organizations (NGOs). The research showed that oil companies did not yet fully appreciate the opportunities to address energy poverty in a substantial way. They then suggested three levels at which the oil and gas companies can engage in tackling energy poverty.

Uduma and Arciszewski (2010) proposed the use of sustainable energy systems based on solar and biomass technologies to provide solutions to utility challenges in Nigeria and acute water shortage both in rural and urban areas of that country. They highlighted that despite the fact that Nigeria is oil-rich there was abject poverty in rural and urban communities as well as the erosion of social order and threats to citizen and their property due to poor energy resources management. They then proposed the adaptation of two emerging technologies for building sustainable energy systems and also, the development of decentralized and sustainable energy sources as catalyst for much-needed social infrastructure development. Nnaji (2010) et al reported that the energy industry in Nigeria faced numerous challenges ranging from political, cultural and socio-economic problems. These challenges hampered the full development and utilization of these resources for poverty alleviation and sustainable development. They reviewed those prospects and challenges of integrating the mature and

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emerging renewable energy resources for poverty reduction and sustainable development in Nigeria and called for an improved energy conservation and development policy. Ohunakin 2010 examined and discussed the perspectives of energy utilization and renewable energy options in Nigeria from the standpoint of sustainable development. He concluded that full exploitation and promotion of renewable energy would provide a most efficient and effective means of achieving sustainable energy development in Nigeria.

Oyebamiji and Kigbara. (2011) opined that awareness should be created to enhance the acceptability of renewal energy through a strong comparative analysis of its benefits with other energy types. Contributing to the discourse, Newsom (2012a) stated that renewable energy has the potential of providing reliable night-time lighting for households, for refrigeration, and affordable power for businesses and that these would change many lives of Nigerians. However government policies would need to change in favour of renewable energy for solar power, hydropower and wind energy to be made available on a significant scale. They went further to advocate that affordable loans should be made available to finance development and market growth for a range of installations, including solar thermal power systems. Government and non-government organizations must implement a strategy to increase among individual consumers, business people and policymakers about the benefits of renewable energy. Newsom (2012b), stated that renewable energy has considerable potential in Nigeria, and could bridge the major energy gaps in rural areas however, that finance for renewable energy remains a huge issue. He went further to state that capital, market development and reliability are still needed to be linked by some key steps which could bring swift changes to that sector. Wide-ranging changes are needed for Nigeria to realize its renewable-energy potential. These changes require application together, and with adequate resources. He then presented key recommendations that reflect the critical need for a holistic approach to the changes.

Mohammed et al (2013) reviewed the renewable energy resources for distributed power generation in Nigeria. They evaluated the potentials of four major renewable energy resources in Nigeria and their level of usage and concluded that renewable energy resources in the county were underexploited. Omolola (2013) while noting that Sustainable Environmental Management was far from being achieved in Nigeria, presented an overview of the factors which worked against the achievement of Sustainable Environmental Management in. He stated that the Nigerian environment still degraded due to anthropogenic activities. He suggested that the country could only be sustainably developed if attention was paid to environmental sanitation and conservation. He however stated that poor funding, poor environmental management (seen as the responsibility of only the government) and non-inclusion of environmental management in national development plan were hindrances to the sustainable development. The author then suggested some possible sources for obtaining sustainable funding to alleviate the situation.

Adejumo and Adejumo (2014) carried out their study with a view to enhancing the understanding about the analytical content of sustainable development. They tried to clarify the concept of sustainable development and to present its necessity. They attempted to address the key developmental areas that required sustainability in Nigeria. Another study done by Ezugwu (2015) pointed out that due to the danger posed to the environment by fossil fuels; the world is shifting towards low carbon energy to be powered by new energy sources. The study further stated that it was regrettable that Nigeria, with abundance of renewable energy resources, was yet to exploit these huge available energy potentials with less environmental and climatic impacts. This shows that as at 2015, Nigeria was yet to embrace renewable usage. Okedu et al. (2015) discussed the various renewable energy sources in Nigeria along with their potentials with reference to the established master plan of the Energy Commission of Nigeria. They highlighted some of the challenges facing renewable energy development and the implementation and also emphasized the various opportunities provide by the usage of renewable energy.

Akuru et al. (2017) tried to highlight the different sources of renewable energy which were critical to solving the problem of electricity generation in Nigeria. They were positive that stable and cost effective electricity can be realized in Nigeria if other forms of electricity energy resources available in the country were considered. They presented that a deliberate transition from conventional sources of electricity energy to renewable and environmental friendly sources was critical for national development. They pointed out that it seemed however, that the Nigerian government was backsliding in adopting renewable energy technologies. Writing on the need to explore the potentials of renewable energy resources, Akinwale and Ogundari (2017) examined the renewable energy resources and their utilization to achieve sustainable development in Nigeria. According to the study, most of the respondents perceived that the level of public awareness and publicity by the government on renewable energy adoption was still relatively low. Majority of the respondents were not concerned about reduction of greenhouse gas emissions. Only 20% were motivated to use renewable energy due to environmental and health factors while more than 50% were motivated to use to renewable energy due to economic factors. Akorede, et al. (2017) stated that petroleum met over 80% of the Nigeria's consumption of primary energy. That called for a serious concern due to the overdependence on fossil fuels derived from petroleum for local consumption requirements. The consequences include the depletion of the resources and the negative impact on the environment with its effects on human health (Matthew et al., 2018). Akorede, et al. (2017) showed that Nigeria will overcome her present energy crisis if she explores the abundant renewable energy resources in the country.

Forbes (2019) reported that as at 2019, Nigeria still relied heavily on the use of fossil fuels. However, Ekechukwu (2019) in his inaugural lecture presented that the renewable energy based systems appear to be the most viable alternatives in Nigeria given the fact that in the rural areas, grid-connected electricity and supplies of other non-

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renewable energy sources were either unavailable, unreliable or too expensive. He went on to say that significant use of renewable energy in Nigeria has been limited but that the potential for the domestic, commercial and industrial application of renewable energy were very large and unexploited.

While the government is working to increase electrification and renewable energy generation, there are also opportunities for renewable energy at the individual level. Some others are making suggestions as to the improvement of the critical energy situation. Some of the proposals are here presented. Eleri et al. 2012 pointed out the failure of the national energy policy. They stated that "contrary to the expectations of the National Energy Policy, deepening poverty has forced a reversal in the transition to more modern and efficient energy forms. Today, more Nigerians are climbing down the energy ladder – moving from electricity, gas and kerosene to traditional use of wood in open fires." In other words, Nigeria was de-industrializing. They attributed the de-industrialization to poor access to electric power. Oyedepo (2012b) wrote that a crucial enabling condition for achieving sustainable development was access to energy. He went further to write that prudent energy policies and research could play an important role in steering Nigeria onto more sustainable energy development paths. By reducing indoor and outdoor pollution and remediating environmental degradation, living standards could be improved. He then examined the factors that needed to be considered and addressed appropriately in order to move Nigeria towards energy sustainability.

Ajayi and Ajayi (2013) assessed the various policy issues of sustainable energy development in Nigeria basically focusing on discussing and analyzing some of the laws of the federation as they related to the development of renewable energy in Nigeria. Among their findings were some policy challenges to promote renewable energy technologies which include weak government motivation, lack of economic incentives, multiple taxations, and non-existent favorable customs and excise duty act. They proposed some legal reforms which may aid the promotion of renewable energy development in Nigeria and make the nation's energy policy robust.

Oluniyi (2014) stated that the activities of man had always affected the natural environment. Over utilization of the natural resources had resulted to conflicts between men and environment and between man and man with the resultant hampering of sustainable development. Nigeria needed to pursue different paths towards a variety of sustainable development options as regards the available natural resources. In order to achieve that the author suggested that different policy mixes, which would incorporate incorporating fiscal, regulating and research and development efforts, should be developed. Shaaban and Petinrin (2014) presented a review of renewable energy potentials in Nigeria. They looked at the extent of renewable energy resources and the existing government policies and proposed various polices, that could possibly incentivize the realization of wider renewable energy applications in rural Nigeria. They discussed the challenges and future prospects of renewable energy and concluded that dissemination of decentralized renewable energy resources would enhance Nigeria's energy and economic prospects for potential global investment and improve the wellbeing of rural Nigerian communities.

Ejumudo (2015) stated that efficient and effective natural resource management were central to sustainable development. The resource management must cover economic, social and environmental components and should require societies to pursue growth paths that would generate optimal flow of income built on the twin principles of justice and equity. He suggested that in Nigeria, an integrated and inter-disciplinary policy planning and management which transcend the legal, political, environmental, economic and ethical boundaries was required to engender sustainable development. In his study, he examined the issue of sustainable development in Nigeria and contended that policy gaps and disconnect and the ensuing action dilemma had the capability of constraining the actualization of sustainable development efforts which could lead to environmental crisis. Consequently, the study recommended an inter-disciplinary policy approach, action programme and governmental/private sector collaboration for sustainable development.

Aliyu et al. (2015) presented that as at 2015, there was no comprehensive review of renewable energy development in Nigeria. They aimed to fill that gap by focusing on the status and future prospects of renewable energy in Nigeria. They also aimed at identifying the key challenges confronting full-scale renewable energy development in the country. They then discussed the existing government policies and legislations, and proposed others that could help speed up the adoption of renewable energy in Nigeria. Emodi and Boo (2015) suggested that effective energy policy options which could adjust to changing circumstances should be instigated in Nigeria in order to achieve sustainable clean modern energy. They presented that the energy situation in Nigeria could be improved by the provision of adequate energy policy options designed to augment the existing energy policies. Thus their study critically reviewed the status of energy resources in Nigeria as well as the existing associated policies. They then proposed some new policies which they believed could improve the sustainable development of Nigeria's energy resources. They then prioritized them based on their likelihood of success in short, medium and long term.

Norbert (2016) analyzed the barriers militating against sustainable energy development in Nigeria. They presented some of the barriers as cost and pricing, legal and regulatory and market performance barriers. He concluded that in order to ensure a secured sustainable energy future for Nigeria some key policies that could assist in addressing some of the identified barriers must be addressed. He highlighted them.

Mohammed et al. (2017) presented the existing renewable energy technologies in the Nigeria. They based their study on suggestions on how to pursue some impending socio-political, technological, investment policy and legislative issues for effective renewable energy development in the country. They then made some recommendations which were hoped to also induce the development of renewable and sustainable energy systems which would be based on

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autonomous energy systems and micro grid technologies. They considered a variety of energy technologies for solar power generation, biomass and bioenergy, wind energy, hydropower generation and the combined generation systems using hybrid energy mechanism and based their recommendations on them. Zarma et al (2017), examined the advantages of using solar photovoltaic electricity over other nonrenewable energy sources. They presented the role of solar power in minimizing rural-urban migration. They subsequently, reviewed the national energy policies in Nigeria and concluded that the policies failed to deliver specific targets that are both measurable, predictable and achievable. They then reviewed the utilization level of solar energy in Nigeria and presented their own views on why solar PV projects failed in Nigeria.

GOVERNMENTAL POLICIES AND PROGRAMMES TOWARDS THE DEVELOPMENT AND IMPROVEMENT OF RENEWABLE ENERGY IN NIGERIA

Along with the advocacy have been proposals towards the development and improvement of renewable energy in Nigeria. The government has not been oblivious of the advocacies. Thus the Energy Commission of Nigeria (ECN) was created in 1988 as an agency for the development and promotion of renewable energy technologies in Nigeria The mandate includes strategic energy planning, policy coordination and performance monitoring for the entire energy sector. Furthermore, laying down guidelines for the utilization of energy types for specific purposes and developing recommendations on the exploitation of new sources of energy. Renewable energy is therefore a component of its mandate (Iloeje, 2002). The key elements in the national policy position on the development and utilization of renewable energy and its technologies are as follows: to develop, promote and harness the renewable energy resources of Nigeria and incorporate all viable ones in the national energy mix; to promote decentralized energy supply, especially in rural areas, based on renewable energy resources; to deemphasize and discourage the use of wood as a fuel; to promote efficient methods in the use of biomass energy resources; to keep abreast of the international development in renewable energy technologies and applications (Ikuponisi, 2004). In 2005, the Energy Commission of Nigeria developed the Renewable Energy Master Plan (REMP) and in 2006 put it into action. The REMP suggests ideas for renewable energy policies, as well as possible technologies that can be used to fulfill their goals. However, it needed to be redrafted.

According to the Ferrero (2018) and GET.invest (2019), the Federal Ministry of Environment in 2011 unveiled the redrafted Renewable Energy Master Plan (REMP) which contained the installed capacity targets for specific renewable energies. The REMP aimed at improving access to electricity with a goal to increase to 75% access to electricity by 2025. In 2016 the government set a goal for generation 2 GW of power from renewables like biomass, small hydro, wind, and solar by 2020. The idea was to tap into Nigeria's large renewable energy potential, increasing electricity generation in a sustainable way. The government established new regulations that distribution companies will be required to source at least half of their procurement from renewables.

THE INTERRELATIONSHIP BETWEEN RENEWABLE ENERGY, HEALTH AND SUSTAINABLE LIVING

According to GBD 2017 SDG Collaborators (2018), in presenting Goal 3 which is to "Ensure healthy lives and promote wellbeing for all at all ages", they noted that as at 2017, there was still a prevalence of household air pollution, and the existing datasets did not comprehensively measure the use of clean fuels and technology for heating and lighting across locations by the populace and how efficiently used when and where used.

According to The U.S. Environmental Protection Agency, (2018) an analysis carried out in the United States of America showed that electricity generation is a major source of creating greenhouse gases (GHGs) and air pollutants. They reported that during the refinement, processing, and transport of fossil fuels, GHGs are produced and pumped into the atmosphere and they contribute to the many environmental problems which harm human health. These environmental problems include the reduction of the air quality and climate change. Matthew et al. (2018) studied the long term effect of burning fossil fuels on health outcomes in Nigeria. They specifically looked at the emissions of GHGs and their effects on health using data obtained from 1985-2016.

The air quality is lowered with the introduction of pollutants such as particulate matter (PM), ground-level ozone (O_3), carbon monoxide (CO), SO_2, NO_x and lead (Pb) and these can be harmful to human health. Using fossil fuels to generate electricity increases levels of these pollutants in the atmosphere. The ozone, when inhaled can lead to adverse health situations like coughing, throat irritation, difficulty in breathing, lungs damage, and aggravate asthma. Also many respiratory and cardiovascular illnesses and death have been linked to inhalation of $PM_{2.5}$. Other serious ailments and health effects such as cancer, reproductive effects or birth defects, or adverse environmental effects have been linked to hazardous air pollutants (HAPs), also known as toxic air pollutants or air toxics. During fossil fuel-based electricity generation, mercury is emitted as one of the by-products. Mercury and most of its compounds are extremely toxic and must be handled with utmost care. It has be found that high level of mercury exposure can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. Thus it is important to reduce emissions of mercury and other HAPs.

The GHGs such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), and sulfur hexafluoride (SF_6) contribute to climate change when excess of them are pumped into the atmosphere. At natural levels, they trap heat in the atmosphere that would otherwise have escaped to space thereby keeping the earth warm. Anthropogenic activities such as electricity generation and industrialization have heightened climate change giving rise to environmental conditions that can have far reaching effects on human health and existence (Mgbemene 2016; The U.S. Environmental Protection Agency, 2018). Extreme

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weather events like heat, flooding, storms and hurricanes lead to spread of diseases and death. Changes in the ecosystem facilitate spread of infectious diseases, changes in agricultural production and availability of clean water. These make sustainable living very difficult.

Energy efficiency and renewable energy that immediately avoid or reduce GHGs can create long-lasting and positive benefits for the atmosphere, human health and improved livelihood while also achieving their short term benefits. Matthew et al. (2018) recommended that in Nigeria, environmental policies should be formulated towards the mitigation of the impact of emissions of CO_2. The policies should be directed towards improving the agricultural and industrial sector in order to create environments that will not constitute hazards to human health.

GENDER ISSUES AND RENEWABLE ENERGY

Without the involvement of women, renewable energy projects risked being inappropriate and failing. Cecelski (2000) analysed the role of women in sustainable energy development. She stated that renewable energy development addressed women's needs in these four ways: (1) The biomass cooking crisis: fuel scarcity, health and safety. (2) The human energy crisis: women's invisible time and effort. (3) Energy for microenterprises: livelihoods and income. (4) Energy for the modern sector: fuel substitution, efficiency and transport.

She expatiated on the importance of women in the renewable energy sector as. According to her, manufacturers of renewable energy and energy policy makers who do not pay attention to women's needs will be missing a huge potential market and failing to make use of a powerful force for renewable energy development. Also energy researchers that tend to leave women out may end up not understanding a large part of energy consumption and production. Finally she noted that donors who do not support gender-sensitive energy assistance are most likely to be overlooking one of their primary target groups.

Abdullahi (2017) analyzed the role of women in curbing this energy poverty in Nigeria. He disagreed with Cecelski (2000) stating that women were a special interest group in the usage of renewable energy but concurred that they were the mainstream users and often producers of energy. According to IRENA (2018), all over the world, women face the largest burden of not having access to modern energy. They are subjected to having to walk long distances in order to collect fire wood, and subsequently, spend their days ingesting harmful air pollution from kerosene and wood fires as they cook, care and provide for their families. This is also the situation in Nigeria.

Aina and Odebiyi (1998) while writing on the domestic energy crisis in Nigeria, presented the detrimental effects which the situation has on the women and family welfare. They also pointed out that the living standards for a majority of Nigerians had plummeted due to the energy crisis and with it came profound implications for the entire nation. They proffered that an important step in finding lasting solutions to household energy problems might be a better understanding of the household sector such as, understanding the household consumption pattern and the impact of fuel shortages on livelihoods. They argued that "no adequate energy planning for the household sector can be achieved without adequate understanding of intra-household dynamics and a proper understanding of factors guiding demand and supply of technology and different energy carriers in the household sector." They suggested that accessibility of the various fuels, affordability of equipment/fuel, and other socio-cultural factors which guide people's fuel choice should be looked at. They recommended that in order to plan for the future that it was important to document the negative effects of the domestic energy crisis as it was. They recommended that the "central role women play in sourcing fuels for household use, and the general impact of the crisis on family welfare and on women as reproducers and producers should be a principal focus."

Nelson and Kuriakose (2017) explained why gender mattered in renewable energy projects. She stated that discriminatory social norms and practices generally limit women's opportunities. Non affordability reduces the ability for the women to have access to renewable energy. She stated that "energy sector investments can contribute direct economic benefits to women through formal sector employment and by providing them with opportunities to improve their livelihoods through small-scale enterprises, skills development, and training. Different renewable energy sub-sectors offer benefits that can be leveraged to improve the livelihoods, employment opportunities, and lives of women, their families, and communities." Thus the enabling environment must be created in order to achieve renewable energy benefits that can improve women's health and families' overall quality of life and women must be involved in decision-making in order for energy efficiency incentives and energy use alternatives to be effective. In that regard, the Rural Women Energy Security (RUWES) initiative was launched in 2013 by the Ministry of Environment. The initiative was "targeted towards the under-served rural woman who is usually off grid, energy poor and has the highest incidence of health related issues from harmful energy practices".

However, some women have devoted their ingenuity in providing their localities with a sustainable and affordable source of energy as well as empowering other women through access to income-generation by the usage of renewable energy resources. Some of them who are making great impact in the renewable energy sector are, as presented by Onehi and Sunday (2108), include Mrs. Damilola Ogunbiyi, a Managing Director of the Rural Electrification Agency (REA); Heather Onoh, the Managing Director/CEO of Smarter Grid International (SGI) Limited; Habiba Ali, Managing Director of Sosai Renewable Energy Company, Kaduna State Nigeria and Hannah Kabir, Managing Director of Creeds Energy. Other are Ify Malo, the CEO of Clean Tech Hub and the Energy Innovation Centre, Abuja; Rahila Thomas, Country Director of Energy Market and Regulatory Consultants (EMRC) and Mrs. Agatha Nnaji, the Managing Director of Geometric Power Ltd. They have been creating the enabling environment for other women to delve into that sector. These women have promoted the renewable energy sector consequently, women should be brought in at the design stages of the renewable energy

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systems because they mostly deploy the technologies in the care and nurture of the family.

OVERCOMING THE CHALLENGES FACING THE USE OF RENEWABLE ENERGY IN NIGERIA

A review of the various policies and strategies promoting renewable energy development around the world with Nigeria as a case study was done by Emodi and Ebele (2016). In trying to analyze the barriers to the development of renewable energy in Nigeria the authors identified some factors that could have long positive impact on the renewable energy development in Nigeria. They stated the factors as financial investment, power purchase agreement, legislation and regulation, politics, policy and strategies, technology and innovation, environmental support program and public awareness.

First and foremost, in order to get it right in the development of the renewable energy sector, the legislation and regulations must be properly put in place. Efurumibe (2013) stated that key elements of the overall policy framework needed to promote renewable energy technologies must include clear rules, legislation, roles and responsibilities of various stakeholders along every stage of the energy flow from supply to end-use. Urgent attention must be given to such policy, legal and institutional frameworks since they are very crucial to the development of renewable energy programme. As an example of legislative effect, in 1999 in USA, the Texas State Legislators established a 'Renewable Portfolio Standard' and set a goal of 2,000 MW of renewable electricity generation by 2009. By 2006, that goal was exceeded by wind generation alone and the legislature reset the standard to 5,880 MW by 2015 and 10,000 MW by 2025. By the end of 2007, Texas had about 4,200 MW of installed wind generation capacity in service and another 2,600 MW lined up to join the grid shortly after (Testa, 2008). This clearly shows that the legislature can influence a positive change towards renewable energy programmes. Thus functional and responsive legislation, fiscal and regulatory instruments are very significant to achieving adequate energy supply the renewable energy sector. Coupled with the recommendations by other authors, when implemented, will no doubt bring about more stable power supply that would attract domestic and international investments (Chineke et al. 2015).

Secondly, the fiscal policies towards the renewables need to be made favorable and should include fiscal support and tax incentives. These can address financial barriers to the development of renewables. Fiscal support can come in various forms which may be from tax exemptions on imported renewable energy equipment, to tax holidays on generation incomes (Painuly, 2001). Some tax incentive policies include: import duty/excise duty concession, VAT concession, tax credit, production tax concession, and tax holiday on generation income. In some countries like Denmark and USA environmental taxes have proved to be an effective fiscal support. Lockhart (1997) stated that in the United States, environmental taxation was widely accepted as a policy tool for promoting environmental goals. Tax subsidies, including income tax credits and property tax exemptions, were viable options for creating incentives to meet environmental goals.

Denmark was one of the first European Union countries to implement an environmental tax scheme. The energy consumers were charged a CO_2 tax and some of the revenue generated went to generators of electricity from renewable energy (Fouquet & Johansson, 2005). The same approach was adopted by Sweden. This approach made energy from fossil fuel such as coal very expensive, thus discouraging further investments into fossil fuel energy (Joelsson, 2011). This strategy can as well be adopted in Nigeria in order to address the challenges of renewable energy development. The reduction of complete exemption on tax can stimulate investment private sector investors into investing in renewables. Different forms of this exemption have been successfully tried out in Sweden, Germany, Ireland, Netherlands and Spain (Rathmann et al., 2009; Emodi and Ebele, 2016).The case was the same in Greece (Menanteau, 2007). Contrary to the European cases, in Nigeria, the high tax rate imposed on renewable energy private investors and equipment has a direct link to the slow development and output level of renewable energy sector.

The issue of public awareness of the renewable energy sector is one that needs to be addressed urgently. All the analysis and recommendations made without bring the existence and the potentials of that sector to the public knowledge will amount of a waste of time. The Nigerian public is grossly unaware of the potentials of renewable energy. In cases where there is the knowhow, it is often accompanied by a great bias as to its ability to solve the energy problem. A survey carried out by this author in a university environment showed surprisingly, that even educated people in Nigeria are unaware of the potentials of renewable energy as at 2019. When they get convinced about renewable energy, the immediate reaction to it is that it is very expensive apparently referring to the PV system. This on its own is erroneous because they do not consider the benefits of renewable on the short and long runs and the payback period after which it is virtually free of charges.

According to (Painuly, 2001), awareness of the opportunities offered by renewable energies and their technologies is low among public and private sectors in Nigeria. Sadly, this is still so in 2019. This lack of information and awareness creates a market gap that results in higher risk perception for potential renewable energy projects. There is till this general perception is that renewable energy technologies are not yet mature technologies, and is only suitable for the affluent, hence are only suited for niche markets. Consequently, it will require heavy subsidy from whoever with the interest and wherewithal to make it work (Oghogho, 2014). In order to help the situation the right information needs to be disseminated to those with the fiscal ability who intent to investor in that sector in order to promote renewable energy technology projects. Public confidence and acceptance of renewable energy technology should be made a priority. There is therefore an urgent need to raise the awareness of the general public and generate activities in the area. Social workers, community leaders, National Orientation Agency and other major stakeholders will need to be engaged for the

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dissemination of information on renewable energy resource availability, benefits and opportunities. This campaign is critical to the success of that sector.

Technology and innovation are also vital to the development of the renewable energy sector. The idea that the renewable energy technology is immature is erroneous. The technology has become competitive with fossil fuel technology in some areas. However due to the poor fiscal structure towards the renewables in Nigeria, the development of renewable energy requires support in all stages of research, demonstration and deployment so as to achieve a competitive local industry. In the developed nations, the renewable energy technologies have become popular and have been the subject of debates in the parliaments, the same cannot be said in many developing countries especially in Nigeria. The renewable energy technology is still being seen as a new technology. As such, it is still being treated with some skepticism leading to low investments in innovations towards its development. There is therefore the need for the Nigerian government to invest in research and development activities in renewable energy so as to enhance technological innovation. Private sector investment is also vital for the realization of technological innovation because the public sector funding is not be enough to increase the research and development activities in renewable energy.

Since the usage of renewable energy involves everyone, renewable energy projects could be described as socio-technological and multidisciplinary in nature. There is therefore the need for interdisciplinary collaborations. For the renewable energy project to be successful and productive in Nigeria, there is the need for a functional interdisciplinary approach to be established involving stakeholders such as social workers, renewable energy engineers/technicians and policy makers. This can have a direct effect on the successful outcome of renewable energy power-sector projects when proactively engaged via transparent and regular communications. Stakeholders have diverse professional experience, advice, concerns, and valuable input that can be harnessed and channeled toward developing and improving renewable energy sector (Efurumibe, 2013).

The earth's natural resources, especially fossil fuel resources are being depleted largely because of population explosion on earth and with it, more pressure is put on the remaining reserves. This leads to conflicts and ultimately to wars with the attendant killings. Social vices are on the increase partly because of competition for these resources. The cause of these could be traced to unsustainable lifestyles of the society. This is more evident in sub Saharan African countries and particularly here in Nigeria where the social lifestyles lend a hand to the careless and wasteful living. The result is that the scarce resources get further depleted while little efforts are made towards harnessing the renewable resources. Thus consumption of the fossil fuels and our poor lifestyles have a direct relationship with our level of good health (Owusu and Asumadu-Sarkodie, 2016).

Non-embracing of the renewables and the overdependence on petroleum are based on two social facts about Nigerians. Nigerians consider installation of renewable energy harvesting systems as too capital intensive and are not easily willing to spend on such a system despite the immediate results from it. This is based on social bias. Secondly, the ownership of power generating units showed some kind of affluence. This could be seen by the nickname given to a popular and common small unit of power generating set "I beta pass my neighbor". This name indicates that by owning a generating set, no matter how small, one was better than his neighbor who does not have any.

Social work as a profession has also embraced renewable energy and the exploration of other natural resources through its green social work specialty. As noted by Dominelli (2012), green social work is a form of holistic professional social work practice that focuses on the interdependencies amongst people, the social organization of relationships between people and the flora and fauna in their natural habitats and the interactions between socio-economic and physical environmental crises and interpersonal behaviours that undermine the well-being of human beings and planet earth. It seeks to tackle structural inequalities including the unequal distribution of power and resources. Green social work focuses on global interdependencies; and utilize limited natural resources including land, air, water and energy sources and minerals for the benefit of all rather than the privileged few.

The aim of green social work is to work for the reform of the socio-political and economic forces that have a deleterious impact upon the quality of life of poor and marginalized populations and secure the policy changes and social transformations necessary for enhancing the well-being of people and the planet today and in the future (Besthorn, 2012; Gray et al. 2013). In an interdisciplinary collaboration on renewable energy development, the engineers will have to create the needed structures and deliberate on the requirements for the successful execution of the project with policy makers who will provide the necessary financial and logistics support. Social workers and other related agencies such as the National Orientation Agency can sensitize the public on the need to embrace the benefits of renewable energy resources.

CONCLUSION

How Nigeria has fared in the renewable resources usage, health and sustainable living has been reviewed. The poor attitude to the environment which has a direct bearing on our health has been pointed out. These situations have been linked to the low level of awareness of the relationships between the use of renewable resources, health and sustainable living. This review has tried to look at the power challenges in Nigeria and the potentials of renewable energy as the possible alternative and solution to the problem.

Access to clean modern energy services is still an enormous challenge facing the Nigeria. She still relied heavily on the use of fossil fuels for its domestic energy needs and the culture of sustainable living had not really caught on. The public perception of renewable resources' capabilities and usage was that of doubt. Power generation was still hugely dependent on fossil fuels, recycling of waste materials for power generation, manure development, improvement of the environment, extraction reusable materials such as plastics and biodegradables were not being taken seriously. These had affected the public health, economic and agricultural

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growth and development. Businesses in the renewable energy area, which could have been creating jobs in the country, were consequently not developed. Biogas generation, water recycling and harvesting were yet to be seriously looked into. Clean cooking was not a seriously supported program.

Absolute development and utilization of renewable energy resources is very imperative at this point in time. To achieve this, all relevant stakeholders including policy makers, renewable energy experts, non-governmental organizations, social workers and other relevant agencies must come together and work collaboratively in order to accelerate an effective renewable energy structures. Based on the serious bias against renewables, it has therefore become necessary to create awareness about this situation and consistently educate the society about the benefits of usage of renewable resources and the ills of unsustainable living. This could be achieved by a combination of interdisciplinary ideas and principles.

Due to the link to social life, there is no doubt that the present power crisis afflicting Nigeria will persist unless the psyche of the people changes and the government diversifies the energy sources in domestic, commercial, and industrial sectors and adopts new available technologies to reduce energy wastages and to save cost. Energy is fundamental for socioeconomic development and poverty eradication the solution to this Nigerian problem is as much social as it is technological.

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