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Prospects and Constraints of Investment in Environmentally-Friendly Infrastructure in Western Nigeria

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By

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List of Acronyms

CFL	Compact Fluorescent Light
EFI	Environmentally-Friendly Infrastructure
GVE	Green Village Electricity
IEEE	Institute of Electrical and Electronics Engineers
LED	Light Emitting Diode
NESP	Nigerian Energy Support Programme
OER	Open Educational Resources
PV	Photovoltaic cell
REAP	Rural Energy Access Project
RUWES	Rural Women Energy Security
W	Watt (unit of energy)

Abstract

Peoples' perceptions and challenges with the use of environmentally-friendly infrastructure will change if sustainable investments are made. This paper examined awareness, acceptability, uses and constraints associated with the use of environmentally-friendly infrastructure (EFI) in rural western Nigeria. Primary data was generated from field survey of 160 households, conducted in Ekiti and Ondo states. Data was analysed, using descriptive statistics, likert scale, Chi-square and regression analysis. Results show that only about 23 percent of the respondents are fully using EFI like energy saving bulbs, while about 48 percent are partially using it.

Environmentally-friendly infrastructure used in public places include those in schools and community health centres and they are street lights and water boreholes. Over 72 percent of the respondents claim cost and financial problems as well as limited skills and presence of low quality /fake products, constitute major hindrances to the use of EFI technology. Factors that determine the use of EFI technologies include level of awareness of climate change, age, and income level. There is therefore the need to create more awareness on the use of EFI technologies.

Keywords: Prospects, constraints, infrastructure, energy, green

1.0 Introduction

Our environment is under threat by climate change, which is exacerbated by energy consumption pattern. Energy is invaluable, as it is used to drive the world's economic and social life; but the current trend of energy consumption cannot support sustainable development in the emergent era of climate change. The quest for good environment, cleaner and sustainable energy resources and usage has become reoccurring issues in world development. The achievement of the desired goal of using cleaner energy sources and good environment will essentially require increased investment and change of attitude, with respect to environmentally friendly infrastructure (EFI), which are green technologies and cleaner energy sources (Mkpado, 2013a). EFI include solar energy resources, such as solar panels and inverters, low-energy bulb (LED), as well as rechargeable appliances and wind energy systems. Green technologies among other things, include change in attitude regarding the use of resources. This involves the idea of reduce, re-use and recycling, which have become innovations in resource management.

Sustainable development cannot occur in a vacuum; it can be achieved through a good mix of financial and human resources. The human nature can be considered a complex phenomenon that needs to be handled in a unique way to avoid stifling initiatives. The level of awareness, skills and attitude of the people are to be taken into consideration, when making investments that will be driven by the people. Thus, sustainable and lucrative investments are determined by market demand; consumers with their taste usually direct the nature and magnitude of investment. Effective climate change adaptation and mitigation mainly depend on the nature of innovations, investment and practices on green economy (Igbokwe and Mkpado, 2011; Mkpado 2013b).

This paper seeks to examine factors affecting the demand of EFI products in Nigeria. EFI products, like energy–saving bulb, solar panels and inverters, energy-storage devices and bicycles, which are often in competitive markets, as the products are of different brands, standards, prices, efficiency and durability. What factors affect the demand and use of the afore-mentioned products in Nigeria?

Next are the issues of reduce, reuse and recycle, which are important practices and attitudes for green economy because these practices involve reduction in the carbon footprint. These approaches are particularly recommended for the use of water (domestic activities), cellophanes/plastics, as well as tins and others, which are very helpful in wastes management. What is the level of awareness and practices of these innovations?

1.1 Objectives

The objectives of the study are:

i. To examine the effects of age, income, educational qualification and gender on the use of EFI, such as energy-saving bulbs, solar panels and inverters, as well as assess the awareness of EFI technologies in rural Nigeria
ii. To investigate the constraints to the use of EFI in Nigeria.

The main research questions include the factors affecting the use of EFI innovations, the opportunities for environmentally-friendly investments in rural areas, as well as the constraints to the use of EFI in Nigeria.

The null Hypotheses guiding the research include:

i. Income does not affect the use of EFI technologies
ii. Educational qualification does not affect the use of EFI innovations
iii. There is no difference with respect to use of EFI technologies for private and commercial purposes

1.2 Significance of the Study

Africa is experiencing adverse effects of climate change and the consequences can increase over the years, as rising temperatures are predictable with weather variables. Changes to new innovations with respect to EFI, as well as behavioural changes with respect to reduce, reuse and recycle are inevitable for African societies. Sustainable development tends to start with the people at their present level and push them upwards, with good motivation for participation. The study will give insight into the peoples' capacity, behavioural changes and application of innovations in EFI. It will show the line of actions that will increase the use and

investments in EFI and will stimulate interests of respondents on innovations in EFI. The findings will provide policy makers recommendations on EFI practices in rural Africa, especially in Nigeria. The study will also provide other scholars with literature for expansion of the frontier of knowledge in the area of EFI innovations.

2.0 Literature review

Environmentally-friendly infrastructures are eco-friendly and are a subset of green technology. Environmentally-friendly investments in infrastructure are those investments that take cognizance of the carbon footprint and do not increase it; do not reduce the soil fertility and do not involve non-degradable materials. Investments in environmentally-friendly infrastructure may be in the areas of solar panels; energy-saving devices such as energy-saving bulbs, and energy-storage devices like inverters. This is also complemented by the fundamental practices of reduce, reuse, repair, refurbish and recycle to support efforts in keeping the environment healthy.

Development in environmentally-friendly infrastructure can lead to better technological innovations, which are likely to advance the economy of African continent. The objectives of investing in environmentally-friendly physical infrastructure are multi-faceted. Such facilities contribute to economic growth and are therefore closely co-related with development (Kessides, 1993). Topping the list is the use of solar energy via solar panel. Owing to very poor electricity supply in Nigeria, several dominant players in industrial sector, such as Michelin tyres and Dunlop tyres, have fled the country. This has serious implications for employment and fiscal revenues, which should have contributed to the wellbeing of the Nigerian people. Power generation with solar cells system has received great attention in research because it appears to be one of the possible solutions to the environmental problems (Wai et al., 2008). Climate change, largely driven by global warming, mainly refers to the persistent increase in atmospheric temperature, often associated with dryness. Climate change results from emission of carbon (IV) oxide and other greenhouse gases from fossil fuels, bush burning and other factors; it is driven by anthropogenic activities, as mankind engages in development activities and better life facilities. However, it is now apparent that mankind may witness disastrous consequences, if the current trends associated with fossil fuels consumption continues unabated. The quest for greener environment and secured future has reinforced and motivated the search for green technologies and renewable energy resources. (IPCC 2007; Igbokwe and Mkpado, 2010)

Africa and the rest of the World are developing environmentally-friendly infrastructural products, which are green technology products and which

people are advocating for their uses. Green and renewable energy would provide good opportunity to drastically reduce greenhouse gas emissions, pursue economic growth and enhance energy security for achieving sustainable development. Africa and other less developed economies are suffering the adverse effects of climate change, although they account for the least carbon (iv) oxide emissions because of low capacity to invest in greener technologies and adopt them (Igbokwe and Mkpado, 2010). And this trend may likely continue due to the poverty trap that exists in Africa.

Green energy technologies are components of environmentally-friendly infrastructure, which take cognizance of the carbon footprint; they do not reduce the soil fertility, and do not give rise to non-degradable materials. Green technologies and innovation can open new opportunities for skill acquisition, job and wealth creation, as human resources will be required to manage the new developing sub-sector. It can lead to increased production, as the energy resources, such as solar energy, can be more stable and efficiently used in tropical Africa (Wai, Wang and Lin, 2008; Kessides**,** 1993).

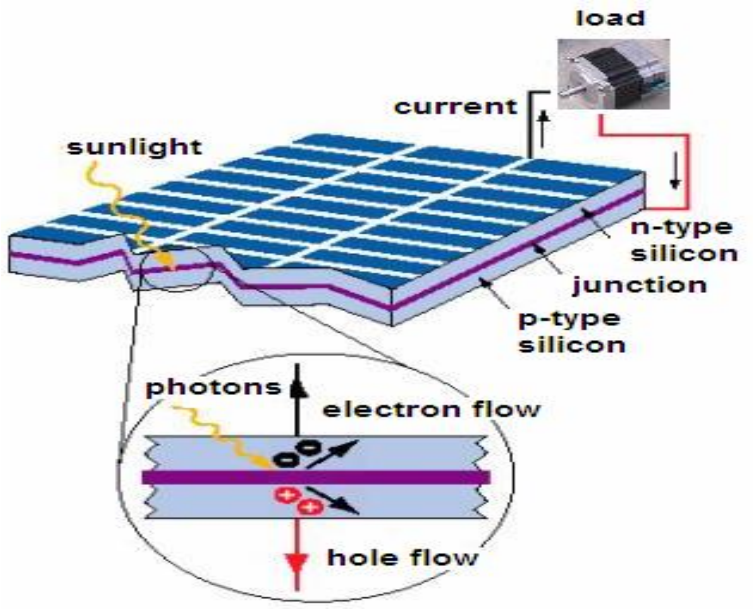

Figure 1 : A schematic diagram of the layers of a typical PV cell

Source: http://www.rise.org.au/info/Education/SAPS/sps003.html (2010)

Figure 2 : Energy-saving bulb

Source: http://eartheasy.com/live_energyeff_lighting.htm#led

2.1 The Poor Situation of Power Sources and Solar Energy Projects in Nigeria

Agbongiarhuoyi (2015), reported Dr Simon Bradshaw, as saying "Four out of five people without electricity live in rural areas that are often not connected to a centralised energy grid, so local, renewable energy solutions offer a much more affordable, practical and healthy solution. The country has a target in 2007 to produce 7% of its 2025 energy needs from renewable with solar and hydro as the major priority''. According to a report by Charles Opara-Ndudu, in Thisday Newspaper of 15th March 2015, Nigeria has the potential to exploit its abundant solar energy resources, considering its geographical location around the equatorial sun-belt. The country receives abundant sunshine throughout the year, ranging from 6.70kwh/m2/day in Borno State to roughly 4.06kwh/m2/d and 5.86kwh/m2/d in such locations as Calabar in Cross Rivers State.

Suleiman (2010) noted that in 2005, the Federal Government constituted a presidential committee to design a 25 year power development plan. The

report projected electricity demand profile for Nigeria as 15,000 MW; 30,000 MW ; and 19,000 MW in the short, medium and long-term, respectively, providing the basis to project a 10% economic growth scenario over the period in view. Based on this projection, the Energy Commission of Nigeria conducted a study, which indicated that renewable energy electricity is expected to contribute about 14% in the short term; 23% in the medium term; and 36% in the long term of the total energy and electricity supply, as stated by the National Energy Policy. The lapsing period of the short, medium and long-term are 2008, 2015 and 2030, respectively.

The Bank of Industry (BoI) Chief Executive was reported saying that Nigeria's current electricity situation had been unsatisfactory and put the total electricity supply on the national grid at less than 4,000MW, relative to the electricity demand, conservatively estimated at 40,000MW (Opara, 2015). For an African economy like Nigeria, with a population of more than 170 million people, this is grossly inadequate. Many Nigerians and Nigerian businesses that can afford it have resorted to electric generators, at a great expense. Kerosene lanterns, used largely by rural dwellers, adversely affect the environment, and are dangerous, untidy and dim, besides high cost of petroleum products. The unsteady supply of petroleum products needed to power these generators or lanterns has exposed the unreliability of using generators or lanterns, as a long-term alternative source of electricity. Not to mention the environmental/noise pollution associated with several generators in the city's neighbourhoods and factories (Opara, 2015).

Nigeria has recorded some milestones in the area of solar energy. The Bank of industry (BoI), in collaboration with United Nations, has established solar-powered home systems under the BoI/ United Nations Development Programme, which was expected to last for a minimum of 25years and started in 2013/2014 (IEEE, 2015). In 2013, the bank implemented a six kilowatts PV solar-powered rural mini-grid at Egbeke, Rivers State, and is currently implementing an 18KW PV solar mini-grid at the same location. It also implemented stand-alone PV solar-powered systems in communities in Lagos and Ogun states. The BoI further made a provision of long-term financing for the installation of off-grid solar-powered home systems in six communities, with an average of 200 homes each in a pilot phase, as part of its renewable energy partnership with the UNDP. The communities, selected are located in Anambra, Delta, Gombe, Kaduna, Niger and Osun states.

The facility will enable "each home to power three LED light bulbs, one electric fan, one radio/TV set and, of course, mobile phone charging. These are the basic energy needs of the average rural family, **(**Opara, 2005**).** The BoI wanted rural communities to take control of their energy generation and pay only for the energy used. The BoI medium-term vision of the scheme is to have 100,000 homes installed with solar-powered systems in the next five years, through a combination of micro-grid and stand-alone solar-powered home systems (Opara, 2015**).** This is .essentially a programme aimed at poverty alleviation and rural economic development.

RUWES (2015) noted that the Rural Energy Access Project (REAP) represents the lighting component of RUWES designed to address the need to source for and deploy alternative and sustainable, clean and renewable energy sources for lighting and heating purposes, which will impact positively on income, health and environment, as well as create sustainable livelihood for the rural poor and those most affected by the shortage of electricity and energy supply in the country. REAP is striving for reduction in our National Emission Factor (by using clean, energy efficient LED bulbs) and introducing Household Stand-alone Solar-powered kits to replace incandescent bulbs, single-wick kerosene and oil lanterns, as well as small generators in rural areas.

IEEE Smart Village programme is to support electricity projects in off-grid communities of Cameroon, Haiti, India, Kenya, Nigeria, South Sudan and Zambia, among others. IEEE (2015) noted that Nigeria, Green Village Electricity (GVE) Projects Limited, did receive a US$675,655.40 equity and debt investment from the country's Bank of Industry, and to further support the investment, IEEE Smart Village will provide GVE with US$65,535.20 of matching funds, as part of a seed-funding, program-supporting grant, bringing the total investment to US$741,190.60 (IEEE, 2015).

Eleri, Onuvae and Ugwu 2013 noted that **t**he SUNGAS project, which is funded by the European Union, is being implemented by the International Institute for Environment and Development (IIED); the Niger Delta Wetlands Centre (NDWC) and the Living Earth Foundation (LEF), with the aim to catalyse development of Nigeria's natural gas and renewable energy markets through innovation, demonstration, policy dialogue and advocacy. Small demonstration projects for both renewable and gas-to-power will show that community-based energy facilities are

technically viable, financially sustainable, and can ensure better access to modern energy services for rural communities.

Investments in clean energy facilities in Nigeria have been in large and small hydroelectricity generation, solar PV, biomass, bio-fuel, and wind energy. These can be used for domestic, agro-industrial purposes and health facilities. The agro-processing endeavours, such as flour grinding, oil expelling/extraction, crop drying and threshing; small-scale Industry, such as saw-milling, wool and cotton processing, stone crushing have been noted. Dayo, 2008; Usman, 2012; Huzi, 2014 observed that there were a number of projects to improve the life of the rural people, using green energy technologies in western Nigeria. Some of these projects include street lighting; improving education and health services, using environmentally-friendly infrastructure.

2.2 Possible Uses of Environmentally Friendly Infrastructure in Nigeria

Usman (2012) reported that villagers use solar energy for cooking, water heating, refrigeration, house lighting, domestic water pumping-distribution, ironing, television and radio powering. Green infrastructure is particularly useful for the agricultural economy, providing solar technology for drying, processing and storage of agricultural products, especially the perishable ones; water pumping and distribution for irrigation; flour grinding; threshing; oil expelling; crop drying and operation of various agricultural implements. Green infrastructure is also useful for commercial purposes. These include usage of solar energy in businesses, such as shops lightening, community banks, restaurants, stone crushing, saw milling, wool/cotton processing and local bakeries, especially mobile cell phones' battery charging business. The list can include cinema houses, powered with solar systems for watching sports events like football.

Domestic usage includes solar cookers, solar water heaters, lightening and refrigeration, electricity for refrigerators and deep freezers, in which vaccines and drugs can be safely stored, without losing their potencies, especially during immunization in remote areas. Solar Stills are designed to produce distilled water from brackish water and will be useful for hospitals,

industry and laboratories. When sized appropriately, they can provide for the needs of comprehensive health centres of semi-urban areas. Solar water heaters based on flat-plate collectors, with appropriate storage units can produce water at temperatures of up to 800 degrees centigrade, which will find applications in hospitals, hotels, industry, and private residences and can significantly reduce electricity bills. Water pumping can be demonstrated by the use of photovoltaic solar modules for pumping water from wells and boreholes, especially in rural areas for providing the water requirements of entire communities. Photovoltaic powered pumps can also be used for irrigation purposes (Usman 2012).

2.3 Some Constraints to EFI Development Finance, Poverty and High Initial Capital Outlay

Financial problems constitute a huge constraint to development of EFI/ green economy. In developing nations with very limited financial resources like Africa, green energy facilities, like solar panels, inverters and energy-saving bulbs, are more expensive than the traditional electricity generators and incandescent lamps. Due to higher initial cost of solar panel installation, even though on the long run it becomes cheaper, majority of the people cannot afford to install it, (Arun and Gopalkrishnan, 2012). With respect to the higher cost, King and Lenox (2002) noted that energy Star-rated compact fluorescent bulbs to replace 100-watt incandescent may cost between $2 and $15 per bulb, depending on the manufacturer, while the first 100-watt LED bulbs cost as much as $50.

Skills and Knowledge: There is little knowledge among the masses on environmentally friendly infrastructure amidst climate change. There is a crucial need for governments, non-governmental organizations and the educational systems in Africa, especially Nigeria to create awareness and training on the types, uses and advantages of green technology infrastructure. This will accelerate acquisition and use of environmentally friendly infrastructure. For instance, the use of inverters requires a general knowledge on the size of the inverter that will be commensurate to the appliances to be used during power outage, including the voltage, which could vary from 110V to 120V. Some of the appliances could have voltages much higher than the above, in which case a special purpose inverter should be used. The electric current usually applicable is 6A.

Power = current x voltage; therefore if V=110 and I =6A therefore P=IV =110x6=660W. If an inverter of 660W is to be used, then the appliances should not exceed 660W. Also, 1750W is the commonest inverter. To use this inverter, the appliances must be worked out and should be lower than 1750W. Furthermore, 12V batteries connected in parallel are also required to work with the inverter. A back-up battery is essential should power failure last longer than expected. Majority of both urban and rural dwellers are not well-acquainted or knowledgeable with these facts. Also, improved skills on how to design, manufacture and market green products are seldom available. This only shows that most of the green technology devices are being imported, creating difficulty in availability of spare parts, repair and servicing, whereby in the case of major breakdown, expatriates are sought for, leading to enormous resources being expended.

Lack of Awareness on EFI Products Available: A good proportion of African people, particularly Nigerians are very much ignorant of the concept of green economy. There should be a focus on creating interactive environment for the experts in green economy to communicate with the masses. There should be credible platforms through which genuine change to green economy should be engendered. Public enlightenment programme should be made available for the masses. The Head, Operations Integrity, OER, Mr. Kayode Boladale, said, "It is necessary to develop a communication and awareness action plan to raise awareness on the benefits of using renewable energy and energy efficiency against other forms'' (Wai, Wang and Lin, 2008**).**

Low Promotion and Marketing: Marketing and promotion is highly critical to the growth of any business. EFI should be promoted and the products extensively marketed. There is an immediate need for green economy businesses to embark on e-commerce solutions in order to grow and improve productivity and boost economic growth. Seminars and workshops on the use of energy-saving bulb, inverters and solar panel, where people will be gathered and tutored on the associated benefits, should be organised. Digital and Physical marketing interaction is crucial at this stage. This will make a lot of meaningful impact on EFI across Africa. There is poor explosion/build-up in social media on environmentally friendly infrastructural products, such as the use of LED bulbs, inverters and others. Their use and benefits are seldom advertised on social media, as well as on

such mass media as newspapers, magazines, radio and television. Also, they are hardly featured on local Nigeria television and radio platforms. Promotion and marketing must be stepped up to enhance growth.

Attitude to change: General African attitude to technological changes is highly discouraging. The average Nigerian is slow to embrace change and is of the old school; he is not easily taken by new technological innovations and would prefer to keep up with what he is already familiar with.

Lack of robust policies on EFI technology in Nigeria: Practical policies must be rolled out and put in place to encourage the use of EFI and also to enable investors to embrace the endeavour. A sound and profitable economy is realistic only when there are basic laws and order in the society. There is an imperative to develop legislative and regulatory frameworks to drive renewable energy use (Wai, Wang and Lin, 2008). Policy can stipulate percentage of financial involvement through government budget, strategies for measurement and evaluation of objectives, tax incentives structures and mass campaign and educational systems to improve green energy development (Mkpado 2013b).

Muhammed T. L. (nd) aptly noted that low literacy level; lack of/low level of awareness of the mitigation technologies and their potential benefits; inefficient energy use; inappropriate energy pricing; financial constraints; low income-level; technological incapability; and pressures from population growth are constraints affecting green energy development. Abubakar, Mohammed and Nma (2015) study identified weak institutional framework, poor policy implementation, inadequate financing, and lack of awareness of the socioeconomic, technological and environmental merits of renewable energy technology, as the major barriers hindering its development and diffusion. Usman (2012) observed that in Nigeria, there is little national policy dedicated specifically to energy efficiency and renewable energy, or its applications to rural and remote areas. There are, however, other policy instruments on the environment and energy that may be relevant to supporting such applications. For example, the Nigerian National Policy on Environment provides that the goal of the policy on the environment is to achieve sustainable development in the country and, particularly, to conserve and use the environment and natural resources for the benefit of present and future generations

Poor Research Capacity on EFI technology: Across Africa and Nigeria, in particular, researches carried out on green energy devices are quite few. Greater proportions of Nigerians do not know much about these devices and their benefits. These devices are yet to become common household commodities in Nigeria. Intensive effort is highly imperative to ensure that all African countries are actively included in collaborative research on EFI, as well as green technology. Team work is to get good encouragement and brainstorming can produce better results than individual approach. No indigenous and result –oriented research has been recorded on green technology product. Mkpado and Onuoha (2008) have demonstrated that technologies are better appreciated and adopted by the people, when local scientists have modified it with local content, thus indigenizing the process.

Low Level of Investment on EFI Technology: For environmentally-friendly infrastructure products to reach the next level, governmental and non-governmental organisations, instead of going back and forth akin to a simple pendulum, should arrange an injection of cash into it by first providing some of these products and services free or at subsidized prices to the market. A total of €24.5m (N5.33bn) has been earmarked by the European Union and the German Federal Ministry of Economic Cooperation and Development to fund Nigeria's renewable energy, energy efficiency and rural electrification programmes. The amount, which has its beneficiary as the Federal Ministry of Power, will be used to promote the Nigerian Energy Support Programme for five years.

The availability of the funds was disclosed by the Head of Unit, Capacity Development, NESP, Mr. Felix Nitz, during the signing of a Memorandum of Understanding between the NESP and the Renewable Energy and Efficiency Programme with 11 Nigerian training institutions in Abuja. He explained that the MoU was part of efforts by the EU, the German Government and the United States Government to support skills development for Nigeria's growing clean energy sector. Nitz noted that the objective of the MoU was to create a skilled workforce in Nigeria's clean energy sector by empowering local institutions to offer seven training courses on renewable energy and energy efficiency for engineers, architects and technicians. He said the courses included off-grid renewable energy design for engineers, energy efficient building design for architects and solar photovoltaic installation for technicians (Punch newspaper; July 31, 2015 Okechukwu Nnodim).

2.4 Prospects in Environmentally-friendly Infrastructure in Nigeria.

Improvement of quality of life for rural Africa: In the case of Nigeria, there is acute deficiency in electricity supply. Consequently, the populace do not have any option than to resort to the use of generators, thereby increasing exposure to the inhalation of carbon monoxide (CO), which is highly detrimental to health. The advent of solar energy is accompanied by the prospects to transform human lives. In the area of recycling, Nigeria is bereft of a robust recycling culture. Therefore, if adequate awareness is created on this issue, it will generate a lot of employment and transform the health conditions of Nigerians, in particular, and Africans, in general.

Increased life span: While energy-saving light bulbs may cost more initially, these devices can pay for themselves through energy savings over a greatly increased lifespan. A typical incandescent bulb may last 1,000 to 2,000 hours before burning out. Compact fluorescent light bulbs have a lifespan approaching 10,000 hours, while LED bulbs could potentially last 25,000 to 50,000 hours or more before failing. The precise lifespan of a bulb depends heavily on usage patterns and environmental conditions, but consumers can expect to go considerably longer between bulb changes, once they switch to energy-saving light bulbs.

Less monolithic economy: Shares in some of the world's biggest energy groups tumbled, as the collapse in oil prices battered the profits of ExxonMobil and Chevron, capping a week in which European rivals announced thousands of job losses and slashed spending by billions of dollars; the oil price has continued to decline (Nigerian Punch Newspaper; August 1 2015, vol. 7290, no. 1790 www.punchng.com). Nigeria's monolithic economy is under threat, the Nigerian Association of Chambers of Commerce, Industry, Mines and Agriculture (NACCIMA) has warned. It is expected that Nigerian government, in particular, would therefore look at opportunities in other sectors of the economy, such as green technology; according it a priority by developing an action plan, akin to the oil and gas sector. This is aimed at diversifying the economy, which invariably brings about more opportunities, thereby generating more revenue and increasing the Gross National Product (GNP).

Creation of job: For Africans, the use of solar panel, in particular, is a novel technology. It calls for massive job creation, as people will surely demonstrate interest in learning, as well as marketing the technology. Jobs are not created in a vacuum. The foundation of economic growth and job creation is the presence of "Startup communities," which come into existence when "Some People" bring, blend and develop synergies between (1)"Energy", (2)"Aggregate of Socio-economic Activities" and (3) Innovation in specific geographical areas (Nzamujo G, 2013). There are multiple windows of huge opportunities for green technology for those who understand and can leverage the terrain. There are still enormous opportunities for economy growth associated with green technology.

Poverty Alleviation: Boladale, while speaking at the 'LiveWell Initiative 2015' Annual Multi-sectoral Grand Health Bazaar in Lagos, stated that the use of renewable energy would help alleviate poverty, especially as it could enhance technological capacity and economic development in the developing world.

Innovation: The use of solar panel, which is relatively new in Nigeria, calls for innovation in that angle. Nigerians, exercising prudence, will definitely work on a lot of innovative ways of installing, fixing and general maintenance of the set up; bringing tremendous improvement, innovation and growth on environmentally-friendly infrastructural products.

Safety Concern: On energy-saving design; the compact fluorescent, has raised safety concerns because of the materials used in its design. Compact Fluorescent Lights (CFLs) contain a small amount of mercury, enough to present a health hazard if the bulb breaks. In addition, when a CFL reaches the end of its lifespan, the electronics at the base of the bulb implodes, as a safety precaution. This process can produce a puff of smoke and even scorch the plastic housing.

3.0 Methodology

The study was conducted in South-West, Nigeria. Primary data was generated by conducting surveys, featuring both structured questionnaires and oral interviews. Two states were purposely selected, based on population density and level of business development, or active programmes for climate change mitigation in the states concerned.
One hundred and sixty (160) households were randomly selected from the study area, which means eighty respondents from each state.

3.1 Analytical techniques

Logistic regression model was used to analyse (i) objective and (ii) hypotheses
The implicit formula is:
$Y = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$
Where:
Y = a dummy variable, with one for use of green economy innovation/EFI; otherwise, zero.
An index was constructed for with the use of energy saving bulbs, solar panels and inverters, as well as bicycles. Households that score up to 60 percent were judged as adopting green innovation and scored one; otherwise, zero. This is necessary to have a smilingly composite view of green technology adoption in the study area.
X_1 = gender: a dummy variable for gender, with a value of one for females and zero for males.
X_2 = income in naira
X_3 = educational qualification, measured as number of years of formal education
X_4 = family size: Number of people in a family.
X_5 = Government equipment ownership status: This measures the state of ownership of climate change facility in use by government or NGOs, with one for government provided facility; otherwise, zero.
X_6 =Private equipment ownership status: This measures the state of ownership of climate change facility in use by private entities; with one for privately provided facility, or zero otherwise.
X_7 = age range

X_8 =level of awareness of climate change: scaled variable measured unaware =0, slightly aware= 1, very much aware =2.

b_o = Constant
b(s) = Coefficients
e = Sample error term.
The model above was also used in testing the hypotheses.
Descriptive statistics and likert scale were used to analyse objective (i), (ii) and (iii). The descriptive statistics and likert were also useful in answering the research questions that have to do with the nature of institutional and government policies that will favour green economy and evaluating peoples' opinions on the issue, with respect to usage, opportunities and constraints. The researchers developed the questions with options to enable good survey, coding and analysis.

Likert scale: Five point likert scales with the following format: strongly agree, agree, undecided, disagree and strongly disagree. The mean (neutral or undecided) response was computed as: 5+4+3+2+1=15/3=3. In order to have three points of inference, take a deviation of 0.5, then any response less than 2.5 (3-0.5) is considered to be disagree, while any response up to, or greater, than 3.50 (3+0.5) is considered to be agreed upon.
The Chi-square Statistics was also used to test a hypothesis and the implicit format is presented as:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

df=(c-1) (r-1)

χ^2 = Chi-square Statistics, O= observed frequency, E =expected frequency, df=degree of freedom, c= number of columns, r= number of rows.

3.2 Data source

Ekiti states and Ondo states were selected because of availability of community solar-powered water supply system and solar-powered ICT in rural schools, besides individuals' use of other climate change adaptation and mitigation innovations, such as energy saving bulbs. In fact, a clean energy organization has reported the use of many facilities /activities in favour of

green economy development in the states proposed for this study, especially in Ondo State (Huzi, 2014*)*. There are government initiatives to improve the peoples' welfare with environmentally-friendly infrastructure in the proposed study area. The study concentrated on the communities, where these infrastructures exist.

4.0 Results and Discussions

4.1 Socioeconomic characteristics of respondents

The socioeconomic characteristics of respondents are presented in Tables 1 and 2. Table 1 starts with the age distribution of respondents. Six percent of the respondents were less than 25 years of age. This represented the minimum age range of the people surveyed. Actually, 23, 66, 38.5, and 9.9 years represented the minimum, maximum, mean and standard deviation of the age, respectively. The frequency distribution of the age range is presented in Table 1. It may be heart-warming to note that the majority of the respondents are still within their useful and productive age. This age group can be a strong force in driving the concepts of green technology (Mkpado and Arene, 2003).

Gender is another important socioeconomic variable presented. Majority of respondents were male, accounting for 74 percent of the respondents, while 26 percent of respondents were female. The survey tried to include both gender, as excluding one gender can lead to conflict and stifling of efforts to transfer innovation. Related to gender is the marital status: majority of the respondents (71.3%) were married; while 25 % were single and 3.7% were experiencing widowhood.

Table 1 : Socioeconomic Characteristics of Respondents

Characteristics	*Description*	*Frequency*	*Percentage*
Age in years	Less than 25	12	7.5
	26-30	30	18.75
	31-35	32	20
	36-40	30	18.75
	41-45	24	15
	46-50	14	8.75
	51-55	6	3.75
	56-60	10	6.25
	Above 60	2	1.25
	Total	160	100
Gender of household head	Sex		
	Male	120	75
	Female	40	25
	Total	160	100
Marital status	Marital status		
	Married	114	71.25
	Single	40	25
	Widowhood	6	3.75
	Total	160	100
Major Occupation	Occupation		
	Farming	16	10
	Trading	18	11.25
	Salaried job	106	66.25
	Artisan/skilled worker	8	5
	Others	12	7.5
	Total	160	100

Source: Authors' computation, using data from field survey, 2015

The uses of environmentally-friendly infrastructural products involve many people in different walks of life. This can be seen from the distribution of respondents according to their occupation. Table 1 showed that about ten (10) percent were farmers, while about 5 percent were artisans or skilled workers. Traders accounted for eleven percent and the majority (66%) were civil servants. This development could be attributed to targeting, where the EFI technologies and facilities exist. Also, some people use such facilities in their business or place of work. Socio economic features are important, as Abubakar, Mohammed and Nma (2015) noted 'weak institutional framework, poor policy implementation, inadequate financing, and lack of awareness of the socioeconomic, technological and environmental merits of Renewable Energy Technologies, as the major barriers hindering its development and diffusion'.

Other socio economic characteristic, such as education status, household size and income are presented in Table 2. Only about three percent of the respondents did not possess any form of formal education. Table 2 also showed that 3.75 percent had secondary education, while 22.5 had National Certificate of Education, or National Diploma. Those possessing higher national diploma and first degree accounted for 15.5 and 27.5 percent, respectively. The relatively higher levels of education possessed by respondents may be due to the fact that employees at the offices or organizations, where EFI technologies exist were selected for the interview.

Table 2 : Other Socioeconomic Characteristics (continues)

Characteristics	*Description*	*Frequency*	*Percent*
Educational level/status	No formal education	6	3.75
	Primary school	20	12.5
	Secondary school	6	3.75
	NCE/ND	36	22.5
	HND	28	17.5
	BSc.	44	27.5
	Others	20	12.5
	Total	160	100
Household size	1-2	8	5
	3-4	50	31.25
	5-6	62	38.75

	7-8	30	18.75
	9-10	6	3.75
	Greater than 10	4	2.5
	Total	160	100
Monthly Income in Naira*	Less than 15000	4	2.5
	15000-25000	2	1.25
	25001-35000	26	16.25
	35001-45000	38	23.75
	45001-55000	36	22.5
	Greater than 55000	54	33.75
	Total	160	100

*Naira exchange to Dollar =200 official, parallel market= 225
Source: Authors' computation using field survey, 2015

Household size can be a variable determining expenditure profile. The minimum, maximum, mean and standard deviations of household size are 1, 12, 5 and 2, respectively. Large family size characterize the people, as 13 and 38 percent have 3 to 4 and 5 to 6 members in their households, respectively (Table 2). Household income is a variable that can determine welfare and ability to try new technologies. Table 2 showed relatively higher levels of income for the rural people. This can be explained by the fact that most of respondents possess higher educational certificates and are employed either by local, state or federal government of Nigeria. Mkpado, Nweze and Igbokwe, (2012) reported that income is a major factor determining the choice of cleaner energy for cooking purposes. Also, Mkpado, and Ugbaja (2008) noted that socioeconomic issues are to be taken into consideration for motivating certain groups and youth for purposeful actions.

4.2 Level of Awareness of EFI Technology in the study area

The level of awareness of EFI technologies could be an important factor affecting the use of such technologies. Table 3 shows that over 63.75 percent of the respondents claimed to be very much aware of them; while nineteen (23.75) and ten (12) percent, respectively, claimed to be slightly aware and unaware of EFI technologies. This result is acceptable because some EFI technologies are used to provide public goods and services.

There is need to create more awareness on the use of EFI technologies. This may not be limited to slight introduction but detailed discussion, including merits and prospects of using these technologies. Also to be given emphasis is skills acquisition and training on these technologies. The need for this is reinforced by the fact that eight (80) percent of the respondents indicated that they needed some assistance on the use of EFI technology. The types of assistance specified by respondents included both financial and technical assistance. It may be easier to provide technical assistance by some type of training and mass enlightenment programme.

Energy-efficient bulbs emit less heat and are climate change compliant. Households are yet to engage fully the use of energy-saving bulb innovation. Only about 23 percent of respondents fully engaged in this by making use of only energy-saving bulbs. About 48 percent were partially using energy-saving bulbs as they used both energy-saving bulbs and ordinary ones, concurrently. On the other hand, 28.75 percent of the respondents were yet to change to use of energy-saving bulbs (Table 3).

It may be heart-warming to note that the people's attitude towards the concept of saving energy is impressive, as the majority (76.25%) accepted the ideas as a good initiative (Table 3). It is often easier to accelerate the speed of people on the direction they voluntarily choose. This indicates that programmes and projects on energy saving will be welcomed. This result is inconsonance with the use of energy-saving bulbs, since the majority is either using such bulbs fully or partially.

The use of bicycle is one of the green transportation facilities. The results showed that only 37.50 percent of household have at least one person using bicycle to either school, market or farm, while the majority (62.5 %) do not use it (Table 3). There may be disdain on the use of bicycle. This is associated with the high risk prevalent on the roads, fuelled by the absence of marked lanes for bicycle users. All vehicles, both big and small, as well as motorcycles and bicycles use the same roads, which are often in poor conditions. This tends to reduce the motivation of using bicycles in the area studied.

Table 3 : Indicators of Awareness of LED bulbs and bicycles in the study area

Awareness of EFI technology	*Level of awareness*	*Frequency*	*Percentage*
	Very much aware	102	63.75
	Slightly aware	38	23.75
	Unaware	20	12.5
	Total	160	100
Need of assistance on the use of EFI technology?	I need assistance on it	128	80
	I do not need assistance	32	20
	Total	160	100
Use of LED bulbs?	Yes the bulbs	38	23.75
	A few bulbs	78	48.75
	Not at all	46	28.75
	Total	160	100
Attitude to energy saving	It is good	122	76.25
	I don't care/ or like it	18	11.25
	I am neutral	18	11.25
	It is for the white man	2	1.25
	Total	160	100
Any household member Using bicycle?	Yes	60	37.50
	No	100	62.50
	Total	160	100

Source: Authors' computation using data from Field survey, 2015

4.3 Types of EFI Technologies in the study area

The types of EFI technologies in the study are presented in Table 4. The communities can have more than one type of EFI technology at a time. This is indicated by the multiple Reponses recorded in Table 4. Result indicates that only about 31 percent of the respondents had street light powered by solar technology. The low proportion experiencing it may be due to its high cost. Muhammed (nd) noted that the cost of solar rural electrification and water-pumping project in three villages in Jigawa State, Nigeria is

$600,000.00. Rural electrification can be achieved with solar-powered technology. NESP (2014) noted opportunities and solar resources available in Nigeria for using green technology for rural electrification. The use of solar-powered water bore holes and solar-powered technology in schools and public library had good response with the use of green technology in the area, accounting for over 68 and 75 percent of the response, respectively (Table 4). Educational programme has become the largest recipient of this technology. This helps with online library, registration of external examinations for certificate classes online, as well as easy teaching of computer basic education, including information and communication technology (ICT) skills in primary and secondary schools in the study areas. Next to these is the use of solar-powered technology in hospitals and health centres. Usman (2012) aptly noted that photovoltaic power components have also been shown to adequately provide the electricity for refrigerators and deep freezers, in which vaccines and drugs can be safely stored without losing their potencies, especially during immunization in remote areas. Access to drinkable water is critical for the adoption of solar energy (Table 4). This may have been cushioned by the impetus given by the Millennium Development Goals (MDGs), with respect to improved health and education, which have been accorded priority by the MDGs, as they have a common trend with water access.

Table 4 : Types of EFI Technologies for Public usage in the study area

Green energy use in the community	*Frequency*	*Percentage*
ICT in schools and public library	110	68.75
Hospitals and community health centres	96	60
Street light	50	31.25
Water bore holes	120	75
Total	376	multiple responses recorded

Source: Authors' computation using data from Field survey, 2015

4.4 Building and maintenance of public EFI

The provision and maintenance of EFI technology facilities are critical to the usage. Table 5 indicates that government Ministries, Departments and Agencies (MDAs) constitute the major providers and also care for the maintenance. Politicians are also involved with the provision and maintenance of such facilities. This may be one of their campaign strategies; non- government Organizations and Philanthropists also have a share in this regard (Table 5). It is pretty significant to note that the community using such technology has a share in its maintenance. This information gives insight into the usage of the facility, as well as its sustainability. In a similar vein, 55 and 37 percent of the respondents view EFI technology facilities in their locality as very good and good, respectively (Table 5). Such an appreciation can serve as encouragement to motivate increased investment in the trend. It is good to sustain the culture of investment and maintenance with democratic processes, which will endear the project to the people (Mkpado, and Arene, 2007).

Table 5 : Building and Maintenance of Public EFI

Question	*Answers /options*	*Frequency*	*Percentage*
Who installed solar panel in your community?	Government Ministry/Agency	80	50
	NGO's/Philanthropists	30	18.75
	Politicians /political leaders	38	23.75
	I don't know	12	7.5
	Total	160	100
Who maintains it in your community?	The provider	74	46.25
	Community using it	32	20
	Both community and Providers	38	23.75
	I don't know	14	8.75
	Total	160	100
How do you view use of green technology for	very good	88	55

public purposes?			
	Good	60	37.5
	Bad	0	0
	I don't know	12	7.5
	Total	160	100

NGO=Non-government Organization

Source: Authors' computation using data from field survey 2015

4.5 Domestic EFI technology use in the study area

The domestic or household EFI technology use in the study areas included bulbs for lighting, refrigeration, water-pumping, communications, using radio and television (TV), but no one indicated using it for cooking or Ironing. The commercial EFI energy usage was limited to lighting systems of the business facilities. The rural populace is yet to expand the use to agro-processing activities, such as flour grinding, oil expelling/extraction, crop drying and threshing. Small-Scale Industry, such as saw-milling wool- and cotton-processing and stone crushing has not seen the light of green technology in the study area. Dayo (2008) aptly noted that investments in clean energy facilities in Nigeria have been in large and small hydroelectricity generation, solar PV, biomass, bio-fuel, and wind energy.

Table 6 : Use of EFI Technologies for Domestic and Commercial Purposes

Some EFI technologies	*For household usage*		*For commercial purposes*	
	Frequency*	Percentage	Frequency*	Percentage
Energy saving bulbs	80	40.81632653	42	35
Energy saving appliances	24	12.24489796	20	16.66667
Rechargeable lanterns	76	38.7755102	38	31.66667
Solar panels	6	3.06122449	20	16.66667
Inverters	10	5.102040816	2	1.6
	196	100	120	100

*= Multiple responses recorded; Chi-square test=69.21, df 6, sig level 0.000 (sig at 1 % probability level); likelihood ratio= 67.007 df 6, sig level 0.000; Pearson's Correlation coefficient R=.783, sig level 0.000

Source: Authors' computation using data from Field survey, 2015

The use of EFI technologies and innovations can be for domestic and commercial purposes. Energy saving-bulbs appear to be the most popular in the study area. About 35 and 40 percent of people use it for domestic and commercial purposes, respectively. Next to this are the rechargeable lanterns, which the respondents use for domestic and commercial purposes were 38.8% and 31.7%, respectively. However, the use of solar panels was more for commercial than domestic purposes. The Chi-square test had a coefficient of 69.21, which is significant at 1 percent probability level. The significant likelihood ratio indicates that the trend may not be easily changed. Incidentally, Table 6 shows a similar trend for the use of the technologies for domestic and commercial purposes, as the Pearson's Correlation coefficient (R) is 0.783, which is significant at one percent probability level. The positive sign of R indicates a positive trend with respect to the use.

However, the magnitude of the use differs. This is because the Chi-square test is significant at one percent probability level, with a coefficient of 69.21; signifying that the number of EFI technology appliances/innovations/ used for commercial and domestic purposes differs. It is reasonable because, as can be seen from Table 6, the number of units of each facilities used differed.

4.6 Recycling

Recycling of materials is one of the desired behavioural changes in green economy. Although the materials that can be recycled are not mutually exclusive, which gives indication of multiple response, only 63.75 percent of respondents indicated that they have been involved in it (Table 7). Twenty percent of the respondents have used organic manure, which is an indication of recycling organic waste. The organic manure consists of animal droppings and/or crop residues used as fertilizers to enrich the soil; a common practice

with farmers. Iron and aluminium are very important metals for building different structures, but iron is recycled more than aluminium (Table 7). Rubber and plastic materials are also involved in the recycling processes. Other things people recycle include bottles. However, many households may not see the need to recycle items due to very small money they can bring and the fact that people who buy these items are not always available. They can throw items that can be recycled away, which poorer people will scavenge on. This may account for the low response with respect to recycling items.

Table 7 : Recycling of Materials and Wastes

Items	*Frequency*	*Percentage*
Iron	26	16.25
Aluminium	12	7.50
Rubber/Plastic	24	15.00
Others	8	5.00
Use of Organic manure	32	20.00
Total	102	63.75

Source: Authors' computation using data from Field survey, 2015

EFI technology, especially solar-powered energy systems, serves useful purpose in providing very clean water. The solar-powered borehole water, being more potable than water from other sources, is mainly used for domestic purposes, especially drinking and cooking food (see Table 8); some households use it especially for baby food. This usage is contrasted with the use of well water for laundry and flushing toilet. Thus, it is apparent that rural households understand the significance of good water source and EFI technology serves very well in this context. The menace of health risk posed by poor water sources are well reported in literature (Yanda, Kangalawe and Sigalla, 2005).

Table 8 : Sources and Uses of Water

Sources	*Uses*	*Frequency*	*Percentage*
Solar-powered borehole	Drinking and	38	23.75

	cooking food		
	Washing	4	2.5
	Flushing toilet	8	5
	All of the above	70	43.75
	All having the water	120	75
Well water	Yes, flushing toilet	126	78.75
	No	26	16.25
	Total	150	93.75

Source: Authors' computation using data from Field survey, 2015

4.7 Factors affecting the use of EFI Technology

High cost and poverty are factors that pose problems when both occur together and the rural poverty level in less developed economies, like Nigeria's, is usually more severe than urban ones **(**Mkpado and Arene, 2010). This may account for the reason why over 72 percent claim that cost and financial burden constitute major problems to the use of EFI technologies. There are also the problems of how to use the technology, as about 13.75 percent claim that they do not have skills to operate them; therefore, while they have the finance, the lack of awareness and skills will limit the usage. Standardization of green technology products is very important, as consumers are aware of the presences of low or fake EFI products, such as LED bulbs. Fake products enrich their manufacturers, but deter the rate of development and attainment of desired adoption level. On Table 9, about 13.75 percent claim that the presence of fake products affects them. This, again, shows the need to regulate the quality of the products in the country.

Table 9 : Major Factors Affecting the Use of EFI Technology

Factors	*Frequency*	*Percentage*
Cost /finance	116	72.50
Awareness/skills	22	13.75
Low quality /fake products	22	13.75
Total	160	100

Source: Authors' computation using data from Field survey, 2015

Table 9 illustrates the major factors affecting the use of EFI technology by the households. Costs and financial problems were the most limiting factors; about 72% claimed that they were constrained by finance with respect to access and use of EFI technologies. The result is in consonance with Mkpado, Nweze and Igbokwe, (2012) report. Awareness and skills were also noted; to be aware of a product and know how to use it can motivate one to key-in and embrace the product. Some EFI technology requires the use of electricity, which is associated with the risk of electrocution. There is also the need of understanding the capacity of the facilities, such as those of inverters and solar panels to avoid overload and damaging of the facility. The very limited knowledge of the rural people with respect to capacity of inverters and solar panels can cause lack of interest and adoption of the innovations/technology. In a similar manner, RUWES (2015) advocated establishment of training schools and workshops on renewable energy in Nigeria. This can spur local content and indigenization of the processes that will increase acceptance and usage (Mkpado and Onuoha, 2008).

The presence of low quality and fake products in the market constitute another problem. Unscrupulous business people can use low quality materials to build their products. This will create uncertainties in the market, as consumers may not be able to differentiate between the genuine and fake products at the point of purchase. Soon, the fake products will either become disused, or perform with very low efficiency, and the consumer will be disappointed and count such purchases as a waste. The Nigerian Customs Service and the Standards Organization of Nigeria can help with quality maintenance for clean energy technologies (RUWES, 2015; Muhammed,

nd). Suleiman (2010) aptly noted that lack of capacity and standard quality control, as well as quality assurance limits consumer confidence in the new and growing market of renewable energy. This is also accompanied by the general low level of public awareness of the renewable energy technologies in Nigeria.

4.8 Some challenges to the use of EFI Technology in the study area

The qualitative assessment of some other challenges with respect to the use of EFI technology is presented in Table 10. The availability of fake or inferior rechargeable bulbs is reducing peoples' ability to use them; family size and income are also major factors determining how much is spent on solar-powered facilities. The needs of training on the use of solar-powered facilities are noted, as Power Holding Company of Nigeria (PHCN) is damaging many rechargeable bulbs due to poor voltage and epileptic power supply. It is undecided that energy- saving bulbs and rechargeable lanterns are very poisonous to dispose and that cost of materials and water can affect their recycling (Table 10). The electricity suppliers in Nigeria need to overhaul and upgrade their facilities to serve the people efficiently, as their services can greatly affect the use of EFI technology appliances.

Table 10 : Some Challenges to the Use of EFI Technology/Innovation

Some challenges to the use of EFI technology/innovation	*total respondents*	*total score*	*mean sore*	*Remarks*
The availability of fake or inferior rechargeable bulbs is reducing peoples' ability to use them.	160	690	4.259259	Agree
Family size and income are major factors determining how much we spend on solar powered facilities.	160	662	4.08642	Agree
I need training on the use of	160	672	4.148148	Agree

solar powered facilities.				
Power Holding Company of Nigeria (PHCN) is spoiling many rechargeable bulbs due to poor voltage.	160	650	4.012346	Agree
Used rechargeable bulbs are very poisonous to dispose.	160	580	3.580247	Undecided
Increasing cost of materials and water affect recycling and household water usage.	160	584	3.604938	Undecided

Source: Authors' computation using data from Field survey, 2015

Use of EFI technology in the rural areas

An index was constructed for the use of energy-saving bulbs, solar panels and inverters, as well as bicycles. Households that score up to 60 percent were adjudged as using EFI innovation and scored one; otherwise, zero (Table 11). This is a gross index for using EFI technology, both at domestic/private level and public places. The majority represented by 51 percent of the respondents are yet to be adjudged as using EFI innovation, while the minority represented by 48.75 percent of the respondent were adjudged to be using EFI technology to a reasonable level. Mkpado (2013c) aptly noted that future livelihood of rural people will be improved with innovations and technologies.

Table 11 : Classification of Respondents by use of EFI technology in the rural areas

Index score	*Frequency*	*percentage*	*Remarks*
Less than 60% = 0	82	51.25	Non adopters, score 0
60% and above = 1	78	48.75	Adopters, score 1
Total	160	100	

Source: Authors' computation using data from Field survey, 2015

4.9 Regression Analysis

The overall estimate of determinants in the use of EFI technologies is acceptable because of its significant log likelihood ratio (35.6) and relatively high Cox & Snell R Square (.451); Nagelkerke R Square (.664). The variables that were significant include income, Government ownership of facility, Private ownership of facility, Age and level of Awareness of climate change (Table 12).

Table 12 : Logistic Regression Estimation of Determinants of Use of EFI technologies

Variables	*Coefficient*	*Standard Error*	*Wald statistics*	*Remarks*	*Exp(B)*
Gender of household head	-1.091	.894	1.491	Ns	.336
Educational status	.107	.189	.320	Ns	1.113
Income	.671	.357	3.530	**	1.956
Government ownership of facility	.266	.145	3.369	**	1.304
Private ownership of facility	.639	.324	3.902	**	1.895
Household size	-.010	.156	.004	Ns	.990
Age	.252	.146	2.986	**	1.287
Very much aware of climate change	.543	.306	3.140	*	1.721
Constant	-1.693	2.091	.655	Ns	.184

Note: **, * =significant at .5% and 10% probability levels respectively; Ns=not significant

Source: Authors' computation using data from Field survey, 2015

Age has positively and significantly affected the use of EFI technologies. Its coefficient is 0.252, while its Wald statistics is 2.986, which is significant at five percent probability level. It means that older people are more likely to adopt the technologies.

Level of awareness of climate change had a positive and significant relationship with the use of EFI technologies. Its coefficient is 0.543 and its Wald statistics is 3.140, which is significant at ten percent probability level. It means that those who are very much aware of climate change are more likely to adopt the technologies.

Private ownership of facility has positive and significant relationship with the use of EFI technologies. Its coefficient is 0.639 and its Wald statistics is 3.902, which is significant at 5 percent probability level. It means that increasing private investment/ownership of green technologies will bring more people to adopt it; it is reasonable to believe that those who invest in such technologies own and use them.

Income had a positive and significant effect on adoption of green technology. Its coefficient is 0.671, while its Wald statistics is 3.53, which is significant at 5 percent probability level. It means that rising personal income will increase the likelihood of the use of the innovation/technology. It is possible because the use of such technologies will be at a cost to the household.

Government ownership of facility had a positive and significant effect on use of EFI technologies. Its coefficient is 0.266, while its Wald statistics is 3.369, which is significant at 5 percent probability level. This can be as a result of government investment on EFI technologies, like solar-powered water boreholes, solar-powered street lights, solar-powered hospital facilities and solar-powered ICT facilities in public schools and libraries. Thus, it is easy to identify people who use and benefit from these facilities. Increased investment by government is desirable and can be achieved by setting the right policy and priority. For example, African countries have been advised by NEPAD to invest at least 10 percent of their annual budget to agriculture

(CSAC, 2008; Mkpado 2013b). A similar pattern can be followed by African countries setting a goal to invest certain percentage of their budget for investment in environmentally friendly infrastructure.

The model indicates that gender, educational status and household size all have not significantly affected the use of EFI technologies/innovations; but level of awareness of climate change and ability to make investments counts.

5.0 Recommendations and Conclusion

5.1 Recommendations

It is recommended that Adults need to encourage younger people to embrace EFI technologies, as age is positively correlated to the use of EFI. Government can improve regulation and standardization of EFI technology products sales in Nigeria; this will reduce presence of substandard EFI facilities, which tend to reduce motivation for adoption of EFI facilities. Training and workshops on EFI technologies are important to motivate the rural people towards the desired goal; as knowledge and level of awareness of EFI have been identified as constraints. Increased investment in environmentally-friendly technology by both public and private sectors should be encouraged as low income and associated poverty problems abound in rural areas. There is the need for development partners and African Governments to work out modalities to provide finance for the needed transition to green economy. Adequate policy framework is required to spur increases of government expenditure on environmentally-friendly infrastructure and set targets, as well as regulate the general business conduct of EFI technologies in Nigeria.

5.2 Conclusion

The study reveals that EFI are unattractive to local people. The present situation can be described as that of early users. The study further reveals that there is the need to create more awareness on the use of EFI technologies, as well as awareness on climate change. This may not be limited to slight introduction but detailed discussions, including merits and prospects of using EFI technologies, public campaign on EFI technologies via electronics and mass media is imperative. The types of assistance specified by respondents include both financial and technical support. It may be easier to provide technical assistance by some type of training and mass enlightenment programmes. There is the need for development partners and African Governments to work out modalities to provide finance, or subsidize costs associated with the transition to EFI technology. Government can improve regulation and standardization of EFI technology products, thus reducing fake products to the barest minimum in Nigeria.

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MATE MASIE

"What I hear, I keep"-Symbol of wisdom, knowledge and understanding.

NEA ONNIMNO SUA A, OHU

"He who does not know can know from learning, -Symbol of life-long education and continued quest for knowledge.

NYANSAPO

"Wisdom knot" – Symbol of wisdom, ingenuity, intelligence and patience.

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