

A Descriptive Analysis of Public Understanding and Attitudes of Renewable Energy Resources towards Energy Access and Development in Nigeria

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ABSTRACT: Nigeria government has set a target of becoming among the top 20 economies by the year 2020. The argument here is not whether this can be achieved or not within the stipulated time, but rather achieving a sustainable economic growth through a clean energy system. The development of renewable energies in every region of the country is one of the tactics that can be used to achieve clean energy. This paper examined the attitudes and understanding of the public towards renewable energy sources and technologies so as to enhance the provision of electricity. The study was conducted in the south west Nigeria using a field questionnaire survey. The study found out that the large numbers of respondents are aware of renewable energy but they do not have a deep understanding of it. Most of the respondents support the use of renewable energy to supplement the current national grid instead of the present dominance of diesel/petrol generating set. Also, the public are willing to pay more for electricity supply once it is stable. Meanwhile, the willingness to pay more for the electricity decreases with the respondents' age but increases with the respondents' income. This implies that people will be willing to pay more for electricity when their incomes increase and also when they are relatively young. The study therefore suggests strong political commitment of Nigeria government on renewable energy applications as well as creation of enabling environment for the private sectors to successfully utilised renewable energy technologies.

Keywords: renewable energy sources; Technologies; public attitudes and understanding

JEL Classifications: D11; Q28; R11

1. Introduction

Energy plays a fundamental role to socioeconomic and technological development of any economy. The role of energy, specifically electricity in improving the quality of life of people cannot be undermined. Various studies (Yoo, 2006; Akinlo, 2009; Akinwale et al., 2013 among others) have shown that there is a strong correlation between electricity consumption and economic growth. Thus, access to modern energy is crucial for the provision of clean water, sanitation and healthcare and for the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunications services. Despite the importance of energy in humans' life, it is sad to acknowledge that billions of people still lack access to the most basic energy services in the present day. According to World Energy Outlook (2012), over 1.3 billion people are without access to

electricity and 2.6 billion people rely on the traditional use of biomass for cooking, which causes harmful indoor air pollution. These people are predominantly in either developing Asia or Sub-Saharan Africa especially in their rural areas. In order to reduce the level of energy poverty in these developing countries, many of their governments have engaged in various strategies to provide energy for their citizens.

Nigeria, among few others, experiences a situation where demand far outstrips supply leading to energy crisis. The electricity production system in Nigeria and most part in the world are based on polluting Thermal Power Stations (TPSSs) for several years now. Conversely, the energy sector has changed drastically during the last two decades. The attention of many countries all over the world has shifted to renewable energy options in view of facing the ever-increasing load demand, soaring oil prices and uncertain resources for conventional power generation with its well-known adverse consequences on climate and human health (Kaldellis *et al.*, 2012). Renewable energy option is seen as an alternative that could bridge the gap between demand and supply if properly harnessed within a country. This renewable energy will abate carbon emission and provide a sustainable environment. In line of this, few countries have already set a target of the proportion of total energy to be generated from renewable options by year 2015, 2020 and 2050 as the case may be.

Nigeria government's efforts on stable electricity production and distribution have not translated to availability of electricity for her populace. This may be as a result of top-down approach usually adopted by the federal government. There are very few studies within the country on the attitudes of the public towards renewable energy generation. In order to be able to generate electricity efficiently from renewable energy sources and providing the local residents with access to energy, there must be an assessment of the understanding and attitudes of the public towards renewable energy sources. Public understanding and acceptance is recognised as an important issue shaping the wide spread implementation of renewable energy technologies and the achievement of energy policy targets. Moreover, it is commonly assumed that public attitudes need to change to make more radical scenarios about the implementation of renewable energy technologies feasible (Devine-Wright, 2007). Related studies (Devine-Wright, 2003 and 2007; Ek 2005; Zyadin *et al.* 2012; Balachandra 2011 among others) have been conducted by some scholars in other countries such as China, USA, Jordan, India, Sweden and UK among others.

The objectives of this study are to assess the understanding of renewable energy options and measure the levels of awareness and general attitudes of Nigerians towards renewable energy sources. This study is significant in making suggestions to the policy makers on the kind of policy to make in order to be able to bridge the electricity gap in the local communities and at the same time to provide awareness to the public if such is previously low.

2. Renewable Energy and Electricity in Nigeria

This section discusses the various renewable energy sources and the position of electricity in Nigeria.

2.1. Renewable Energy Sources

2.1.1. Hydro

Hydroelectricity is generated from the conversion of potential energy of water into electricity by water turbines and electric generator system (Aliyu and Bawa, 2011). This power is derived from the energy of water moving from higher to lower elevations. Flowing water creates energy that can be captured and turned into electricity. Hydropower systems rely on the potential energy difference between the levels of water in reservoirs, dams, lakes and their discharge tail water levels downstream. This potential energy is converted to shaft rotation through water turbines. Hydropower is a mature, proven, and price-competitive technology. It has the conversion efficiencies of approximately 90% (water to wire) which is among the best globally (IEA, 2004).

2.1.2. Wind

Power generated from the wind requires that the kinetic energy of moving air be converted to mechanical and then electrical Energy (Akinwale *et al.*, 2013). The quantity of kinetic energy in the wind that is available for extraction increases with the cube of wind speed (Wiser *et al.*, 2011). The major concern for the wind energy industry is to design cost effective wind turbines and power plants to perform this conversion. Wind energy could only be sourced from an area where there are lots of breeze, and the energy could be converted for practical purposes such as pumping water, grinding

grain, charging batteries and generating electricity among others. There are few pilot installations of wind turbines in the northern part of Nigeria.

2.1.3. Solar

Solar energy sources derive power from the sun. Solar technologies can transport heat, cooling, natural lighting, electricity, and fuels from one location to another. The simplest form of conversion is the one that transforms solar energy to heat, because any material object placed in the sun can absorb thermal energy. However, maximizing that absorbed energy and preventing it from escaping to the surroundings can take specialized techniques and devices such as evacuated spaces, optical coatings and mirrors (Arvizu et al., 2011). There is huge potential for this form of energy globally but its exploitation is still low.

2.1.4. Biomass

Biomass electricity is generated from plant-derived organic matter as well as animal wastes. Biomass may be used as solid fuel, or converted through the use of technologies to liquid or gaseous forms for electric power generation, heat or fuel (Sambo, 2009). This source is considered renewable as it is naturally occurring and when properly managed, may be produced without significant depletion. Developing countries are still characterised by traditional use of wood, straws, charcoal, dung and other manures for cooking, space heating and lighting.

2.2. Energy Position in Nigeria

Having Access to sustainable, modern, affordable and reliable energy services is an essential prerequisite for poverty reduction and sustainable socio economic development. Availability of energy services in any region affects all facets of human lives. Hence, lack of these energy services limit the socioeconomic activities that could happen in such environment. Globally, the potential to provide electricity, heat and transport fuels to deliver all Energy services from Renewable energies is huge (Einar, 2013). The available resources are more than sufficient to meet and surpass the entire human energy demand of the present time and the nearest future.

Though, Nigeria also has huge potentials of renewable energy resources from one end of the country to the other end (North-South, West-East), but these resources remained largely unharnessed. According to NBS (2010), an average of 47% of Nigerians has access to electricity whereas less than 50% of their electricity demand is being met. The estimated total installed capacity of gas and hydro power stations in Nigeria is 8,000 MW, whereas the power generation capacity available is approximately 4,000 MW from both Power Holding Company of Nigeria, (PHCN) and Independent Power Producers (IPPs) out of which only about 1500 MW is readily available to generate electricity (ADB report, 2009). Nigerian households and firms have relied so much on diesel generating sets to provide electricity for themselves but the cost of running self generating sets is too high. This has frustrated some small scale businesses out of market and left the poor who could not afford such costs in darkness. For a majority of Nigerians, cooking is the most important energy requirement of the family and average of 72% of the population depends on firewood for cooking using traditional “three stone fires”¹. The electricity consumption per capita of 120.5kwh in Nigeria is very low compared with many countries such as South Africa with electricity consumption per capita of 4,532.02kwh. Various agencies of the Federal Government have been responsible for power generation, transmission, and distribution over the last 120 years; from the Nigeria Electricity Supply Company (NESCO) through the Electricity Corporation of Nigeria (ECN), the National Electric Power Authority (NEPA) and Power Holding Company of Nigeria (PHCN) (Sambo, 2005).

However, with the current reform and privatisation, one would expect that there would be major improvement in all aspects of generation, distribution and transmission in the electricity sector in Nigeria. Though, affordability to all is another factor that government through regulatory agency must ensure. This is because the main aim of the private investors is to declare as much profit as possible irrespective of the poor masses. Nigerian government should also ensure that renewable energy sources are well exploited using the required technologies. According to Ogbimi (1990), development of relevant skills and capabilities of Nigerian scientists and engineers across various sectors is what can solve Nigerian electricity sector like all other sectors. Nigerian graduates who are engineers and scientists must be trained to be able to solve all the technical challenges of the sector and also be able to bring innovation that will improve the sector’s performance. Thus, Nigerian

¹ NBS-CBN-NCC Collaborative Survey, 2011

government should ensure that the private sector take into consideration the local manpower as well as the poorest of the poor who are living in various villages of the country.

In order for both the government and the private investors to improve the generation and distribution of electrical power in Nigeria, there is need for proper energy mix by using technology to explore renewable energy sources available within the country. Moreover, it is necessary to know the level of understanding, perception and attitudes of the public towards the applications and uses of Renewable energies.

3. Literature Review

This section reviews the past studies conducted on public understanding and attitudes towards renewable energy usage in different countries. Liu *et al.* (2013) examined rural social acceptance of renewable energy deployment taking Shandong in China as a case study via a field questionnaire survey. They adopted the theory of planned behaviour to establish an analytical framework, and a logit model was used to examine possible determinants of local social acceptance. The results of their study show that rural residents are generally in support of renewable energy development given its positive impacts on environment, and that the public willingness to pay more for renewable electricity is positively related to household income, individual knowledge level and belief about costs of renewable energy use but negatively related to individual age. Maklad (2014) concluded in his study that Australia is highly motivated to focus on domestic renewable micro electricity generation for domestic buildings considering the historical and current ongoing economic aspects relevant to Australian households. Kaldellis *et al.* (2012) also conducted a study on the public attitudes towards renewable energy applications in Greece. A questionnaire was deployed for conducting the survey based on a representative sample of local inhabitants. The results showed that there is high level of knowledge and acceptability of renewable energy applications in southern region although the need for additional public information regarding RES exploitation has also been designated.

According to Ek (2005), the public is generally positive towards wind power based on a postal survey that was sent out to 1000 Swedish house owners. The results show that the probability of finding an average individual in support of wind power decreases with age and income. Also, people who have an interest in environmental issues are more likely to be positive towards wind power than the average respondent and the results do not support the "Not in my Backyard (NIMBY) hypothesis". The results also imply that the potential of markets for "green" electricity may be limited, other support schemes is thus required if the

Politically-stated goal to increase wind power capacity is to be fulfilled. Also, Fast and McLeman (2012) conducted a study on the attitude towards new renewable energy technologies in the Eastern Ontario Highlands using a mail-out survey and focus group discussions for the permanent residents, local and regional government decision-makers. The results showed strong support among residents to pursue alternative energy sources (89%), mostly out of concerns with rising energy costs, but also from a desire to use local energy sources. The respondents support was highest for solar technologies (87%) and lowest for wind turbines (58%) and new hydroelectric dams (58%). As there was little evidence of NIMBY in the region; acceptance and uptake will likely be strengthened by locally relevant demonstration projects and by supporting citizen involvement in task groups, workshops or other venues for information sharing. Numerous "willingness to pay" surveys have shown a significant market for "green" electricity, based on recorded consumers' preferences to pay a Premium for buying Renewable energy (Kaldellis *et al.* 2013). Batley *et al.* (2001) and Roe *et al.* (2001) have revealed in their surveys that large number of people in UK and US respectively are willing to pay more for electricity from generation sources that have a minimal adverse impact on the environment.

Despite the various researches that revealed positive attitude towards renewable energy applications, the experience has shown that there exist specific cases where such projects face resistance from the local population (Kaldellis, 2005). According to Krohn and Damborg (1999), there is a great difference between renewable energy such as wind energy as an idea and wind turbines as acceptable structures in the landscape. Public concern often originates from the fact that environmental advantages of RES projects are perceived on a global or national level, whereas environmental impacts of such systems only affect the local environment and habitants. Hence, the positive view of RES may change considerably for an individual when moving from global to local (Walker *et al.*,

2010). This is generally known as NIMBY (Not In My Back Yard) syndrome where people in favour of a certain renewable energy may resist to the installation of such renewable energy (such as windfarm) in their own area (Wolsink, 2000). Devine-Wright (2003) opined that though individuals may be aware of different energy sources but results suggest that more in-depth understanding of these sources vary markedly. For example, it cannot be assumed that individuals have a clear idea about the kinds of Energy sources that may be characterised as high or low carbon, renewable or non-renewable. The study found that many respondents believed ‘natural gas’ to be a form of renewable energy, whilst awareness of ‘biomass’ as a form of renewable energy was low. Devine-Wright (2007) provides a novel classification of personal (age, gender, class, and income), psychological (knowledge and direct experience, environmental and political beliefs, place attachment) and contextual factors (technology type and scale, institutional structure and spatial context) explaining public acceptance. The study concludes by arguing for the need for inter-disciplinary research combining qualitative and quantitative approaches, using innovative social research methods with a greater emphasis upon the symbolic, affective and discursive nature of beliefs about renewable energy technologies. There is dearth of scientific studies on the public understanding and knowledge of renewable energy sources and technologies in the developing countries in general and Nigeria in specific. This study therefore aims to contribute to the pool of existing knowledge and bridge the gap in developing economies.

4. Methodology and Discussion of Results

This section describes the method of collecting the data used for the study as well as discuss the research findings.

4.1 Methodology

The data for this study was obtained from a survey conducted in South Western (SW) Nigeria by the authors of this study in 2013. The study employed a structured questionnaire to collect data from various households through a random selection. There are very few studies that have assessed public attitudes and opinion about renewable energy in the country. This has prevented the government to know the extent of public knowledge and acceptance of renewable energy. The primary survey was conducted to sample opinion of people about their knowledge, usage, technology acceptance level, public support, and attitudes toward renewable energy. A total of 200 questionnaires were given out across Lagos, Oyo, and Osun states in South Western Nigeria, and 143 was filled correctly which represents 72% of the total respondents sampled. Some of the questions were dichotomous, likert scale type, and multiple choice questions. The dichotomous type of question is where respondents have only two choices (Yes or No) and the likert scale ranges from strongly agree to strongly disagree. Few other questions were open ended questions. The combination of open and close ended questions is for easy comprehension of issues under study. A descriptive analysis is then carried out to analyse the understanding and attitude of the public towards renewable energy sources.

4.2 Discussion of Results

The findings show that 65% of the respondents are male and table 1 also shows that the majority of the respondents fall within the middle income and high income earners. This is not unconnected with the locations where the survey was conducted.

Table 1. Monthly income of the respondents

Range of Respondents' Monthly Income	Percentage
Less than N40,000 (Low income)	21.7
N40,000- N100,000 (Middle income)	39.9
Above N100,000 (High income)	38.4
Total	100.0

The qualification of the respondents were also analysed as can be seen in Table 2. Majority of the respondents possessed HND/BSc degree which means that the large proportion of the respondents should have a basic understanding of the subject matter.

Table 2. Academic Qualifications of the Respondents

Qualification	Frequency	Percentage
SSCE	4	2.8
NCE	3	2.1
OND	3	2.1
HND/BSC	90	62.9
Masters	38	26.6
Doctorates	5	3.5
Total	143	100.0

Larger proportions of the respondents are aware of mainly Solar PV (74%) followed by large hydro (55%), Firewood (51%), Solar heating (45%), Wind (39%), and traditional biomass (29%). Meanwhile, further enquiry was carried out to find out the extent of knowledge of such renewable energies but it was discovered that most of those that are aware of the RES did not have a deeper understanding of them. For example, some of the respondents do not know the constituents of solar PV and how it works. Also, some of them did not even know that biomass is a renewable energy source. The respondents were also asked which renewable energy sources they are currently using in their homes. The result is shown in figure 1.

Figure 1. Current renewable energy usage in the respondents' home

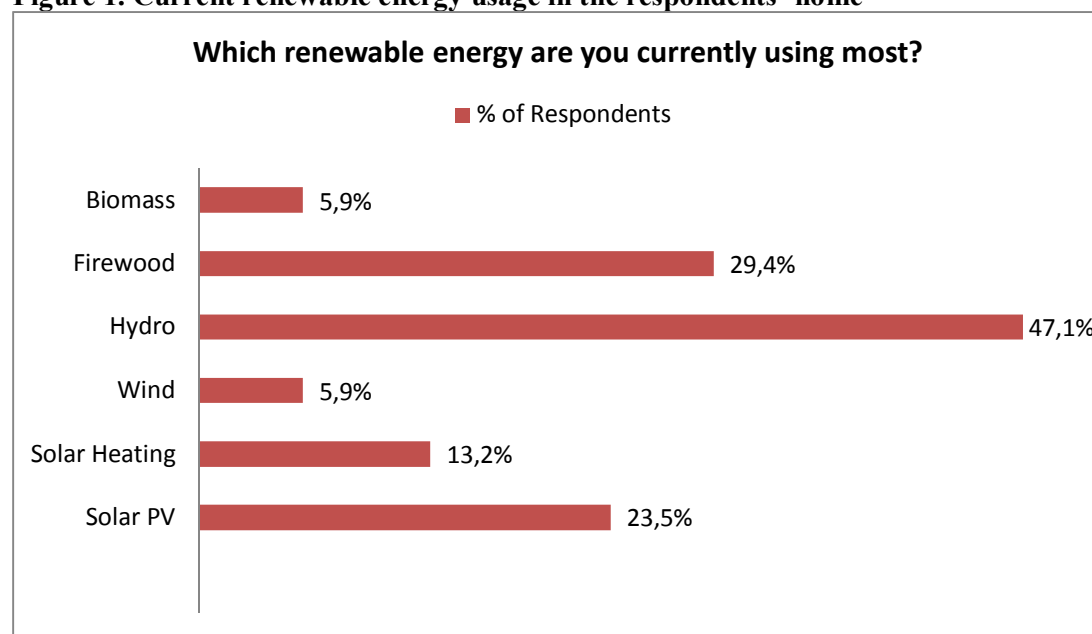


Figure 1 shows that 47.1% of the respondents use hydro renewable energy sources which represent the highest for the sampled respondents. Whereas the lowest renewable energy sources use by the respondents are biomass and wind (5.9% each). This is not unconnected with the poor knowledge of the efficient use of biomass and wind technologies. Though, the probability of the success of wind energy sources in the South-western Nigeria is low because the environment might not be wind supported unlike the Northern part of the country. It can be inferred from this figure that the 47% of the respondents that claimed the usage of hydro is enjoying such from the national grid. This is further corroborated with the question which required the respondents to declare the alternative sources of energy which they use to augment the national grid supplied to them. An average of 78% of the respondents stated that their major alternative to national grid supply is diesel/petrol generating set followed by kerosene stoves or lantern. This means that majority of the respondents make use of nonrenewable energy as their major source of energy in their various homes. The emission from the diesel/petrol generating sets contributes to the global negative effect on the ozone layer. The

respondents were also asked which renewable energy sources can help solve the electricity problems in their community, and the result is shown in Figure 2 below.

Figure 2. Perception of the renewable energy sources that can solve electricity problem in the respondents' community

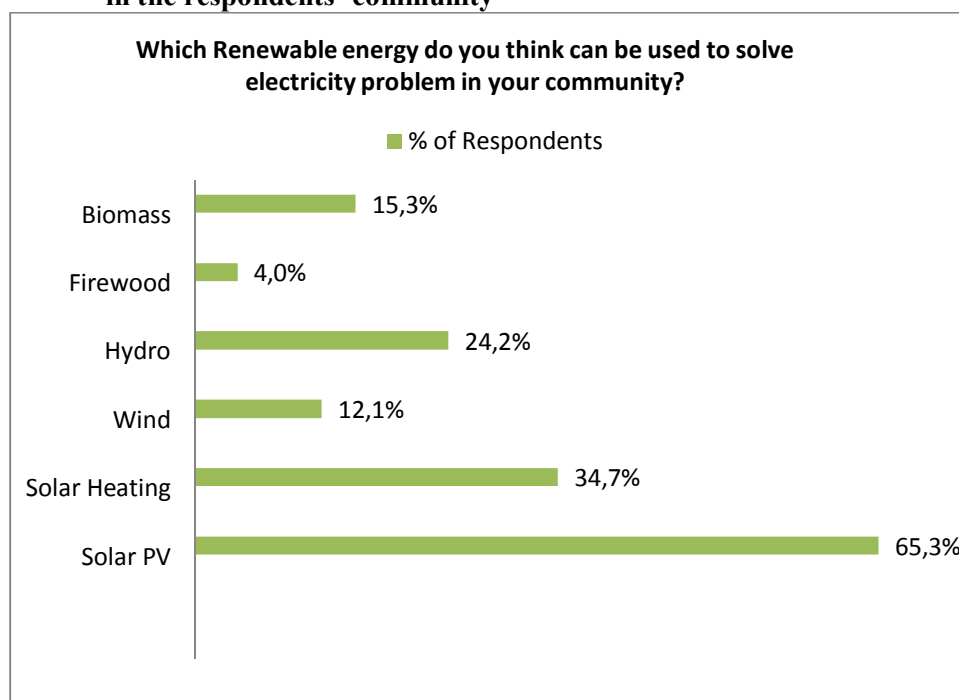
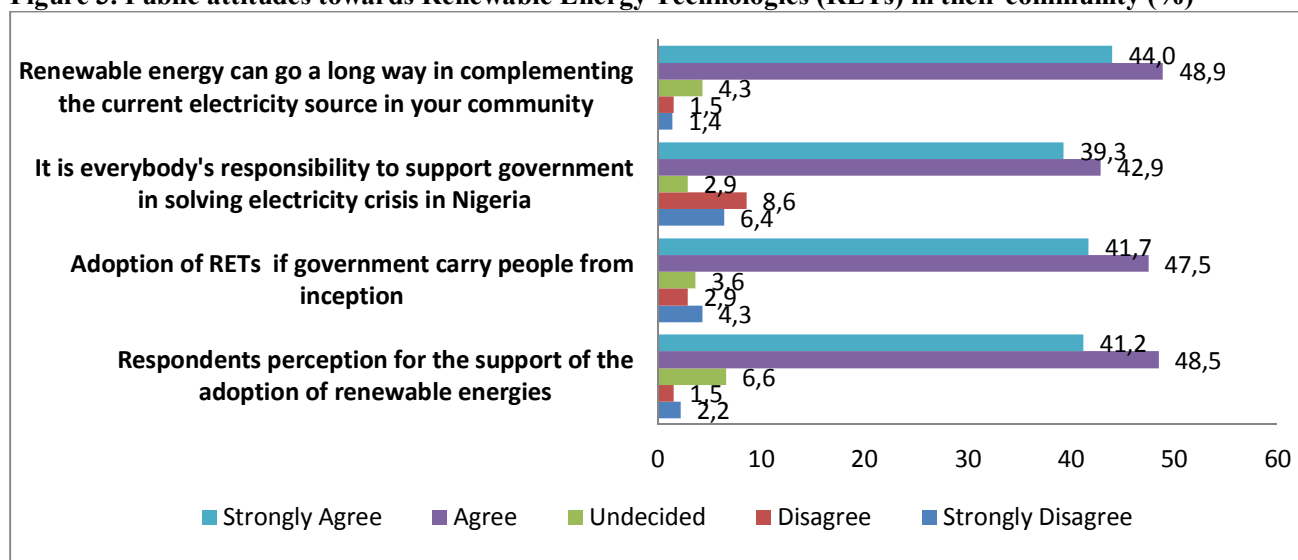


Figure 2 shows that majority of the respondents perceived that Solar PV followed by Solar heating, Hydro and Biomass respectively can be used to solve electricity problems in their community. They believed solar and hydro are averagely available in the region and what is only required is the technology to generate the required electricity from these sources.

Figure 3. Public attitudes towards Renewable Energy Technologies (RETs) in their community (%)



An average of 90% of the respondents perceived that renewable energy can be used to complement the national grid in their community. The figure also shows a large support for the adoption of renewable energy sources. That means that there is actually huge support for renewable energy in the south west region of the country. The larger proportion of the respondents (82%) also

believed that every citizen in the country has a role to play in supporting the government to solve electricity crisis in the country and average of 88% of the respondents agreed to adopt renewable energy technologies (RETs) if government carry people along from the inception of such technologies. This clearly showed that the majority of the respondents whose opinions were sampled do not have the tendency of ‘Not In My Backyardism’ (NIMB). The perception of the respondents about their operational knowledge and government involvement in renewable energy were also analysed as shown in Figure 4.

Figure 4. Respondents’ perception about the extent of government involvement and knowledge of the operations of renewable powered electricity

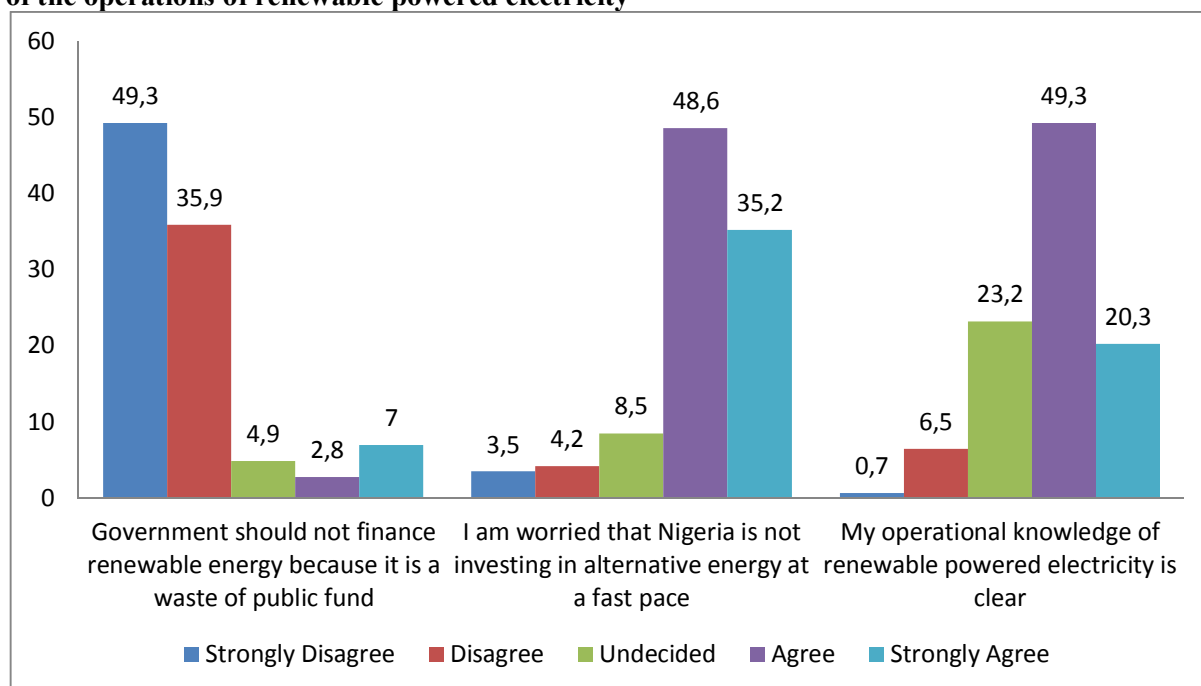


Figure 4 shows that majority of the respondents (84%) disagree with the statement that government should not finance renewable energy, but rather that the pace of investment of government in renewable energy is relatively too slow. Most of the respondents opined that government is just engaging in lip service by saying it wants to diversify the energy mix, this is because there is nothing that shows that there is political commitment from that same government towards renewable energy. The figure also shows that an average of 60% of the respondents claimed that they have an operational knowledge of renewable powered electricity. However, when we engaged a deeper quest of their extent of knowledge, we realised that 72% of the respondents who claimed they have an operational knowledge just have a mere knowledge of the energy source and not a deeper knowledge of how it works to generate electricity. Respondents were also asked questions about the number of hours they currently enjoy grid electricity generation and their willingness to pay. This is shown in table 3.

Majority (84.6%) of the respondents reported to be over-paying for the current electricity supply as 28.4% of the respondents claimed to have access to electricity between 4 to 6 hours daily using the present source of energy while 21.6% of the respondent had less than 2 hours Access to electricity daily. Correlation analysis was conducted to show the direction of relationship between the respondents’ willingness to pay more for electricity if the supply is regular and respondents’ income and age. The analysis showed that there is positive relationship between willingness to pay and the respondents’ monthly income (0.69); whereas, there is negative relationship between the respondents’ willingness to pay and age of the respondents (-0.51). These imply that respondents’ willingness to pay increase with individual’s income but decrease with individual’s age. The high income people as well as the youth will be willing to pay more for a regular supply of electricity than the low income

and old people. The result of willingness to pay, age and income is similar to the study conducted by Liu *et al.* (2013) in China.

Table 3. Extent of enjoying national grid electricity supply in respondents' home

Hours of electricity access	Percentage of Respondents
Below 2 hours	21.6
Between 2 and 4 hours	26.9
Between 4 and 6 hours	28.4
Above 6 hours	23.1
Total	100.0

5. Conclusions and Policy Recommendations

This paper examines the understanding and attitudes of the public on renewable energy sources towards realising energy access and development. This is with the view of making appropriate recommendation to the policy makers. This study seeks the level of understanding of the public about renewable energy so as to know whether these people will readily accept renewable energy to solve electricity crisis in their environment. This becomes important as some studies in the past by some scholars showed that the residents of some localities did not support the location of renewable energy projects in their areas. In order to harness the untapped renewable energy potentials in enhancing access to electricity, the attitudes and understanding of the public about the renewable energy cannot be overemphasized. For this purpose, a questionnaire was used to assess the opinions and attitudes of the population towards renewable energy (e.g. wind, small hydro and PV projects) applications in the south-west region.

The conclusions drawn from the survey show that large proportion of the respondents are aware of mainly hydro and solar PV and they are not knowledgeable about their operations in generating electricity. They supported the application of RETs in augmenting the current national grid to solving electricity crisis in their communities. More than 70% of the respondents claimed to have electricity supply of less than 6 hours in a day, and 84% of the respondents are willing to pay more for electricity generated from renewable energy once it is regular. The Nigerian government should truly commit itself to diversify energy mix by educating and training the populace on using RETs in providing electricity as well as creating an enabling environment for the private sector to use renewable energy technologies in various communities.

The study like some others has some limitations. The study was carried out in a particular region of the country due to financial and time constraints. The future studies will try as much as possible to cover the six geo-political zones of the country in order to examine whether the attitudes are different or not so as to come up with a robust framework in using renewable energy to provide electricity to the entire Nigerians.

This study shows that the public fairly understand the sources of Renewable energies but most of the sample respondents do not have a deep understanding of the operation of renewable energy technologies in generating electricity in the South-west Nigeria. Majority of the respondents showed interest of supporting renewable energy to augment the national grid supply in their communities instead of the current diesel/petrol generating sets use by them. This study makes suggestion that Nigerian government should educate its citizens more about renewable energy through various means such as media (e.g. Television, radio, newspapers etc), academic class and public awareness in different communities.

It is also suggested that government should commit itself politically in funding renewable energy technologies (RETs) as well as training many people on the operations of RETs so as to develop the capabilities to liberate Nigeria from depending on fossil fuel as the only alternative to generate electricity in various households. This will further create access to diverse energy sources. Nigeria government is also expected to create an enabling environment for the private sectors to operate successfully in using RETs to generate electricity as this will facilitate easier access to electricity in various communities since it has been established that youths and relatively high income people are willing to pay more once there is stable electricity supply.

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