

A Quantitative Study of Public Perception on Nuclear Power in Nigeria

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Abstract:

Nuclear power is among the best means of realising electrical generation in adequate capacity that improves both socio-economic and technological growth of any nation. This energy source is not without occurrences of severe and deadly accidents like that of Fukushima in 2011. However, the use of nuclear energy still attracts numerous positive and negative perceptions. The positive perceptions include: means of reducing emissions, achieving energy security and climate change mitigation while some of the major problems or negative public perceptions are: management of waste, radioactive waste disposal, distrust in the industry, inadequate security against terrorist attacks, safety concerns and costs of construction and decommissioning. This paper aimed to study public perception of nuclear power in Nigeria. Data for the study were collected from both secondary and primary sources. Secondary data were collected from related literatures and past studies across the World. Primary data was collected from questionnaire with the use of two-stage simple random sampling technique. Been a quantitatively study, the questionnaire were analysed using percentages, Kruskal Wallis and independent sample T-test. The study found that majority of the respondents has positive perception of nuclear power. A Kruskal Wallis test conducted revealed statistically different among the different age groups' perceptions on the statements about nuclear power. Similarly, the study revealed large support for nuclear built in the country while an independent sample T-test revealed that both gender responded similar on support or oppose to nuclear built in the country. The study concluded that since Nigeria has large land mass, nuclear plants can be located in remote areas far away from settlements and operate in safely manner, in order to boast energy security of the country.

Keywords — Public perception, Nuclear power, Nuclear energy, Electricity, Nigeria.

Introduction

Nuclear power is said to be electricity generation through a nuclear reaction named nuclear fission. Nuclear fission occurs in a reactor core and includes producing a nuclear reaction by splitting uranium atoms into smaller particles in a chain reaction that brings about large quantities of heat. The heat in turn is used to produce steam by heating water, which is then used to drive a turbine that turns a generator to yield electricity (Westinghouse, 2013). Many countries of the world used nuclear energy to produce electricity. The World Nuclear Association (2012) posited that

there are about 434 commercial nuclear power reactors operational in about 31 countries. These reactors produce a combined 13.5% of the world's electricity.

As demand for energy rises around the world, the desires for nuclear energy also increase. Although, nuclear power seems to be among the best means of realising electrical generation in adequate capacity, which in turn improves both socio-economic and technological growth of any nation, it is not without incidences of severe and deadly accidents (Kumar, 2008). Hence, in over 50-year history of civil nuclear power generation,

only three major accidents have occurred (Oludare et al., 2014), which are:

- Three Mile Island Reactor Unit 2 (TM1-2), USA, in March 28, 1979; the reactor was damaged severely but radiation was contained and there were no adverse environmental or health concerns.
- Chernobyl RBMK Reactor 4 in Russia in April 26, 1986, the damage of the reactor by steam blast and fire killed about 31 people and had substantial environmental and health concerns.
- Fukushima Daiichi 1-3 Nuclear power plant accidents in Japan in March 11, 2011, the three old reactors, dating from 1971-75 (together with a fourth) were written off.

However, like in other industries, the design and operation of nuclear power plants aims to reduce the possibility of accidents, and avoid major consequences on human when they happen (Oludare et al., 2014). Nevertheless, despite the three major accidents outlined above, they have been reasons or needs to build new nuclear power plants. These reasons include among others: increasing demand for energy, climate change, the need to reduce emissions objectives, an increasing dependency on fossil fuels and energy security (Goodfellow et al., 2011, Greenhalgh and Azapagic, 2009; Parkhill et al., 2010; Venables et al., 2012; World Nuclear Association, 2011).

Additionally, nuclear power has also turn out to be a more favourable choice for producing electricity because it is argued to be the least costly way for electricity generation when compared with other means of electricity generation (DECC, 2011b). WNA (2011) maintained that the benefits (economical) of nuclear power increases as CO₂ emissions reductions are encouraged via emissions trading schemes and incentives by government. Therefore, nuclear power may perhaps come to be a sustainable choice for the UK or other countries because is an established technology which can constantly generate electricity (DECC, 2011b).

Another debate that favoured the creation of nuclear power is increase in understanding of global warming and climate change which have brought about the need for using more proficient low-emission energy sources so as

to substitute fossil fuels (European Commission, 2007; WNA, 2011). This is so because nuclear power has been termed a low-carbon form of energy. Therefore, to meet up with emission targets and reduces the negative impacts of climate change and global warming, efficient energy and low-carbon economy needs to be formed. One way of doing this is creation of renewable energy and new nuclear power stations (DECC, 2011b). For instance, the British government in debating for the creation of “new build” in the UK has used the justification of tackling climate change as one of the reasons. The government claimed that: “Established against the challenges of climate change and security of supply, the proof in support of new nuclear power stations is convincing” (WNN, 2008j). Norris (2000) also argued that climate change is so hypothetically disastrous that any way to lessen greenhouse gases emissions must be exploited. Therefore, Pro-nuclear energy non-governmental organizations like Environmentalists for Nuclear Energy and the US-based Clean and Safe Energy Coalition; have come out to advocate for better use of nuclear energy.

Energy security which is taken to mean complete national self-reliance in energy or “energy independence” is always a fantasy (Trevor, 2010). It is hard to say any country in today’s globalized world, with the likely exclusion of Russia, is able to be energy self-governing (ibid). Many governments and other viewers often use the search for “energy security” to make a case for nuclear power and creating energy diversity. They believe diversity may be the most essential assurance for energy security (Schneider, 2009). Similarly, according to NEA, (2008a: 154): “the central advantages of nuclear power for energy security are the high energy concentration of uranium fuel combined with the steady and varied geopolitical distribution of uranium resources and fuel fabrication facilities, in addition to the easiness that strategic stashes of fuel can be sustained” Moreover, Uranium which is one of the main material needed for nuclear power is available in many countries, hence make nuclear power a feasible choice (WNA, 2011). In addition, unlike fossil fuels, prices for uranium are less likely to change when other

energy sources compared (European Commission, 2010) and Greenhalgh and Azapagic, (2009) maintained that the large amount of energy produce per tonne makes uranium comparatively low-cost.

Presently the energy system in many countries Nigeria inclusive faces numerous challenges in terms of energy security. This is because as domestic fuel supplies drop, prevailing infrastructure finishes and the energy mix starts to change in order to meet low-carbon goals (DECC, 2013a). One major threat to Nigeria energy security is the instability in oil producing states. Other threats to energy security include growing energy prices and disruptions of supply (Greenhalgh and Azapagic, 2009) and these threats have affected the availability of energy (Watson and Scott, 2009).

Nigeria has made considerable improvement over the years towards the goal to build a nuclear power plant by evolving the supportive institutions (such as Energy Commission of Nigeria, ECN; Nigeria Atomic Energy Commission, NAEC; Nigeria Nuclear Regulatory Agency, NNRA; National Energy regulation Commission, NERC among others) and infrastructure essential for its nuclear power plan. The NAEC developed a nuclear roadmap which is anticipated to drive the national nuclear plan. For input of nuclear power to national electricity generation a target has been fixed; as the first nuclear power plant is projected to be linked to the national grid by 2020. This coincide with the same year Turkey will bring its first nuclear power plant online (Tongal, 2011).

For the Nigerian government and in spite of its cost and difficulty, nuclear power has four particular attractions. Firstly, nuclear power would provide base-load generation at prices that are fairly constant, escaping the essential price variations of oil products. Secondly, foreign exchange earnings from the oil industry will be boasted by reduction in the internal demand for petroleum. Thirdly, Nigeria's energy stability will not be at the clemency of militants due to the fact that large share of natural gas needed for electricity generation is found the Niger Delta. Nuclear power would reduce the country's reliance on the unstable Niger Delta for its power needs. Fourthly and finally, if a long-lasting source of

domestic uranium could be safeguarded, nuclear power would donate to national energy independence by decreasing Nigeria's dependence on fossil fuels and water resources coming from adjoining countries (osaisai, 2009a). In Addition, Nuclear power would help Nigeria also add to international efforts to mitigate impact of climate change, particularly if big developing countries such as Nigeria are allocated mandatory carbon reduction targets under a post-Kyoto climate change command (Lowbeer-Lewis, 2010).

However, despite its numerous advantages, the use of nuclear power has regularly drawn controversies around the world with numerous arguments against or favour. These arguments in favour or against is what this paper termed public perception. Goodfellow et al. (2011) posited that public perception of nuclear power is necessary because it can have important effects if a country chooses to develop this form of energy. Previous studies into public perception has revealed that inhabitants living in areas with pre-existing nuclear facilities incline to be more supportive of nuclear power than the general population (Pidgeon et al., 2008). This is so because the construction of such facilities may bring social and economic benefits for inhabitants such as employment, better infrastructure like roads, water and tax revenues for states (Jenkins-Smith et al., 2011, 632; Venables et al., 2012,372). Jenkins-Smith (2011, 632) further stated that these kinds of benefits (be it social or economic) tend to lessen resistance but when these benefits are not in an area, they tend to be problem.

However, studies conducted by Parkhill et al., (2010) and Goodfellow et al., (2011) revealed that eventhough communities living near nuclear facilities tend to be in agreement for its location, they have worries about possible health threats. Sometimes, they are stigmatised by people living in other areas for agreeing to stay close to and accommodating nuclear facilities in their neighbourhood. In a similar research by European Commission (2010, 117), majority of respondents believed that nuclear energy can bring benefits such as combating climate change, reducing energy dependence, and stabilising energy prices. Although, issues such as the cost of nuclear power and the fear of terrorism that usually get high levels of media attention are repeatedly

stated as oppositions to nuclear power (Greenhalgh and Azapagic, 2009). Furthermore, Bickerstaff et al. (2008) study revealed that when nuclear power is outlined together with issues which are important like climate change, people tend to be more considerate to its establishment.

The use of nuclear energy still attracts numerous negative opinions even though it is understood to be a reliable energy source, a means of reducing emissions and energy security. The reasons have been that there are many concerns and problems regarding nuclear power that affect public opinion. This public opinion is what makes Goodfellow et al. (2011) to posit that it is the major challenge to new nuclear power plants construction. For instance, negative public opinion had led to substantial delays to projects e.g. Sizewell B and Druridge Bay and sometimes cancellation (Goodfellow et al., 2011). Studies carried out in the past revealed that some of the major problems the public have with nuclear power comprise; management of waste, radioactive waste disposal, distrust in the industry, inadequate security against terrorist attacks and safety concerns (European Commission, 2010, 11; Venables et al., 2012, 371) and environmental fears like climate change, mining for uranium and contamination (Parkhill et al., 2010, 40; Sovacool, 2011, 246).

Similarly, another reason public opposition to new nuclear power is the costs accompanying it. Nuclear power facilities tend to have high building and decommissioning costs with cost overruns associated with numerous projects (Sovacool, 2011, 39). De Esteban (2002, 3) stated further that ensuring safety of reactors and managing nuclear waste are also associated with high costs. Management of radioactive waste posed serious problem to the development of nuclear power plants because according to Parkhill et al., (2010, 41) and Greenhalgh and Azapagic, (2009), there is difficulty of safeguarding waste over an extended time periods and the lack of explanations for disposal of nuclear waste as well as concerns for environment. Though, WNA (2011) argued that countries with nuclear power handled and managed correctly its radioactive waste.

The media also play a part in influencing negative public perception of nuclear power creation. This is so because the mass media seems to be the only source of information with regards to nuclear power for many people. This information reported most times is untrustworthy or biased. Although a survey carried out by the European Commission (2010, 119) revealed that even though majority of people relied on the use of mass media to attain information relating to nuclear energy; many of them filtered the information reported about nuclear energy.

Materials and Methods

This study employs the use of both secondary and primary sources of data. The secondary sources of data used are journals, government and non-government organisations published reports, online publications among others. Been a quantitative study, primary data was gathered with the use of only structured questionnaire. Survey by questionnaire was adopted for this study because of the need to cover a practically representative and big sample over a reasonably little time period. By this, large public opinions of respondents which are as representative of Nigeria population as possible were gathered. Moreover, due to the intricacy of this topic, it was considered unreasonable to have open-ended questions on the questionnaire. Therefore, questions were shaped to emphasis on particular aspects and had multiple choice possibilities by which respondents could express the strength of their view on a 5 points 'Likert' scale (Bryman, 1995). The questionnaire was designed to comprise three sections:

- Section A: contained variety of questions to state the demographics characteristics of the sample
- Section B: contained questions on respondents familiarity and general understanding of nuclear power and nuclear industry, and;
- Section C: deals with questions on the respondents' perceptions on nuclear power and the nuclear industry;

There are many issues that could possibly influence the public's perception of nuclear power creation and it would be difficult to

investigate all parts (i.e. issues) within one research work. Consequently, to allow cross-comparisons and ensure uniformity with earlier studies on the public's perceptions on nuclear power; several of the questions were drawn from past studies of Eurobarometer, 2010; Greenhalgh and Azapagic, 2009; Ipsos MORI, 2010, 2011; Bickerstaff et al., 2008; Poortinga et al., 2005; Pidgeon et al., 2008 and Spence et al., 2010. Though, little modifications were carried out on the questions to ensure that there are as clear as possible and that terminology/technical language was substituted with simple English. Been an all-inclusive study intended to cover the all of the country; the six geo political zones were put into consideration. This made the study to draw respondents by using a two-stage simple random sampling. States were then randomly selected from each zone with Kano state from North West zone, Adamawa state from north east, Plateau state from north central, Oyo state from south west, Anambra state from south east and Edo state from south-south region of the country. The capitals of the states randomly selected are where respondents for the study were drawn. The reason was because the state capitals have the largest concentration of people as well as people with higher education background that can understand the various energy sources and intricacy of this study. To cover the length and breadth of each state capital, 20 respondents were randomly selected from each of the ten wards that make up the state capitals. This gives a total of 200 respondents from each state capital and an overall sample size of 1200 respondents. According to Ipsos-MORI, (2000), representative sample size for nationwide opinion sampling is about 1000. However, due to internet challenges in the country an online survey could not be adopted and the authors had to make use of physical questionnaire distribution to the respondents across the study areas. This prompts the authors to recruit the services of three volunteers who were trained and equip to help in questionnaire distribution in three of the study areas while the authors handled the rest. In this study, adults aged 18+ were targeted and surveyed over the period 03–18 December 2018.

Results and Discussions

Before delving into the analysis proper, construct reliability and validity were conducted because according to Kumar (2011), it is necessary quantitative studies. Similarly, for the fact that data for this study were mainly derived from scaled responses (i.e. the 5-point likert scale); it is necessary to evaluate the reliability of the scales (Curkovic et al., 2000; Tracey et al., 2005). As a result, reliability tests were conducted to measure constructs of the questionnaire. Cronbach's coefficient alpha which is the most extensively used test of internal consistency (Flynn et al., 1990; Ngai and Cheng, 1997) was employed by this study. The Cronbach's coefficient alpha test revealed a score of 0.849 which is above the minimum of 0.70 as argued by Swafford et al., (2006a). This result shows that there are internal consistencies among the constructs of the questionnaire. The validity of the research instrument was established by ensuring that the constructs of the questionnaire were derived from reviewed literatures and past studies. Furthermore, closed ended questions were asked while completed questionnaires were inspected for completeness and uniformity before embarking on data analysis (O'Leary-Kelly and Vokurka, 1998). Of the 1200 questionnaires administered, 1194 were completed to the fullest and were considered valid and usable for further analysis. The remaining 6 questionnaires were left out from further analysis. Though questionnaires poorly completed still provide some data; scholars habitually exclude such questionnaires so as to decrease the occurrence of missing data in statistical analysis in addition to improve the reliability of results (Gill and Johnson, 2002; Hair et al., 2006; Tabachnick and Fidell, 2007). Table 1 present the demographic characteristics of respondents. As the table revealed, there is representation of all sectors of life from gender, age, qualifications and employment status. This put the study into better perspective to divulge the main aim of the research.

Table1: Demographic Characteristics of Respondents

Demographic characteristics		Frequency	Percentage
Gender	Male	821	68.8
	Female	373	31.2
Age of Respondents	18-27	117	9.8
	28-37	209	17.5
	38-47	348	29.1
	48-57	289	24.2
	58 and above	231	19.3
Highest level of Qualification	Masters/PhD	273	22.9
	Bachelor/HND	241	20.2
	Diploma/NCE/Grade 2	188	15.7
	SSCE	246	20.6
	FSLC	246	20.6
Employment Status	Full time working	208	17.4
	Part time working	120	10.1
	Unemployed	149	12.5
	Retired	310	26.0
	Student	407	34.1

On familiarity with the term nuclear power, Table 2 shows that majority of the respondents 76.2% of the respondents are familiar with nuclear power. This result shows that respondents' are conversant with nuclear power to critically give their perceptions of it.

Table 2: Familiarity with Nuclear power

Familiarity	Frequency	Percentage
Not very familiar	34	2.8
Not familiar	53	4.4
Undecided	197	16.5
Familiar	420	35.2
Very Familiar	490	41.0
Total	1194	100.0

On the respondents' perception of nuclear power, Table 3 revealed that 2.7% (32) of them have very negative perception of it, 7.5% (90) have negative perception, 15.7% (187) are undecided, 35% (418) of the respondents have positive perception while 39.1% (467) have very positive perception of nuclear power. This result shows that majority of the respondents have positive perception of nuclear power and is in agreement with other past studies. In the study by Spence et al. (2010), it was revealed that public perception of nuclear power was much divided. Similarly, Ipsos MORI (2011) posited that the overall tendency toward nuclear power over the last years has been an increase in agreement to new nuclear build. Although, after the occurrences of the three major incidences listed in the introductory part of this study, there was lot of negative comments and opposition to nuclear power but over the years that have change around the world (Goodfellow et al., 2015), Nigeria inclusive based on the result of this study.

Table 3: Respondents' Perception of Nuclear Power

Perception	Frequency	Percentage
Very negative	32	2.7
Negative	90	7.5
Undecided	187	15.7
Positive	418	35.0
Very positive	467	39.1
Total	1194	100.0

To determine if there is statistical difference among the different age groups' perceptions on some statements about nuclear power, Kruskal-Wallis test was conducted, Table 4. The result revealed statistically different among the different age groups' perceptions on the statements about nuclear power. This is because Pallant (2010) maintained that if the significant level is less than .05 (i.e. .04, .01, .001 etc.); one can conclude that there is a statistically significant difference among the groups examined, Table 4.

Table 4: Kruskal Wallis Test on some Statement about Nuclear Power

	High cost	Inadequate management of waste	Poses a risk	Brings benefits	Improve energy security	Operated safely	Reported negatively by media	Limit climate change	Risk from terrorist attacks	Trust of regulations	Exploring other energy sources
Chi-Square	36.3	55.9	31.6	34.5	131.23	79.3	74.3	39.9	62.0	100.4	41.4
df	4	4	4	4	4	4	4	4	4	4	4
Asymp. Sig.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

On the question whether they will support or oppose the building of a nuclear power, Table 5 revealed that 3.4% of the respondents strongly oppose, 8.4% oppose, 10.6% were undecided, 33.4% support while 44.3% of the respondents strongly support. This shows large support for nuclear built in the country. This survey have revealed more positive about nuclear power. However, Ramana (2011, 44) notes that overall, in a survey respondents express less opposition to nuclear power than to a nuclear power station which would be built in their own area. One of the reasons was that such facilities bring risks to the area (Ramana, 2011, 45). Moreover, in the study by Spence et al. (2010, 16), when respondents were asked a similar question, 39% of them oppose the construction of a new nuclear power plant in their area.

Table 5: Support or oppose the building of a nuclear power

	Frequency	Percentage
Strongly oppose	40	3.4
Oppose	100	8.4
Undecided	126	10.6
Support	399	33.4
Strongly support	529	44.3
Total	1194	100.0

Similarly, to determine whether there are statistical differences in the mean on the building of nuclear power for male and female, an independent sample T-test was conducted, Table 6. The table show that there was no significant difference in scores for males (M = 4.07 , SD =1.091) and females (M= 4.07, SD= 1.079); t (1192) = -0.06, 0.95, two-tailed. The magnitude of the differences in the means (mean difference = -.004, 95% CI; effect size or eta squared = .0001 which is very small based on guidelines proposed by Cohen, 1988. Hence, this result shows that both gender responded similar on support or oppose to nuclear built in the country.

Conclusion

Nigeria is faced with a serious energy problem. Presently, Nigeria's infrastructure for power generation is inadequate to produce the amount of energy needs of the country. This is as a result of challenges traditional energy sources (hydro power and oil and gas) are facing. The hydro powers are too old and cannot supply the built capacity while the oil and gas stations are saddled with recurrent increase in the price of oil and gas, doubts about their long term availability and crises in the sector brought about sometimes by militants in the oil rich zone of the country. Furthermore, energy challenges increase as a result of steady increase in population. Nigeria population is about 190 million, the most in Africa continent. It is therefore important to

kick-start the nuclear energy programme. This will help to supply energy (electricity) over a long period, boost GDP, create jobs, reduce atmospheric pollution associated with gas stations as well as climate change mitigation. This study revealed that the general perception of the participants on nuclear power is positive as they support the building of nuclear power in the country. However, respondents of this study are of the opinion that nuclear power should be sought after several options for renewable energy production have been harnessed. Their argument been that nuclear energy comes with loads of risks and other

challenges such as technology development, radioactive waste management among others. It is therefore, recommended that Nigeria been a country with large land mass, nuclear plants can be located in remote areas far away from settlements and operate in safely manner, in order to boost energy security of the country. Similarly, agencies responsible for running the plants should be up and doing to ensure all the risk and hazards are prevented from happening.

Table 6: Independent sample T-test on the Building of Nuclear Power

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Support or oppose the building of a nuclear power	Equal variances assumed	.084	.772	-.062	1192	.951	-.004	.068	-.137	.129
	Equal variances not assumed			-.062	726.8	.951	-.004	.068	-.137	.129

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