Analysis of Public Electricity Demand and Supply in Kaduna South Local Government Area, Kaduna State, Nigeria

by

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Abstract

This study aimed at analyzing public electricity demand and supply in Kaduna South Local Government Area, Kaduna State. The work covered six (6) service centres across the 3 business units of the study area. The centres are Nasarawa, Makera, Tsaunin Kura, Sabon Tasha, Narayi and Barnawa. A total of 393 copies of the designed questionnaires were administered to the respondents and descriptive statistics were used to analyse the data obtained. The results revealed that more than 99.5% of the respondents used public electricity while only 0.5% did not. Analysis of power outage revealed that the majority of respondents experienced power outage that last for about 6 to 10 hours every day, while 24.2% reported 12 to 24 hours disruption of electricity supply. 17% of the respondents reportedly experienced power cut for over 24 hours. For about 15% percent of the respondents, power outage lasted for 2 to 4 hours daily while only 8.1% experienced power failure for less than an hour. Findings from the analysis of the frequency of power failure indicated that 65% (256) of the respondents’ experienced power failure more than 3 times a day while 21% (82) experienced power failure 3 times a day. For 8.7% (34) of respondents, the frequency of power failure was two times a day while only 5.3 % (21) said they experience power cut once a day. The results also revealed that 31% of respondents’ experienced voltage fluctuation monthly, 28% weekly, 24% daily, while 14% experienced voltage fluctuation twice a month with only 4% of respondents not experiencing voltage fluctuation at all.

Key words: Public electricity demand, household, consumption pattern, demand and supply
1. **Introduction**

In human history, energy assumes a significant position and is very essential to the survival of man (Hammond, 2008). Economic development and an improved quality of life are often believed to be dependent on continued extension of the use of energy. According to Bludden and Radish (1996), the growth of industrialized societies over the last three centuries has been strongly dependent on the ever increasing use of fossil fuels such as gas, oil, coal, hydroelectric power and more recently nuclear power. For example France, Belgium, Switzerland, Japan, United States of America and United Kingdom are called developed nations because they have advanced industrially and economically due to improved technology and steady power supply. On the other hand, developing countries like Bangladesh, South Africa, Botswana, Phillipines and Nigeria have been struggling with power supply which is a major driver of industrial advancement (GEI, 2014).

The Federal Republic of Nigeria, with the largest population in Africa and an energy resource base by African standards, both rich and varied, demonstrates many of the problems and potentialities of electricity production in the developing countries of the tropical world (Simpson, 1969). It is endowed with thermal, hydro, solar, and oil resources, and yet it is described as an energy-poor country because the sector is relatively under-developed.

Nigeria has witnessed perennial electricity crisis over the years and this has been evident by the incessant power failure and load shedding prevalent in the country. Various authorities (NEPA News, 2002; Simpson (1992); Lee and Anas (1991) have attributed the problem in Nigeria electricity sector to vandalism of electrical installations, poor funding of the industry, old and insufficient installations, low tariffs, water level fluctuations, stream flow variability and huge debts owed the electricity industry.

As power supply through the Power Holding Company of Nigeria (formerly, National Electric Power Authority) has proved very unreliable. It has become imperative for most industrial or commercial establishments or even individual consumers to acquire diesel standby generating plants at exorbitant costs. Besides, the hazards of diesel fumes to the environment, the situation has contributed significantly to increase in production costs in a highly depressed economy.

Thus, the quest to rapidly and firmly put the Nigerian economy on the course of economic development is technically, a function of adequate supply and distribution of energy particularly, electricity (Ayodele, 1999). In this regard, adequate supply and distribution of electricity constitute a central development issue which cannot be over-emphasized. Apart from serving as the pillar of wealth creation in Nigeria, it is also the nucleus of operations and subsequently the engine of growth for all sectors of the economy (Ayodele, 2001). In recognition of the consolidating linkage between the energy sector and the other sectors of the economy, electricity development and utilization therefore have pervasive impacts on a range of socio-economic activities and consequently on the economic progressiveness and wellbeing of citizens of the country. It is in the light of this facts that Okonkwo (2002) stated that there is a correlation between electricity supply, industrialization, and human comfort.
Bawa (2005) in a study on the effect of power outage on small-scale enterprises on the business district of Sabon-Gari, Kaduna, sourcing data via questionnaire survey, stressed that insufficient and irregular supply of power to small-scale enterprises result to decline in income rate and low revenue due to money spent on fuel for generator without appreciable increment in the amount or cost of goods sold and services rendered. All these studies focused on the effect of power outage on small-scale enterprises, household and industries, while this research is focused on analyzing the quality of electric energy demand and supply to house hold in the Kaduna South Local Government Area of Kaduna State.

2. **Aim and Objectives**

The following objectives were pursued: to analyze the quality of the power supply in the study area; examine the consumption pattern electric energy in the study area; assess the effects of irregular power supply on households in the study area; and to examine the differences in electric energy demand and supply in the study area.

3. **Study Area**

Kaduna South falls approximately within latitudes 10°26′N – 10°29′N and between longitudes 7°23′E – 7°29′E (figure 1). The residential areas in the Southern part of Kaduna metropolis have a unique and district spatial neighbouring pattern. The neighbourhood are broadly recognised as Sabon Tasha, Tudun Nupawa, Tudun Wada, Kabala, Barewa, Narayi, Ungwan Sunday, Television, Kakuri and Nassarawa neighbourhoods. The roads and agricultural land uses cut across all categories of slopes. However, agricultural use is least in the Southern part of Kaduna South because the area is designed for industries and its associated road linkages (Ali, 2004).

Activities in the Kaduna South reflect the commercial, service, administrative, industrial, transport and professional needs of the state and northern Nigeria. The 1956 capital territory law created the limits of the present day city of Kaduna and set in motion, the rapid and dynamic physical, economic and social transformation of the town. This led to the establishment of modern infrastructural facilities such as electricity power supply, pipe borne water, good road, several banks and an international airport. These modern infrastructures were the backbone of the establishment of at least five (5) industries such as textile mills, breweries, bottling companies, flour mills and a motor assembly plant, just to mention a few. These attracted many people especially the youth to seek employment and share in the economic development of the town (Ali, 2004).
The railway serves as a vehicle for economic and commercial tool, the railway line from the East and West meet, hence the name Kaduna Junction, the railway become most important as the surrounding rural population could not produce the food required to sustain the increase influx. Therefore, the railway becomes an important mode of transporting food, industrials and agricultural products both into and out of Kaduna to the cost (Ali, 2004).

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of Kaduna South because the area is designed for industries and its associated road linkages (Ali, 2004).

4. Materials and Methods

Types and Sources of Data

To achieve the set out objectives of this study, a structured questionnaire was created by the researcher and administered to respondents in the study area.

Sampling Technique and Sample Size

There are three business units in the study area which are: Makera, Barnawa and Sabon-Tasha. Barnawa has four service centres while Makera and Sabon-Tasha has five service centres each. A Purposive Random Sampling technique was adopted for this survey such that two (2) service centres from each business unit was used. This was because they were the major control service centres. To select the appropriate number of respondents, the Yamane (1967) formula was used to calculate sample size with 95% confidence level and 5% sampling error assumption to give a total of 393 respondents, using the formula:

\[ n = \frac{N}{1 + Ne^2} \]

where, \( n \) = sample size, \( N \) = population size
\( e \) = sampling error (0.05)

Using the above formula, questionnaire was administered to a total of 393 respondents with pre-paid meters in all business units as shown in Table 1. The three business units had a customer population of 23908 with pre-paid accounts consisting of 5628, 16180, and 2100 from Makera, Barnawa and Sabon-Tasha respectively. The study area formed the sampling frame for the study.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Business Unit</th>
<th>Service Centres</th>
<th>No. of Pre-paid Meters</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Makera</td>
<td>Nasarawa*</td>
<td>500</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gonin-Gora</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Makera*</td>
<td>5,120</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Romi</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trikania</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Barnawa</td>
<td>Barnawa*</td>
<td>9,062</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ungwan Yelwa</td>
<td>7,118</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narayi*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ungwan Maigero</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sabon-Tasha</td>
<td>Tsaunin-Kura*</td>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kamazou</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sabon-Tasha*</td>
<td>1,500</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ungwan Boro</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ungwan Gimbiya</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: PHCN Kaduna South, 2015 * Selected Settlement
Descriptive statistics test was used in analysing all the data collected for this study in order to achieve all the set objectives. The statistical analyses for this study were all computed using SPSS version 21 statistical programme and Microsoft Excel 2007.

5. Results and Discussion

The quality of electricity supply, measured in terms of outages and voltage fluctuation, varies considerably between countries but is rarely measured or described (Steinbuks and Foster, 2010) and is thus more difficult to analyse. The quality of Nigeria’s electricity supply ranks 141 out of 148 countries in the World Economic Forum’s Global Competitiveness Report 2013-2014, and 13 out 129 countries for energy security in the World Energy Council’s Energy Sustainability Index.

Distribution of people that use Public Electricity

Table 2 represents the distribution of respondents that use public electricity in the study area.

Table 2: Distribution of Respondents by the use of Public Electricity

<table>
<thead>
<tr>
<th>Comment</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>391</td>
<td>99.5</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>393</td>
<td>100</td>
</tr>
</tbody>
</table>


Table 2 revealed that despite the epileptic nature of electricity public supply 99.5% of people used public electricity while only 0.5% people did not. This agreed with IEA (2014) that electricity demand per capita in North Africa increased by more than 80%. This means that there is a high dependency of people on public electricity.

Duration of Power Outage

The quality of electricity supplied in a particular area can be judged by the number of hours the area experience power outage. Table 3 presents the opinion of respondents about the duration of power outage the study area.

Table 3: Duration of Power Outage

<table>
<thead>
<tr>
<th>How long each Power Outage last</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1 hours</td>
<td>32</td>
<td>8.1</td>
</tr>
<tr>
<td>2 to 4 hours</td>
<td>58</td>
<td>14.8</td>
</tr>
<tr>
<td>6 to 10 hours</td>
<td>141</td>
<td>35.9</td>
</tr>
<tr>
<td>12 to 24 hours</td>
<td>95</td>
<td>24.2</td>
</tr>
<tr>
<td>Over 24 hours</td>
<td>67</td>
<td>17.0</td>
</tr>
<tr>
<td>Total</td>
<td>393</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3 revealed that the majority of respondents (35.9%) experienced power outage that lasted for about 6 to 10 hours every day, while 24.2% reported 12 to 24 hours disruption of electricity supply. 17% of the respondents reportedly experienced power cut for over 24 hours. For about 15% percent of the respondents, power outage lasted for 2 to 4 hours daily while only 8.1% experience power failure for less than an hour. This suggested that over 50% of the respondents did not enjoy 12 hours of uninterrupted power supply every day. This was relatively worse than the national average record of power outages for eight hours per day experienced in the nation (Moyo, 2012). This observation was also in line with the findings of Nana (2008) who analyzed the effect of erratic power failure on small scale businesses in Maiduguri using primary data and discovered that 59% of the respondents did not depend on electricity from PHCN to run their respective businesses.

**Frequency of power failure per day**

The frequency of power interruption was another way to measure the quality of power supply in any given area. The respondents were asked to express their opinion about the number of times they experience power interruption in a day and the result is presented in Figure 2.

Figure 2 revealed that 65% (256) of the respondents’ experienced power failure more than 3 times a day while 21% (82) experienced power failure 3 times a day. For 8.7% (34) of respondents, the frequency of power failure was two times a day while only 5.3 % (21) said they experienced power cut once a day. The quality of power supply in the study area could be seen to be very poor as more than 60 per cent of respondents indicated that they faced power outages for more than 3 times a day.

![Figure 2: Frequency of power failure per day](source: Field Survey, 2015.)
Voltage Fluctuation

Voltage fluctuations are defined as repetitive or random variations in the magnitude of the supply voltage. The magnitudes of these variations do not usually exceed 10% of the nominal supply voltage. The characteristics of voltage fluctuations depend on the load type and size and the power system capacity. However, some appliances and equipment require stable incoming voltage for them to perform accurately. Lamp flicker occurs when the intensity of the light from a lamp varies due to changes in the magnitude of the supply voltage. This changing intensity can create annoyance to the human eye. Susceptibility to irritation from lamp flicker will be different for each individual. Voltage fluctuations may also cause spurious tripping of relays; interfere with communication equipment; and trip out electronic equipment. Severe fluctuations in some cases may not allow other loads to be started due to the reduction in the supply voltage. Additionally, induction motors that operate at maximum torque may stall if voltage fluctuations are of significant magnitude.

Table 4: Voltage Fluctuation

<table>
<thead>
<tr>
<th>Voltage Fluctuation</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>93</td>
<td>24</td>
</tr>
<tr>
<td>Weekly</td>
<td>109</td>
<td>28</td>
</tr>
<tr>
<td>Twice a month</td>
<td>56</td>
<td>14</td>
</tr>
<tr>
<td>Monthly</td>
<td>121</td>
<td>31</td>
</tr>
<tr>
<td>None</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>393</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*Source: Field Survey, 2015.*

Table 4.4 reveals that 31% of respondents’ experienced voltage fluctuation monthly, 28% weekly and 24% daily. 14% said they experienced voltage fluctuation twice a month while only 4% of respondents do not experienced voltage fluctuation. Dimming of light (lamp flicker) indicating fluctuations was also shared by many of the respondents. Many respondents have also reported cases of high voltage damaging their appliances.

6. **Conclusion and Recommendations**

This study was carried out to analyse the quality of Public Electricity supply in Kaduna South Local Government Area, Kaduna State, Nigeria. Descriptive statistics were used to analyse the quality of public electricity supply. The result of the study has clearly confirmed the epileptic electric power supply in Kaduna South and this has adversely affected every sector of the economy of the study area. Also, the study has identified that irregular supply of electricity has created an additional strain on the financial burden of the households in the study area as most respondents’ uses generators which are usually more expensive to maintain as opposed to direct power supply from distribution companies.
In order to correct the lopsided nature of epileptic electricity supply in the Kaduna South and its attendant problems, the following should be taken into consideration:

Government should provide more funds to PHCN in order to improve power generation. They should ensure this project is carried out and the funds are used for the purpose for which it was allocated. Also, the community should help in protecting PHCN equipment and government should assist the communities with proper security, to stop vandalism of the equipment and ensure that disciplinary actions are taken on those vandalizing PHCN equipment like transformers and cable lines. Further studies should be carried out on private sectors participation in electricity generation, transmission, and distribution on public electricity supply and demand in the area in other to find lasting solution to the problem.

References