Evaluation of the Condition and Utilization of Electricity Transformers in Sabon Gari Local Government Area Zaria, Kaduna State, Nigeria

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ABSTRACT

The study aims at examining the distribution of Electric transformers and their utilization level in Sabon Gari LGA Zaria. The objectives were to; examine the conditions of the transformers and explain the level of utilization of the transformers in the study area. A purposive sampling technique was used to select the study area as well as the respondents. A total of 361 copies of structured questionnaire were administered to the residents in the study area, while 50 copies of questionnaire were administered to the PHCN Staff at the 3 distribution units (i.e. Samaru, Dogarawa and PZ) in the study area, out of which 361 and 50 copies of questionnaires were adequately filled and returned from the residents and PHCN Staff respectively. The results are presented using tables. The results indicated that two-fifth of the Public owned transformers are found in both Samaru and Dogarawa area each, while the rest one-fifth is found in PZ area. Also, private owned transformer nearly one-third of the transformers are found in Samaru area, a little above one-third in Dogarawa and a little above half in PZ where there are more banks and companies. Finding on the conditions of public transformers revealed that four-fifth (80.0%) of the transformers need repair while the rest one-fifth needs to be change. All the private transformers in the study are in good condition. The result on the response of respondents on power supply hours show that well above three-fifth of the respondents reported that they have power supply for 12 hours, while less than one-tenth reported that they have power supply for 24 hours every day.

Key words: Spatial, Distribution, Utilization, Electricity Transformer, Zaria

INTRODUCTION

The Electric power sector is one of the most important sectors to national development. It is also critical to the developmental reform of any country. The Power Holding Company of Nigeria (PHCN) formerly known as the National Electric Power Authority (NEPA) is an organization involved in the supply of electricity in Nigeria and presently due to privatization of the power sector, Kaduna state now has an electricity distribution power body called Kaduna Electricity Distribution Company (KEDCO). The power sector plays a very important role in the economic development of a nation; therefore, the growth of industries, agriculture, infrastructure, and the private sector is dependent on the state of the power sector.

In Nigeria, the Power Holding Company of Nigeria (PHCN) is the public utility company saddled with the task of managing the power sector. PHCN was established in 1972 with a

mandate to maintain an efficient system of electric supply to all parts of the Nigeria. After NEPA was renamed PHCN, the government also unbundled 18 successor companies from the PHCN – six generation companies; one transmission company and 11 distribution companies. These networks are made up of wires, pipes, transformers, valves, meters and poles and these networks needs to be managed by a complex database in order to censure effectiveness of operation (Williams, 2010).

The importance of electric power supply cannot be overemphasized as it is considered the most important commodity for national development. With electrical energy, people are empowered to work from the domestic level and the cottage industries, through the small-scale and medium industries to employment in the large-scale manufacturing complexes. In these days, depriving people of electric power is tantamount to castration (Musa, 2009). Electric power is the engine that drives industrialization, which improves communication, helps innovation in science and Technology, provides sound healthcare delivery system and improves citizen's standard of living. Since electric power is the engine that drives industrialization, a stable supply is the key for Nigeria to become one of the 20 developed economies in the world. However, it is unfortunate that the biggest problem in Nigeria is electricity crisis, a crisis without end. It was also revealed that the total grid capacity of 8,876 MW with only 3,653 MW available as at December 2009.

A number of studies in the years were conducted on different aspects on power generation, distribution and facilities. For example According to Pickering (1993), any organization that expects to run an efficient day-to-day operation and to manage and develop its services effectively must know what asset it has, where they are, their condition, how they are performing, and how much it costs to provide the service.

According to Manga (2012) there are two types of transformers that are being used in Sabon Gari Local Government Area (LGA). These transformers are the dedicated transformers and the Public transformers. The dedicated transformers are the transformers that are been used by personal companies like the banks and other big companies. These companies usually have their transformers in their own premises and these transformers are usually mounted. They usually have electricity most hours of the day. The owners take care of their transformers and because of the security they have in the companies like the banks the transformers cannot be stolen from the premises, while the public transformers are the transformers that are being used by the public. They are installed in the public places on the ground and no security is assigned to watch over the transformer and as a result of that it can be easily stolen and tampered with. And also illegal connection can be done on it (Manga, 2012).

Previous researches have been carried out on electricity distribution in other areas of the country. For instance, Iyanda (1982) adopted the self-assessment methodology to estimate the impact of power shortages on the household sector. He focused on the high-income area of Lagos Island, Ikoyi, Victoria Island, Yaba and Surulere areas of Lagos state in Nigeria. He estimated an average electricity outage cost of N1.19 per hour for each household.

In view of the above previous studies, it is clear that they all focused in measuring the cost of electric power shortages in Nigeria but none to the best of my knowledge have been carried out on the spatial distribution and utilization of electricity transformers in SabonGari LGA. This is the

reason why this research on the spatial distribution and utilization of electricity transformers is been carried out, with a view to determine their efficiency and optimality.

Aim and Objectives of the Study

The aim of the study is to examine the distribution of Electric transformers and their utilization level in Sabon Gari LGA Zaria. This will be achieved through the following set of objectives to:

i. Examine the conditions of the transformers.
ii. Explain the level of utilization of the transformers

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METHODOLOGY

This section presents the reconnaissance survey, types of data, sampling technique and data analyses.

Study Area

Sabon Gari LGA is one of the important LGA in Kaduna State; it is located on a plateau at a height of about 2,200 feet above sea level on the contour of Kaduna state, northern Nigeria and more than 400 miles away from the sea. The LGA lies between Latitudes 11°15' N to 11° 3'N of the equator and Longitudes 7° 30' E to 7° 45'E of the Greenwich meridian with a total land area of approximately 600Km Z (Google earth, 2011). It occupied a land area of about 263km ^{2}.It has boundaries with the neighboring LGAs on the east by Soba, to the north by Kudan, Giwa to the west and Zaria to the south. The Local Government Secretariat is presently situated at Dogarawa village and the local government has eleven wards namely Anguwan Gabas, Chikaji, Muchiya, Dogarawa, Basawa, Jushi, Sakadadi, Shika, Hanwa, Jama'a, BomoabdZabi. It has six districts which include Sabon Gari, Hanwa, Muchiya, Basawa, Samaru and Bomo (See Figure 1 on page 6).

Designed and laid out by British colonial administrators with suburban "garden city" standards in minds occupied and built by commercial southern Nigerians, more recently by northern Nigerian escaping from traditional restrictions with crowded village or city life as an ideal, and built in the pre-auto, pre-electric age, Sabon Gari, is a combination of early twentieth century colonial and Nigerian ways. It existence is geared to the railway, commerce and provincial administration with railway to Kano, and formally to Jos. The railway corporation has made Sabon Gari LGA a focal point for collecting overshadowed by Kaduna. Recently the local market itself has become more important with an increase in the number and size of educational institutions and factories.

The Government Residential Area (GRA) forms the largest part of the old European location, is composed of large plots (1-2 acres) with spacious houses and public offices surrounded by extensively planting of ornamental trees and shrubs. The curved streets, trees lined and shady, are broad and well maintained. The Zaria club with its polo ground race course and golf course separates the GRA from the residential compounds of the senior railway officials, creating an open park in the midst of an ideal type of English suburban life in which house gardens, trees

open space and quiet set the tone. The Commercial areas south of the GRA popularly known as Hanwa fly over and has spacious environment. The roads are crossed at right angle and bound large plots on which both trade and residence can go on with little conflict. Sabon Gari is the gateway to important towns of Kano, Funtua, Gusau, Katsina and

A reconnaissance survey was conducted to be well familiarized with the study area. This gave the researcher an in-depth knowledge of the electricity supply and utilization challenges in the study area. Also the survey helped to determine the sampling techniques to be employed in selecting the sampling areas as well as to determine the various issues to be address in the questionnaires.

The following were the types of data used for this study:

(1) Data on the location of transformers;
(2) Data on the number of transformers in Sabon Gari;
(3) Data on the type and ownership of transformer used;
(4) (4)Data on the status of the transformer; and
(5) Data on the level of utilization of the transformer.

The primary source provided information on power supply and distribution to residential and commercial areas, time and duration gotten from questionnaires and interviews. The questions were designed for residents in the service area. The questions included the number of transformers found within the service area, the quality/frequency of power supply, place / type of resident etc.

This was obtained from PHCN records, books, journal publications, other sources are published and unpublished works from existing materials, on-line materials, and Conference papers among others to know how electricity transformers are been distributed and utilized within and outside the study area.

In order to select the respondents to be interviewed, a multi sampling technique was used. In the first stage, residential houses were used as sample points, this is because, each house is assumed to be connected to the PHCN power grid. Hence questionnaires were administered to every of the occupant present and also to KEDCO staff. To achieve this, the 2006 housing population census of Nigeria was used to determine the number of houses in the study area and the total number of houses in Sabon Gari is 52,977 (NPC 2006).

In the second stage, sampling technique was used to select the specific areas to be sampled in the study area. These selected areas are Sabon Gari, Samaru, PZ Area and Hanwa. The reason for the selection of these areas was due to the fact that they have most of the information required for the study; hence the research is limited to a proportion of the study area selected for study.

Thirdly, to determine the sample size, Kregcie and Morgan (1976) formula for sample size selection was used. According to the formula, population of 50,000-60,000 was use as sample size of 361. Hence, 361 respondents were sampled. Also, 50 staff from the three (3) PHCN units in the study area was sampled. The sampled staff comprised of field engineers and heads of various units. The sampling of 50 staff was informed by the information gathered on the manpower capacities of the units during the reconnaissance survey.

Lastly, to determine the specific number of respondents to be sampled in the selected areas, reconnaissance survey was carried out in order to know the population and the number of houses in the study area. Based on this, questionnaires were distributed proportionally to the housing composition of each type of houses within the study area, while the specific respondents in each of the randomly selected houses were interviewed.

Table 1: Distribution of Housing Units and Proportion of Respondents to be Sample

S/N	Type of Housing Unit	Housing Units Populations	Proportion of Samples
1	Separate stand house	31,107	212
2	Hut structure made of traditional material	2773	19
3	Flat in block of flats	6119	42
4	Semi-detached house	4202	28
5	Room/let in house	8137	55
6	Informal/improvised dwelling	299	2
7	Others	488	3
Total		**52,977**	**361**

Source: Adopted from NPC 2006 Housing Population Census Report

RESULT AND DISCUSSION

This section presents the distribution, capacity and conditions of electricity transformers in the study area.

Table 2: Distribution on number of Public owned Transformers, Private owned Transformers, Lowest Capacity of the transformers, Highest Capacity of the transformers, Conditions of Public transformers and Conditions of Private transformers

VARIABLES	FREQUENCY	PERCENTAGE
Number of Transformer Under PHCN Units in Sabon Gari		
Samaru	35	35
Dogarawa	27	27
PZ	38	38
Total	**100**	**100**
Public owned Transformers		
Samaru	20	40
Dogarawa	20	40
PZ	10	20
Total	**50**	**100**
Private owned Transformers		

VARIABLES	FREQUENCY	PERCENTAGE
Samaru	15	30
Dogarawa	7	14
PZ	28	56
Total	**50**	**100**
Lowest Capacity Transformers		
50 KVA	20	40
100 KVA	25	50
200 KVA	5	10
Total	**50**	**100**
Highest Capacity Transformers		
300 KVA	15	30
500 KVA	35	70
1000KVA	0	0
Total	**50**	**100**
Conditions of Public Transformers		
Needs repair	40	80
Needs change	10	20
In good condition	0	0
Total	**50**	**100**
Conditions of Private Transformers		
Needs repair	0	0
Needs change	0	0
In good condition	50	100
Total	**50**	**100**

Source: Field Survey, 2015.

Presentation in Table 2 shows that PZ unit has the highest percentage of transformer distribution with 38%, followed by Samaru unit with 35% and the least being Dogarawa unit with 27% of distribution transformers under the study area. In addition, both Samaru and Dogarawa distribution unit have more public owned transformer than PZ distribution unit in the study area. This indicates that both Samaru and Dogarawa distribution unit account for 40% each while PZ distribution unit has 20%. This indicates that Samaru and Dogarawa are more of residential than industrial while PZ has more of industrial and bank areas. On the aspect of private owned transformer it shows that PZ distribution unit has more transformers than Samaru and Dogarawa distribution unit in the study area. This indicates that PZ distribution unit account for 56% while Samaru distribution unit accounts for 30% and Dogarawa distribution unit accounts for 14%.

Based on the frequency of the capacity of transformers, 100KVA is the lowest capacity of transformer in the study area while 500KVA is highest capacity of transformer in the study area. The frequency of 100KVA which is the lowest capacity is 50% is mostly found in the banks. This is because the banks have their own transformers and they don't share their transformers while that

of 500KVA which is the highest capacity of transformer is 70%is mostly found in the residential areas because the transformers carry more houses than the 100KVA.

In addition, the condition of the transformer matters for effective distribution and utilization. Majority of the staff (80%) are of the opinion that the public transformers need repairs and about 20% also said the transformers need change. This is as a result of the load the transformers are carrying which makes the transformer to become overloaded and even breakdown. Suleiman and Ali (2009) attributed overloads and poor maintenance of transformers as factors responsible for a total breakdown of over 31 transformers with an estimated cost for repairs and replacements amounting up to 30 million naira in a related study carried out in Sokoto state Nigeria.

While on the aspect of the condition of the private transformers 100% of the staff, are of the opinion that the transformers are in good condition and this is because these transformers are owned by companies, banks etc and they do not carry much load so they last longer than the public transformers.

Results in Table 3 shows that 100% of PHCN Staff are of the opinion that the public transformers are over loaded. This indicates that the level of illegal connections done on the public transformers is high and also the number of transformer are also few compare to the number of houses in the study area. While 80% of the PHCN Staff are of the opinion that the private transformers are moderately utilized and 20% are of the opinion that the private transformers are under loaded utilized. This shows that the private transformers carry fewer loads and the number of houses, banks and companies that make use of these transformers are few compare to that of the public transformers. The maintenance culture is also very good because it is done by the engineers in companies and banks.

Table 3: Utilization Level of the Electricity Transformers based on PHCN Staff

VARIABLES	FREQUENCY	PERCENTAGE
Utilization Level of Public Transformer		
Over loaded	50	100
Moderately loaded	0	0
Under loaded	0	0
Total	**50**	**100**
Utilization Level of Private Transformer		
Over loaded	0	0
Moderately loaded	40	80
Under loaded	10	20
Total	**50**	**100**
Type of Transformer under load shading		
Public Transformer	50	100
Private Transformer	0	0
Total	**50**	**100**
Type of Repairs Done on Transformer		

VARIABLES	FREQUENCY	PERCENTAGE
Change of Fuse	35	70
Replacement of coils and core	10	20
Replacement of radiator, tanks	5	10
Others	0	0
Total	**50**	**100**

Source: Field Survey, 2015.

On the aspect of the transformers that load shading carried out on, 100% of the PHCN Staff indicated that load shading is done on the public transformers because the transformers are usually overloaded due to the fact that the houses are more than the transformers and for every house to have electricity rationing of the light must be done and this is done in a way that an area will be given electricity for 6 hours and the other areas alike. Load shading cannot be done on the private transformers because their transformers are not overloaded.

Based on the type of repairs carried out on the transformers, 70% accounted for change of fuse, 20% accounted for replacement of coils and core while 10% accounted for replacement of radiator and tanks. This indicates that the changing of the fuse is mostly common because of either high voltage or overloading of the transformers this makes the fuse to burn and in the aspect of the replacement of coils, core, radiator and tanks it's not that common because it takes a longer time before they get damaged unlike the fuse.

CONCLUSION

This study examined the spatial distribution and utilization of electricity transformer in Sabon-Gari local government area in Kaduna state. The supply of adequate and stable electricity to consumers is the back bone of socio-economic growth of any nation and Nigeria is not an exception. The power sector in Nigeria has multidimensional problems such as bribery, corruption and mismanagement of funds for execution of electricity power projects. The overloading of transmission and distribution transformers, vandalizing of power lines by thieves, winds, construction projects, soil erosion etc., are not unconnected with power problems faced in Nigeria. These factors are seriously affecting the performance indices of electricity utilities in the country. The performance indices are efficiency, number of customers connected to distribution line per transformer, high maintenance cost and transmission line losses (Copper losses). The loading of transmission and distribution transformer should be reduced. This is in order to trim down the number of customers per transformer. Illegal connection should be discouraged by the stakeholders. PHCN's management should develop a maintenance culture whereby they check on their equipment more regularly rather than waiting for the equipment to finally breakdown before they find a solution. The management of PHCN should also employ and train competent staff in order to be able to deal with the challenges of providing quality services to its numerous customers. And also they should be upgrading their equipment to be able to meet up with the demand of its customers. The Federal Government should also give PHCN more funds to enable them get more transformers and also monitor the buying and fixing of the transformers.

This research has found and concluded that GIS is a tool capable of mapping and building a geo database for all the transformers in Sabon-Gari LGA. A digital map was produced to show the positions of each transformer with a textual data (attribute data) providing all the necessary information's about the transformer.

RECOMMENDATIONS

Based on the findings of this research, it is recommended that more transformers be provided in the study area in order to reduce the pressure on the existing ones. Moreover, servicing of transformers should be carried out regularly. It is further recommended that the result of this research be utilized by decision maker for sustainable development.

For Nigerians to have adequate electricity supply this study recommends the following:

1. The loading of transmission and distribution transformers should be reduced. This is in order to trim down the number of consumers per transformer to a ratio of about 10 consumers per distribution transformer.
2. Illegal connections should be discouraged by electricity power stakeholders.
3. More effort must be made to bring in refined and scientific approaches such as Geographic Information Systems into the management of electricity distribution network.
4. Training programs should be organised for technical online staff on electricity distribution on the integration of GIS in the management/ monitoring of electricity distribution.
5. Establishment of more distribution substation transformers in low voltage area within the study area.

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