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Research Paper

Spatial Assessment of Building Encroachment Level of Existing Alaoji - Onitsha 330 kV SC Transmission Line Project Right of Way

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Abstract
The study assessed the building encroachment levels of existing Alaoji-Onitsha 330 kV SC transmission line project right of way. Four hundred copies of questionnaire were administered to the residents of the study area while the information of buildings wereobtained from the Open Street Map website.Descriptive and inferential statistics were used for the data analysis. Findings showed that majority (72.36%) were males, married (54.77%) and low-income earners (51.01%). Majority of the buildings were "face to face" structures and were used for residential (30.15%) and commercial (34.92%). There was a significant variation in the characteristics of buildings along the powerline high voltage ($F=15.626$, $p<0.05$). The analysis of the buildings shows that the residential recorded 1452 (51.71%), industrial recorded 257 (9.15%), religious recorded 89 (3.17%), and commercial recorded 600 (21.37%) while educational buildings recorded 410 (14.60%). The study can be concluded that the right of way of the Alaoji-Onitsha transmission power line has been occupied by the residents of the neighbourhood with varying socio-economic characteristics and the buildings are mostly used for residential and commercial purposes. The study recommended that the buildings or any construction taken place in this ROW of transmission line should be demolished but the residents can be resettled somewhere else with little amount of money to be paid by whoever interested to make use of the advantage. The government should provide a solid resettlement action plan after displacing the occupants of the ROW.

Keywords: *Encroachment, building, transmission line, right of way*

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I. Introduction

Electricity transmission can produce many negative externalities that include landscape and visual impacts (Tempesta et al. 2014); health risks associated with electrical and magnetic fields (Bickel and Friedrich, 2005); damage to the environment and wildlife (Sumper et al., 2010; Soulsbury and White, 2015); damage to scientific, historical and cultural areas; reduced profitability of productive activities; land use conflicts (Doukas et al., 2011); decreased property values (Furby et al., 1988). In particular, when negative impacts are evident, studies have highlighted a discount between 1% and 10% of property value (Des Rosiers, 2002), which decreased rapidly as the distance from the power line increased, and usually disappeared at 60-90 meters from the line (Colwell, 1990). It was also posited that selling prices of vacant residential land with future potential residential use does not affect the value of land close to the power line (Mitchell and Kinnard, 1996). The effects on the value of properties in rural areas were also uncertain. Several authors (Chalmers, 2012) found no effects, even where land use was recreational (for example, with a high level of environmental amenity) and rural-residential. On the contrary, Woods (1981) found some effects in a few percentage points, but perhaps related to the fact that these farms would soon become residential areas. Ball (1989) highlighted a 2% reduction, while Jackson and Pitts (2010) assessed a depreciation of 1%-2.5%, although this was considered too small to be statistically significant and attributable to the presence of the line alone.

Speedy urban development and increasing land use changes due to influx of population and economic growth is being witnessed in Port Harcourt in the recent times and much of this growth is unplanned and unregulated (Udia, 2014). Olerum, (2021) reported the growth in the population growth and rising urbanization

especially in the Niger Delta whereby the capital cities keep expanding with many buildings constructed near and under medium voltage overhead power distribution lines (otherwise known as high tension lines). In the recent times, there is increase urban expansion, development and business activities along the electricity grid lines in parts of Port Harcourt. According to Olapeju and Elesin (2017), Nigeria, like most countries is undergoing a period of rapid urbanization. The level of urbanization in the country rose from 4.8% in 1921 to an estimated 31.7% in 1985 (Ogu and Adeniji, 1989). Aliyu and Amadu (2017) expressed that UNICEF put Nigeria's level of urbanization at 50%. This has led to occupying areas that are not supposed to be occupied by law towhich the transmission line right of way belong. Thus, the present study thus focussed at spatial assessment of building encroachment of the existing Alaoji - Onitsha 330 kV SC transmission line right of way which will be retained for the proposed Alaoji - Onitsha 330 kV DC quad conductors project.

II. Materials and Methods

The study was carried out in the South Eastern Nigeria, which as East Central State, was one of the initial 12 states created during the Nigerian Civil War, which later became the name of one of the six geo-political zones in the country in the 1990s consisting of Abia, Anambra, Ebonyi, Enugu and Imo States. (Figure 1). It is the home of the Igbo speaking people of Nigeria. It is located within latitudes 4° 47‟ 35‟‟N and 7° 7‟ 44‟‟N, and longitudes 7° 54‟ 26‟‟E and 8° 27‟ 10‟‟E. The local language in this region is Igbo. Before the British colonial government, South-eastern Nigeria was home to many ethnic groups such as the Igbo, Ijaw, Ibibo, and Efik.

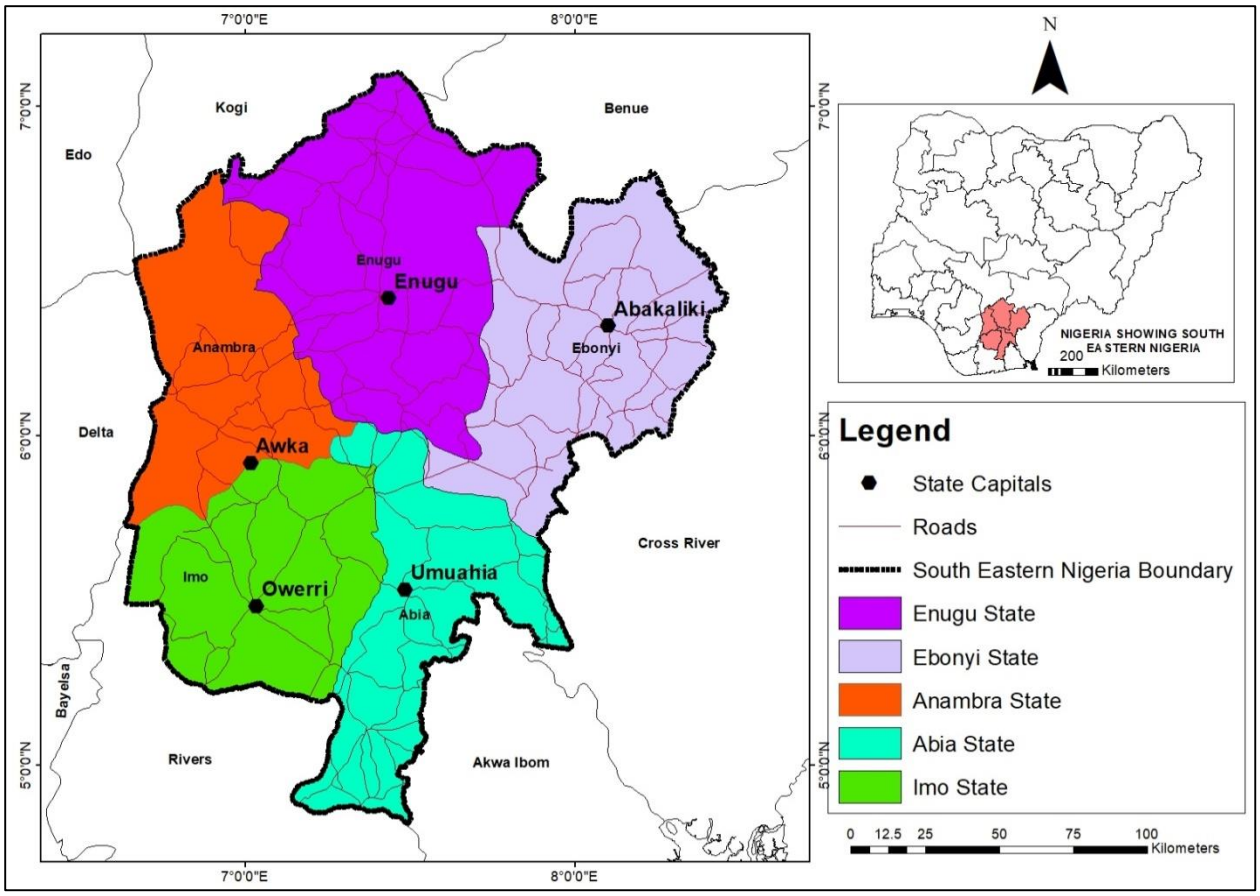

Figure 1: South Eastern Nigeria showing the States

The climate is characterized by the Equatorial type found in Southeastern Nigeria mainly warm and humid, and of two seasons:the dry season and the rainy season. The rainy season begins in April and continues into October while the dry season runs from November to March. During the rainy season, a marked disruption in the rains occurs during August, resulting in a short period of no rains universally referred to as "August break", though, for years now, this has not been consistent in August as a result of climatic changes. The rainfall of South Eastern Nigeria is influenced by the interaction between air-masses blowing over the surface. These are the Tropical Continental (CT) air-mass and the Tropical Maritime (mT) air-mass.

The warm, dry and dusty tropical continental air originates over the Sahara, while the warm and humid tropical maritime air originates over the Atlantic Ocean They alternate seasonally with each other. The tropical maritime air is predominant over South-Eastern Nigeria during the rainy season while the tropical continental air is marked by the dry season. The area is known to have the pre-Cambrian basement rocks and the lower cretaceous age rock also referred to as the "Albian Formation". Igneous and metamorphic rocks constitute the Precambrian basement complex which is the oldest, crystalline, solid physical foundation of the country. Sedimentary rocks fill up the basins which are vast depressions between basement landmass. The pre-Cambrian rocks located to the Oban axis of the region and the Obudu region now Cross River State composes rocks such as granite, migmatites, basic and ultra-basic rocks. Generally, the region is categorized as a plain with an elevation of 200m above sea level. The study area is characterized by cuesta topography, plateaus, rolling plains, scarp slopes, conical and isolated hills of discontinuous resistant beds where Guinea savannah vegetation occurs.

The region is drained by networks of rivers and streams among which is dominated by the Cross River, Anambra-Manu and the Imo River system. The Cross-River basin takes its rise from the Mbu Head water Cameroon at an elevation of about 2,236 meters above sea level to its mouth in the Calabar river estuary in the Bight of Bonny and a total stretch/length of about 540kilometers. Within the eastern states, the Cross-River tributaries are River Afi, Okpaoko, Konshishe and the Ombi-Npode-Oiyona. South-Eastern Nigeria has a remarkable diversity of vegetation formations (Igbozurike, 1975). The region has maritime stretches, at one end, where the sandy monotony is occasionally broken by the humblest of bushes, or where the scene is one of an intimate partnership of hardy trees and putrid water. The other end has segments of space with plenty of grass that a cursory inspection may mislead one into regarding the area as having a gramineous climax. The dominant vegetal community, however, remains the tropical rainforest. Though no typical case of montane vegetation is strictly found in South-eastern Nigeria signs of it can be traced at the top of Obudu Plateau. The population of Igbo land stated here is an aggression of the five (5) States namely Abia, Anambra, Ebonyi, Enugu, and Imo States only. The total population is about 40 million with the population density of $400km^{-2}$ (1,000/sq mi), with highest elevation of 1,000m (3,300ft) and lowest elevation of 0m (0ft) (NPC, 2015). The region is largely agrarian and there is thus much dependenton land resources, due to its dense population averaged to about 1000 $peoplekm^{-2}$. The acquisition of high-tension powerline data in the study area was done using the global positioning system (Etrex instrument), GIS. The GPS was used to acquire the location coordinates of the transmission right of way. The GIS software and the image analysis over the study area enabled the determination of the level of encroachment, displacement extent of environmental resource and land cover displacement and the conformity to stipulated distances from the right of way (ROW). Global positioning system (GPS) was also used to collect the actual position of the high-tension lines and map the power transmission line across the study area. The information of buildings was obtained from the Open Street Map website (https://www.openstreetmap.org/#map=11/4.9008/6.0796&layers=N).

Thereafter, Spatial Manager Desktop software was used to extract and convert the data into shapefile and later imported into the ArcGIS environment for further analysis.Four hundred copies of questionnaire were also administered to residents of the study area to elicit some information on the livelihood and building types in the study area. Descriptive and inferential statistics were employed for the data analysis. Frequency and percentages were involved in the descriptive statistics while the analysis of variance which is used to detect variations in the variables was involved in the inferential statistics.

III. Results and Discussions

Socio-economic status of the residents being displaced in the course of construction of the Alaoji - Onitsha 330 kV DC quad conductor transmission line project and right of way

Table 1 shows the socio-economic status of the residents in the study area. The males were 72.36 % (287) and females were 27.64 % (108). This shows that the males were more than females in the residential area of the right of way of 330 kVtransmission powerline in the study area. In the first instance the implication of the analysis is that men showed more interest in this research and the higher number of males is a true reflection of the gender involvement at the ROW of transmission line. This is also found out in Olerum et al. (2022) whereby more males were recorded than the females at the ROW of low and medium voltage powerlines in Yenagoa, the capital city of Bayelsa State in Nigeria.

The marital status of the respondents showed that 14.57% (58) were singles, 54.77% (216) were married, 14.82% (59) were divorced/separated and 16.08% (64) were widows/widowers. The married people

that are higher in the study area showed that due to low cost, more married people of low earnings would prefer staying in a place like this.

The type of family being kept in the study area displayed that 95.45% of the total respondents were monogamous while only 4.55% were polygamous. This is a true reflection of the economic situation of the residents of the study area which promotes monogamy so that they are able to maintain themselves amidst the harsh economic situation of the country. This also informs the kind of room size and the nature of buildings built for the use of the family.

The age analysis of respondents reveals that 6.28 % (25) were less than 20 years while 29.40% of total respondents were between 21 and 30 years and 7.54% were found between 31 and 40 years. However, 30.90 % of respondents were between 41 and 50 years, 11.81% were between 51 and 60 years while 8.79% were between 61 and 70 years and 5.28% were found in ages greater than 70 years. People within the working age were more than the dependant ages in the study area. The survival of the fittest syndrome or hustling as commonly used by individual youth to survive in recent times may be the reason majority of the people at the working age brackets are found in the study area.

The educational status of respondents showed that 2.12% of the total respondents did not have formal education while 18.52% (73) of total respondents had primary education, 31.48% (125) had secondary education or secondary school certificate, 18.52% (72) had Ordinary National Diploma (OND) while 15.87% (63) had Higher National Diploma (HND) and 13.76% (54) had first degree/masters/post graduate degrees. This shows that majority of the respondents had a minimum of primary education, signifying that majority can read and write and this made it easyfor the completion of the questionnaire administered to be completed easily by majority of the respondents.

The income per month analysisfound that 52.25% had an income less than 20,000 naira, 18.34% had between 20,000 naira and 40,000 naira, 19.60 % had between 41,000 naira and 60,000 naira, while 11.56% had 61,000 naira and above. This shows that more than 50% had a minimum monthly income of 20,000 naira which demonstrated that their living conditions were relatively poor.Analysis of the household number revealedthat 59.24% (235) have between 1 and 5 persons, 19.94% (79) between 6 and 10 persons and 16.42 (65) had between 11 and 15 persons while household with 15 persons and above were 4.40% (17).

This showedthat more than 60% of the respondents had minimum of 10 persons in their households. This also corresponds and triggers the type of family which is monogamy which dominated in the study area.It is noted in the analysis that 51.01% (202) of respondents are low incomes earners, 17.09% (68) were medium income earners while 14.07% (56) were high income earners. These shows that majority of the respondents were maximum of medium income earners in the ROW of 330 kVpowerline in the study area. This also can be similar to their level of income per month which largely reveals that many of them received minimum of 20,000 naira per month at a maximum level.

The type of ethnic groups found in the study area showed that Igbo tribe took the lion's share by having 74.19% while Anioma, Edo and Hausa/Fulani had 11.83%, 1.08% and 0.54% respectively. The Ijaws were made up of 0.54%, Ibibio/Efik was made up of 1.61% while Isoko, Itseriki and Urhobo had 0.54%, combined. The Tiv/Idoma, Ikwerre and Yoruba had 1.08%, 5.38% and 3.23% respectively. The findings revealed that the study area was composed of different tribes but Igbo tribe was seen greater than other parts. This could be attributed to the proximity to their home soil.

The occupational status of respondents revealed that the civil servants recorded 11.06% (44), police and paramilitary personnel recorded 8.79% (35) while unemployed/under employed recorded 25.38% (100). Furthermore, farmers had 12.56% (50), fishermen recorded 10.30% (41), artisans had 11.06% (44), traders had 9.55% (38) while palm wine tappers and weaving practitioners had 9.55% (38) and 3.77% (15) respectively. The analysis is simply deducing that as there are many self-employed people or employees in the study area, there are also the unemployed/ under employed individuals which were mostly found there. However, farmers, traders, civil servants and artisans were significantly found in the study area. The analysis reveals that the civil servants owned 15.58% (62) of the buildings, political officers or generally politicians owned 12.56% (50), traders/business people owned 17.59% (70) %, self-employed owned 33.42% (132) while unemployed/under employed owned 20.85% (83). This shows that people whoare self-employed are more interested to build houses in the right of way of transmission powerline while under employed and unemployed also build in those areas because of the possibility to survive at all cost as a home owner.

Table 1: Socio-economic Characteristics of Respondents

Gender	**Frequency**	**Percentage (%)**
Males	287	72.36
Females	109	27.64
Total	**396**	**100.00**
Marital Status	**Frequency**	**Percentage (%)**
Single	58	14.57
Married	217	54.77
Divorced/Separated	59	14.82
Widowed/Widower	64	16.08
Total	396	100.00
Type of Family	**Frequency**	**Percentage (%)**
Monogamous	378	95.45
Polygamous	18	4.55
Total	**396**	**100.00**
Age (Years)	**Frequency**	**Percentage (%)**
Less than 20	25	6.28
21-30	116	29.40
31-40	30	7.54
41-50	122	30.90
51-60	47	11.81
61-70	35	8.79
Greater than 70	21	5.28
Total	**396**	**100.00**
Educational	**Frequency**	**Percentage (%)**
No Education	8	2.12
Primary education	73	18.52
Secondary education	125	31.48
Ordinary Diploma	72	18.25
Higher National Diploma	63	15.87
Bachelor's Degree/Masters/Post Graduate	54	13.76
Total	**396**	**100.00**
Income per month (Naira)	**Frequency**	**Percentage (%)**
Below 20,000	199	50.25
20000-40,000	73	18.34
41000-60,000	78	19.60
61000 and Above	46	11.56
Total	**396**	**100.00**
Household Number	**Frequency**	**Percentage (%)**
1-5	235	59.24
6-10	79	19.94
11-15	65	16.42
Above 15	17	4.40
Total	**396**	**100.00**

Gender	**Frequency**	**Percentage (%)**
Categories of Income Level Earners at ROW	**Frequency**	**Percentage (%)**
Low income earners	202	51.01
Medium income earners	68	17.09
High income earners	56	14.07
Total	**396**	**100.00**
Ethnicity	**Frequency**	**Percentage (%)**
Ibo	294	74.19
Anioma	47	11.83
Edo, Afemai& Ishan	4	1.08
Hausa/Fulani	2	0.54
Ijaw	2	0.54
Ibibio &Efik	6	1.61
Isoko, Itsekiri& Urhobo	2	0.54
Tiv&Idoma	4	1.08
Ikwerre	21	5.38
Yoruba	13	3.23
Total	**396**	**100.00**
Occupation	**Frequency**	**Percentage (%)**
Artisans	44	11.06
Civil Servants	43	10.80
Farmers	50	12.56
Fishermen	41	10.30
Palm wine tappers	38	9.55
Police and Paramilitary personnel	35	8.79
Traders	32	8.04
Unemployed/Under employed	100	25.38
Weaving Practitioners	15	3.77
Total	**396**	**100.00**
House Owners	**Frequency**	**Percentage (%)**
Civil Servants	62	15.58
Political Class	50	12.56
Traders/Business person	70	17.59
Self employed	132	33.42
Under employed/Unemployed	83	20.85
Total	**396**	**100.00**

Level of Encroachment by Different Building Types

The level of encroachment with respect to the building types in the entire study area is displayed in Table 2 and Figure 2. It is shown that the buildings were categorised into 5 major types which were residential, industrial, religious, commercial and educational buildings. The analysis of the buildings shows that the residential recorded 1452 (51.71%), industrial recorded 257 (9.15%), religious recorded 89 (3.17%), and commercial recorded 600 (21.37%) while educational buildings recorded 410 (14.60%). It thus revealed in the analysis that residential buildings recorded the highest, and then followed by commercial and educational. The implication is that the level of poverty and economic situation might have led many to build residential buildings along the ROW of Alaoji-Onitsha Transmission Line.The number of the types of buildings being encroached within the 30m ROW of the power transmission line of 330 kV from Alaoji to Onitsha is displayed

in Table 3 and Figure 3. It is shown that the residential buildings recorded 695 (69.39%), industrial recorded 123 (12.28%), religious recorded 90 (8.98%), commercial recorded 51 (5.09%) and educational recorded 43 (4.29%).

The total number of buildings under the 30m ROW was 1002 buildings categorised into different major building types. The number of buildings being affected in the 50m ROW of transmission power line was 1805 and 55.62% were residential, 8.03% were industrial, 2.83% were religious, 19.78% were commercial and 13.74% were educational (Table 4; Figure 4).Figures 5, 6 and 7 show the expanded distribution of buildings along the 330 kVAlaoji-Onitsha Transmission Line in the entire study locations, 30m ROW and 50m ROW respectively. The hypothesis which says there is no significant variation in the functions of buildings among 30m ROW, 50m ROW and entire study area was tested using analysis of variance and displayed in Table 5. It is revealed that there was a significant variation in the building types across the study location ($F=1876.05$; $p<0.05$).

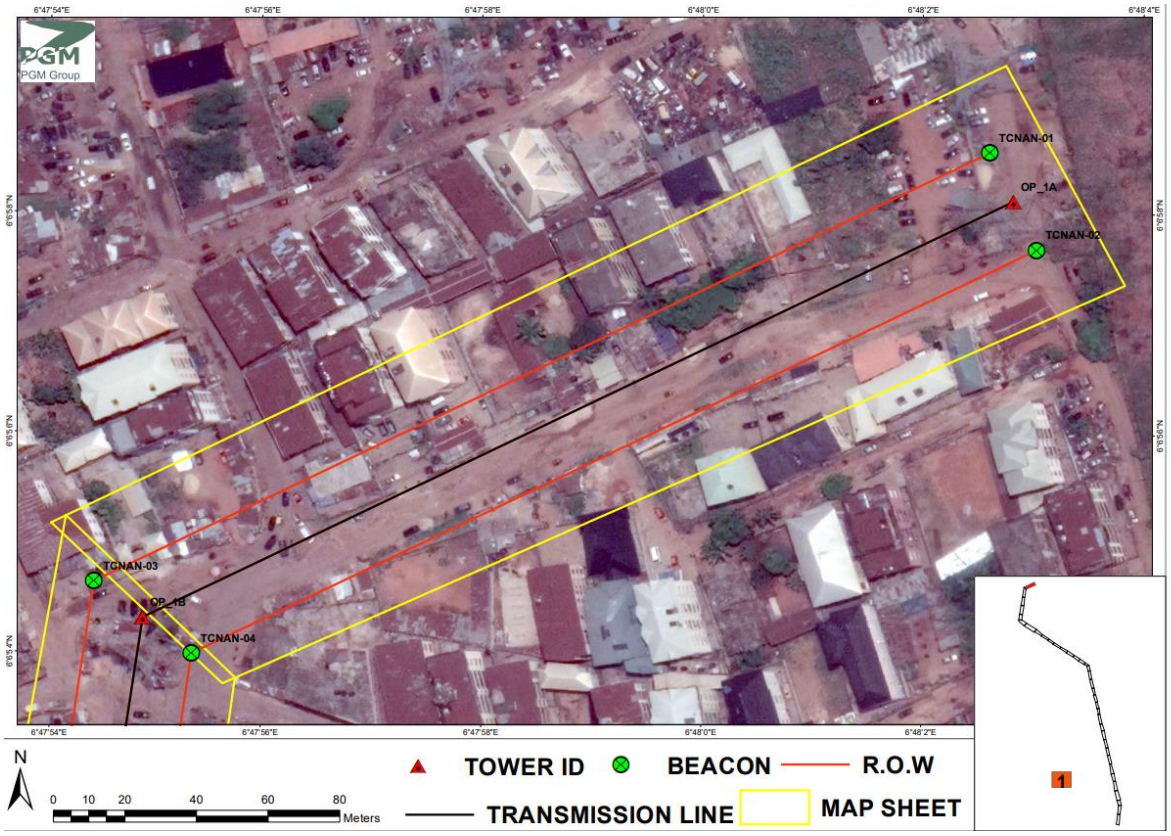

Figure 2: Constraint map showing heavy ROW encroachment at 50 m, reduced at 30 m in Ugwuaba, Obosi(Source: RAP Report of the Alaoji-Onitsha TL, 2019)

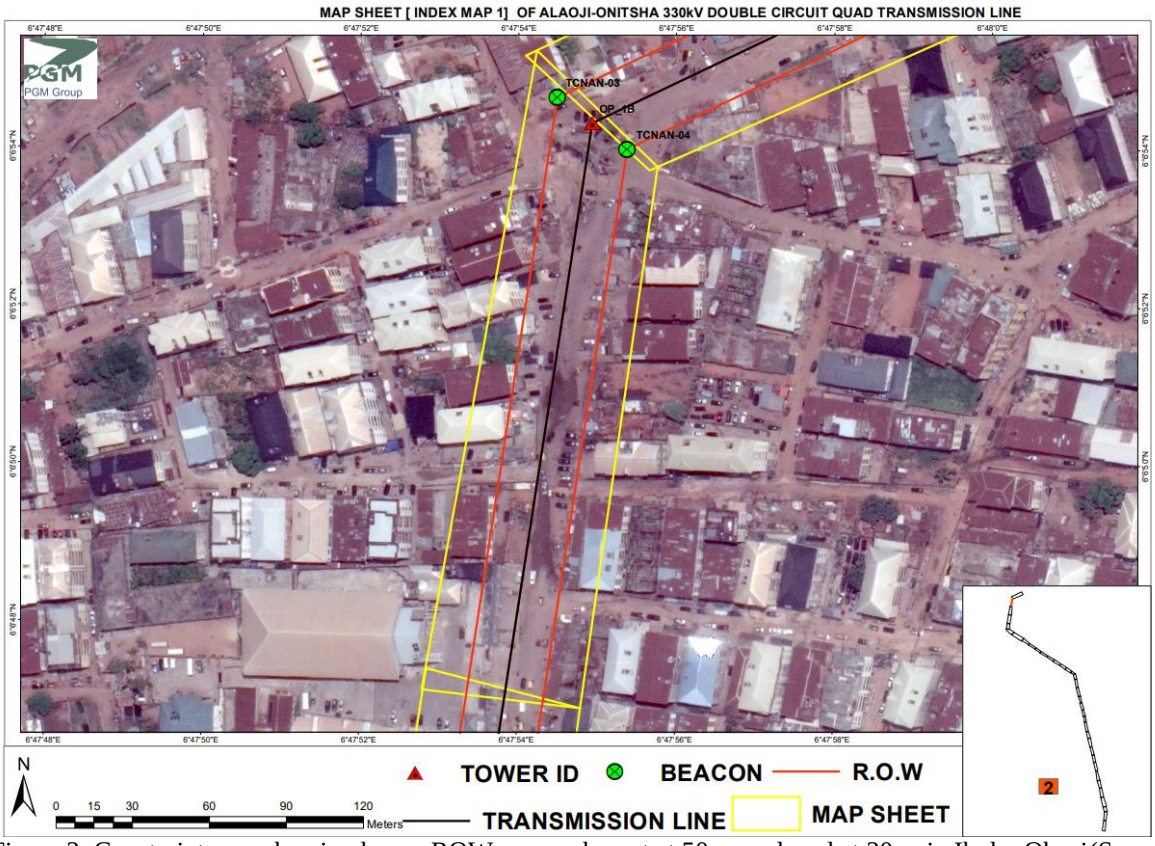

Figure 3: Constraint map showing heavy ROW encroachment at 50 m, reduced at 30 m in Ibolo, Obosi(Source: RAP Report of the Alaoji-Onitsha TL, 2019)

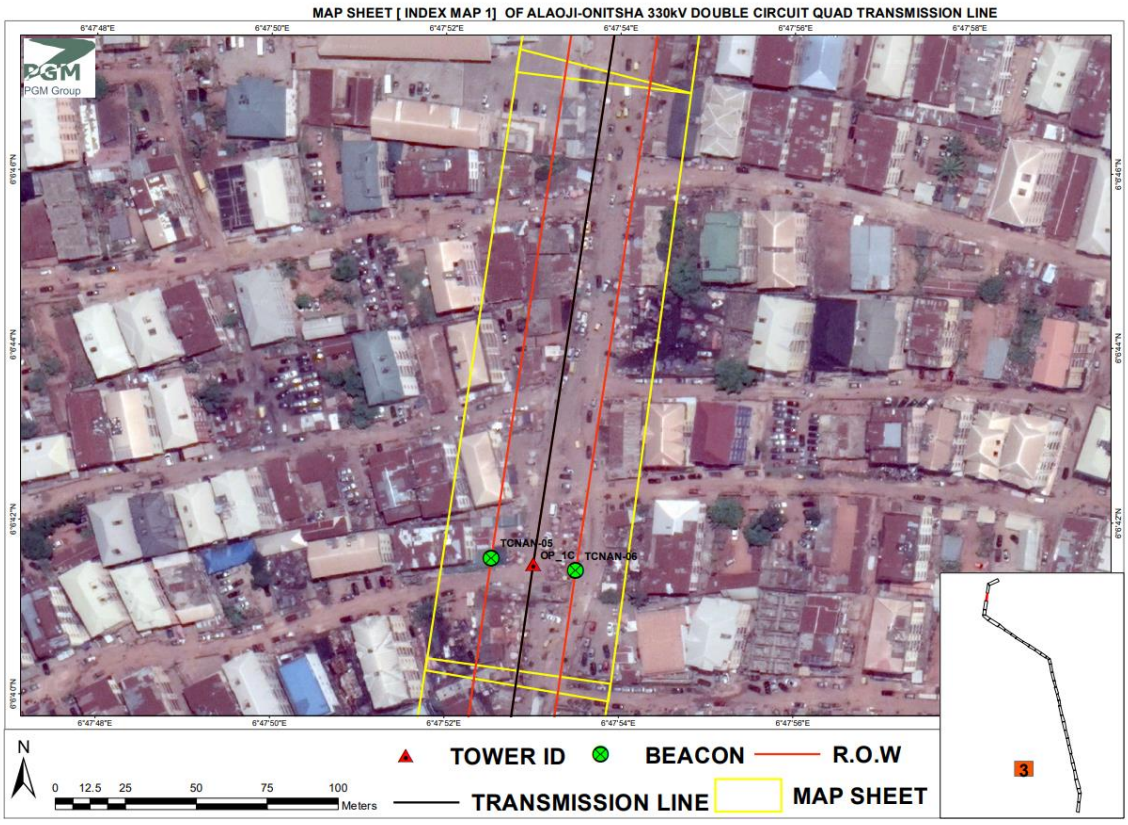

Figure 4: Constraint map showing heavy ROW encroachment at 50 m, reduced at 30 m in Oba (Source: RAP Report of the Alaoji-Onitsha TL, 2019)

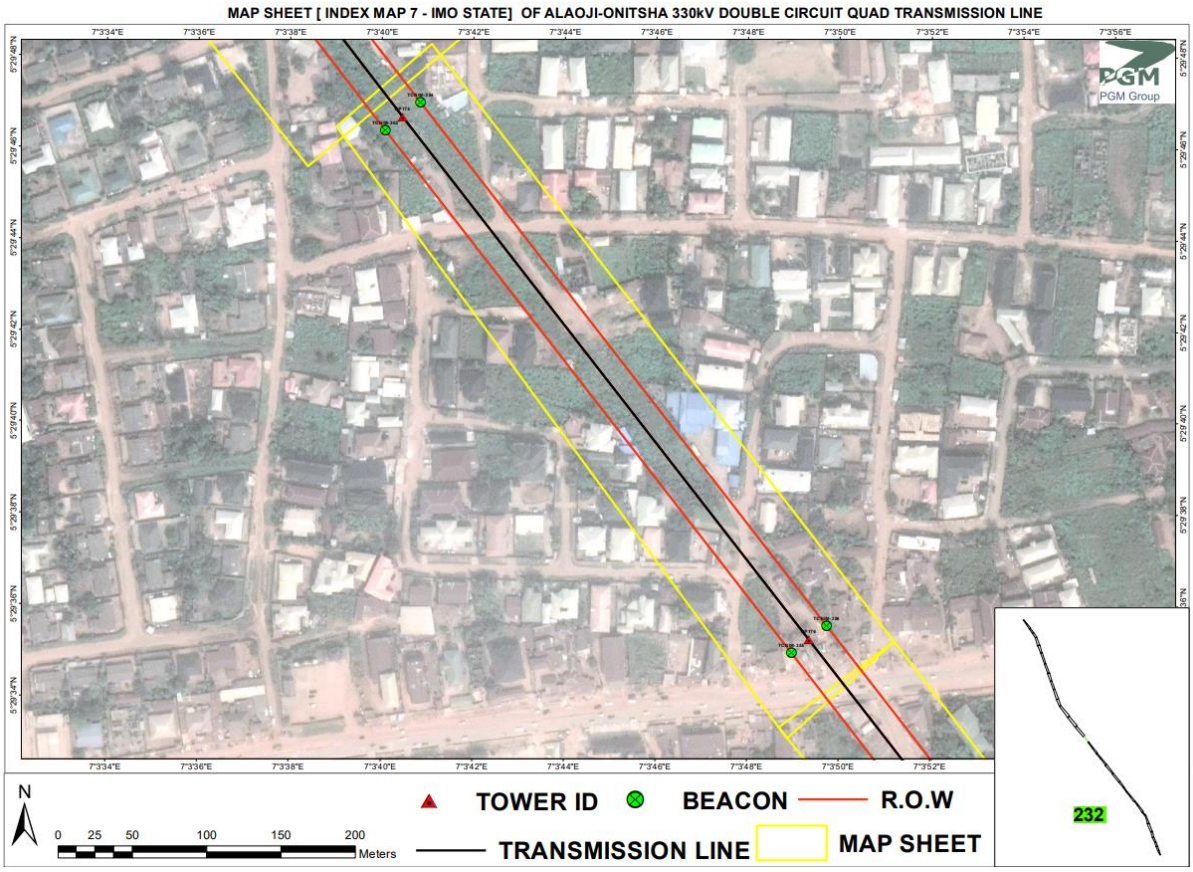

Figure 5: Constraint map showing moderate ROW encroachment at 50 m, avoided at 30 m in Orji-Uratta, Imo State (Source: RAP Report of the Alaoji-Onitsha TL, 2019)

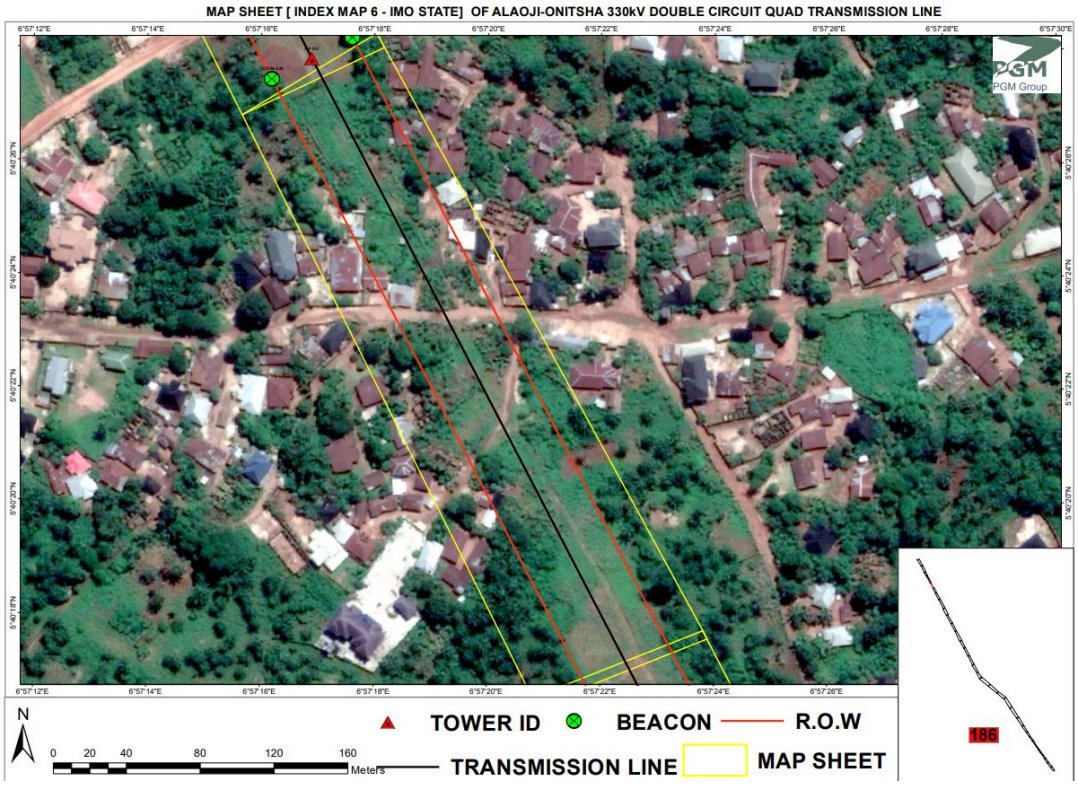

Figure 6: Constraint map showing light ROW encroachment at 50 m, avoided at 30 m in Emekuku/Emii, Imo State (Source: RAP Report of the Alaoji-Onitsha TL, 2019)

Figure 7: Constraint map showing zero ROW encroachment at 50 m at Agbala (same throughout NgorOkpalla LGA in Imo and Osisioma LGA in Abia State (Source: RAP Report of the Alaoji-Onitsha TL, 2019)

Table 2: Total Type of Building at Encroachment Level

Type of Buildings in relation to functions	Frequency	Percentage (%)
Residential	1452	51.71
Industrial	257	9.15
Religious	89	3.17
Commercial	600	21.37
Educational	410	14.60
Total	**2808**	100

Table 3: Types of Building in relation to function within 30m ROW

Type of Buildings in relation to functions	Frequency	Percentage (%)
Residential	695	69.36
Industrial	123	12.28
Religious	90	8.98
Commercial	51	5.09
Educational	43	4.29
Total	1002	100.00

Table 4: Types of Building in relation to function within 50m ROW

Type of Buildings in relation to functions	Frequency	Percentage (%)
Residential	1004	55.62
Industrial	145	8.03
Religious	51	2.83
Commercial	357	19.78
Educational	248	13.74
Total	1805	100.00

Table 5: ANOVA of building types in the study area

Building Types			Sum of Squares	df	Mean Square	F	Sig.
Building Types and Functions	Buildings	Between Groups	70.352	5	14.0704	1876.05	0.000
		Within Groups	21.285	2803	.0075		
		Total	91.636	2808			

IV. Discussion of Findings

It is found that residential buildings recorded the highest, and then followed by commercial and educational. The implication is that the level of poverty and economic situation might have led many to build residential buildings along the ROW of Alaoji-Onitsha transmission line. Findings are in tandem with the study of Uzodinma(2020) that both residential and commercial buildings were the highest in the study locations whereby 202 residential buildings, 267 commercial buildings, 11 public buildings were recorded. Findings revealed that majority of the buildings within the high-tension voltage set back were used for residential and

commercial. This is possible because of the major two functions that building is subjected to in the urban space. The increase in the immigration into the urban landscape usually gives room for people to reside anywhere as long as it is within the urban area where they could sustain their lives.

This finding is also in tandem with the previous works like Olerum et al (2022), Oluwunmi et al (2012), and Olamiju and Oyinloye (2015). Some buildings are being used for both residential and commercial; and that shows the level of curiosity to dwell in the urban places because of the easier survival attached to it. The industrial setting within this ROW is always small simply because of the fear of being banned by government or losing out their investment totally. The total number of buildings under the 30m ROW was 1002 buildings categorised into different major building types while the number of buildings being affected in the 50m ROW of transmission power line was 1805 and 55.62% were residential. It is revealed that there was a significant variation in the building types across the study location ($F=1876.05$; $p<0.05$). The differentials in the building types could be attributed to the socio-economic differences of the residents in the study location.

V. Conclusion and Recommendations

The study concludesthat the right of way of the Alaoji-Onitsha transmission power line has been encroached by the residents of the neighbourhood with varying socio-economic characteristics and tribes and the buildings are mostly used for residential and commercial purposes. The study recommendsthat the buildings or any construction takingplace in this ROW of transmission line should be salvaged and demolished but the residents shouldbe compensated for the loss of their assets.

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