Geospatial Analysis of Encroachments on the Nigeria Electricty Grid Right-of-way in Parts of Port Harcourt, Nigeria

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Abstract- This study is to geospatially analyze and assess the rate of encroachment on the Nigeria Electricity Transmission Grid Right of Way (ROW) in parts of Port Harcourt, Rivers State of Nigeria. This research work was done using ground truth survey and remote sensing technique. Coordinates of the electricity power line pylons were obtained from the office of the surveyor general, Rivers State Ministry of Lands and Survey, the coordinates where used to geo-reference the spot satellite images of the year 2007, 2012 and 2017 respectively using ArcGIS 10.1. The spot images were used for spatiotemporal changes in the study area. Buffer of 50m ROW was created and buildings within ROW were digitized to ascertain the rate of encroachment on the Electricity Power Line Right-of-Way. The total Length and Area of ROW under study was 5.68km and 558,381.804sq.meters respectively. The research findings and results shows that a total built-up area of 21,330.184sq.m, 75,660.733sq.m and 111117.979sq.m were encroached in the year 2007, 2012 and 2017respectively for buffer of 50meters with a percentage encroachment of 3.82%, 13.55, and 19.90%. The ground truth survey also shows that there is persistence building encroachment and business activities on the Eelectricity Transmission Power line ROW of the study area. Immediate removal of structures on the ROW was recommended and further study should be carried out to monitor further encroachments and forestall destructions of life and property of residence within ROW.

Index Terms- Buffer, Encroachment, Geo-spatial, Pylon.

I. Introduction

The Nigeria Electricity Power Transmission Grid is an integral part of the electricity value chain. The operation of the electricity transmission network is vested in the Transmission Company of Nigerian (TCN), one of the companies unbundled from the Power Holding Company of Nigeria Ltd. (Odion, 2016). The National Power Transmission Grid line composed of 132kv and 330kv lines respectively across the country. TCN has continuously cautioned and alert the public on the dangers of erecting buildings and conducting business on the Electricity Transmission Line Right of Way (ROW) across the country. The continuous building and erecting of structures on the electricity grid ROW by land developers who are ignorant of the dangers is highly alarming and of serious concern to the Government.

The National Electrical Code (NEC) mandates 50m acceptable clearances for power lines to keep the public safe and prevent contact with electrical currents. According to the Nigerian electricity news online, government must act now in ensuring safety of life and property by protecting utilities ROW across the states of the nation. The just concluded National Power Safety Summit held on the 21st of November, 2017 at Uyo, Akwa Ibom State Capital, Nigeria revealed that over 445 deaths were recording in the sector between 2014 and 2017. The Submit also revealed within the same period under review that over 289 persons sustained various degrees of injuries across some state of the nation. Table 1:1 below shows the recommended and acceptable ROW or required setback of respective power lines.

Table 2:1 Recommended and acceptable ROW

S/N	VOLTAGE	TYPE OF POWER LINE	HEIGHT OF POWER LINE	RECOMMENDED ROW
1.	0 – 150 volts	Low tension	10 meters	3 meters (Horizontal)
2.	300 – 600 volts	High tension sub transmission line	12 meters	4 meters (Horizontal)
3.	11KV	High Tension (Commercial areas)	15 m	12.5 meters (Horizontal)
4.	33 KV	Power High Tension Transmission line	15m	12.5meters (Horizontal)
5.	132 KV	National Grid	30m	50meters (Horizontal)
6.	330KV	National grid	30meters	50meters (Horizontal)

Source: The Nation Newspaper May, 2016.

II. Nigeria Electricity New Online

Many land developers are ignorant of the stipulated ROW on the National Grid as recommend by the National Electric Code (NEC) and electric power sector reform act, No 6, of 2005 of Nigeria.

(Udia, 2014) noted that those public infrastructures that are usually involved in ROW acquisition may traverse many states, this usually involve large scale land acquisition. Examples of these public infrastructure that required ROW include:

1. Road and highway network infrastructure, including bridges, culverts, side walk etc
2. Electricity infrastructure including the national grid, other transmission lines, power stations, street lights etc
3. Gas/oil pipeline, including the storage and distribution terminals as well as distribution network.
4. Water infrastructure including the system of pipes used in the collection and disposal of water, drainage system, sewage collection and disposal of water, drainage system.
5. Telephone/ telecommunication mask including telegraph lines.

(Timothy, 2017) noted that Overhead electricity transmission power lines are subject to strict guidelines for height clearance (Right of Way) over streets, sidewalks, alleys, drive ways and other traffic areas. A Right Of Way (ROW) is a term used to describe the legal right, established by usage or grant, to pass along a specific route through grounds or property belonging to another, it is also a type of easement granted or reserved over the land for transportation purposes; this can be for highway, public footpath, rail transport, canal, electrical transmission lines, oil and gas pipelines, etc.

2.1 Area of Study

The area of study is a section of the Nigeria Electricity Power Transmission Line ROW in Port Harcourt. The ROW under study stretches from Rumuagholu - Rukpokwu towns of Port Harcourt, Rivers State of Nigeria. It is situated on projected coordinates of 538707.45mN – 541977.39mN and 272939.52mE – 279196.93mE in WGS-84, UTM Zone 32N coordinate system. As shown in figure 1.0, the total distance of the right-of-way under study is 5.68km; The ROW is undergoing massive illegal development and business activities in all directions which prompted the study. This study is targeted at determining the rate of development within the national grid right-of-way in the study area.

Figure 2.1 Study Area Map Showing spot Image and Electricity Grid ROW

2.2 Statement of Research Problem

Rapid urban development and increasing land use changes due to increasing population and economic growth is being witnessed in Port Harcourt and much of this growth is unplanned and unregulated (Udia, 2014). Presently, there is increase urban expansion, development and business activities along the electricity grid lines in parts of Port Harcourt. Many structures are erected almost at the centre of the Power Transmission grid lines. Erecting building and conducting business under the high tension power lines constitute dangers that could have fatal consequences

Figure 2.2 Building and Business activities on the Electricity Transmission Grid ROW in Rukpokwu axis of Port Harcourt.

2.3 Aim and Objectives of the Study.

The aim of the study is to geospatially assess and analyze the rate of encroachments along the Nigeria Electricity Grid ROW in parts of Rivers State using ground truth surveys and remote sensing technique.

2.4 Objective of Study

1. To create 50m buffer ROW and overlay it on the images of 2007, 2012, and 2017.
2. To digitize the buildings within ROW
3 To determine the rate and percentage of encroachment for respective years

III. Research Method

Planning
Ground truthing, Geo-referencing

Data processing: Buffer analysis, Digitizing of built-up areas within 50m buffer zone.

Data sets: SPOT satellite images of 2007, 2012 and 2017 with spatial resolution of 2.5m x 2.5m. SPOT satellite image was chosen because of its high resolution content.

Instrumentation: Garmin 76CSx GPS receiver, 50m standardized steel tape, field book, etc.

Software/hardware: Hp Laptop computer with processor Intel® Core (TM2) Duo CPU P9700, 4.00GB RAM, and 64-bit operating system. ESRI's ArcGIS 10.3 (Arbi and Florjan, 2014) – vector based GIS software. The choice of ArcGIS 10.1 was based on its ability to support vector analysis.

3.1 Data Processing

3.2 Buffer Analysis

Buffering analysis is a spatial analysis operation found in ArcGIS. It is used to create specific distance around a feature, and region called buffer zone. Buffer analysis can be used in locating slums from the city centre and for determining impact of air pollution over a given distance (Olaleye, 2017). In assessing the level of encroachment of the Electricity Transmission ROW, buffer of 50m was created. Buffer analysis was performed from the Analyst Tools in ArcGIS 10.3 software. Proximity was clicked in the 3D Analyst Tools, and buffer was double click. The feature (electricity grid) was clicked; file name and buffer distance (50m) was clicked as output. Finally Ok was clicked to generate buffer zone at specified distance.

3.3 Digitization of Built-up Areas

Image digitization is the process of converting geographical data into vector data. The built-up areas within ROW were vectorized using line and point features (Ghilani and Wolf, 2008). The area of each buildings, rate and percentage encroachment for each epoch were determined (ghilani and wolf, 2008).

IV. RESULTS AND FINDINGS

V.

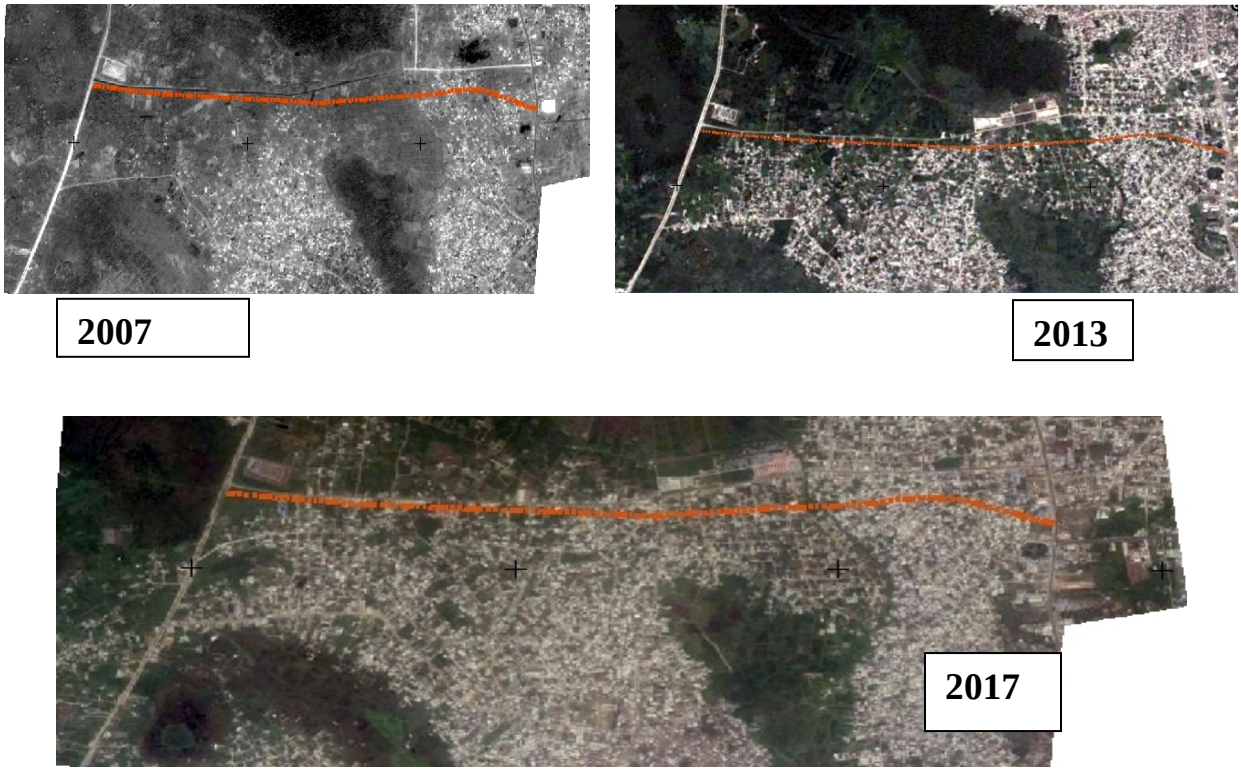

Figure 4.0 Overlay of 50m ROW in (red line) on Spot images of 2007, 2012 and 2017

Figure 4.1 Overlay of a section of 50m ROW on spot image of 2017.

Figure 4.2 Section of digitized buildings on 50m buffer ROW.

Table 4.3: Percentage Encroachment of ROW by built-up computed in square meters for 50m buffer

YEAR	AREA OF 50M BUFFER ROW (Sq.m)	TOTAL BUILT-UP AREA ENCROACHED PER YEAR	PERCENTAGE ENCROACHMENT
2007	558,381.804	21330.184Sq.m	3.82%
2012	558381.804	75660.733Sq.m	13.55%
2017	558381.804	111117.979Sq.m	19.90%
Area not encroached		350272.905.Sq.m	62.73%
Total Percentage			100%

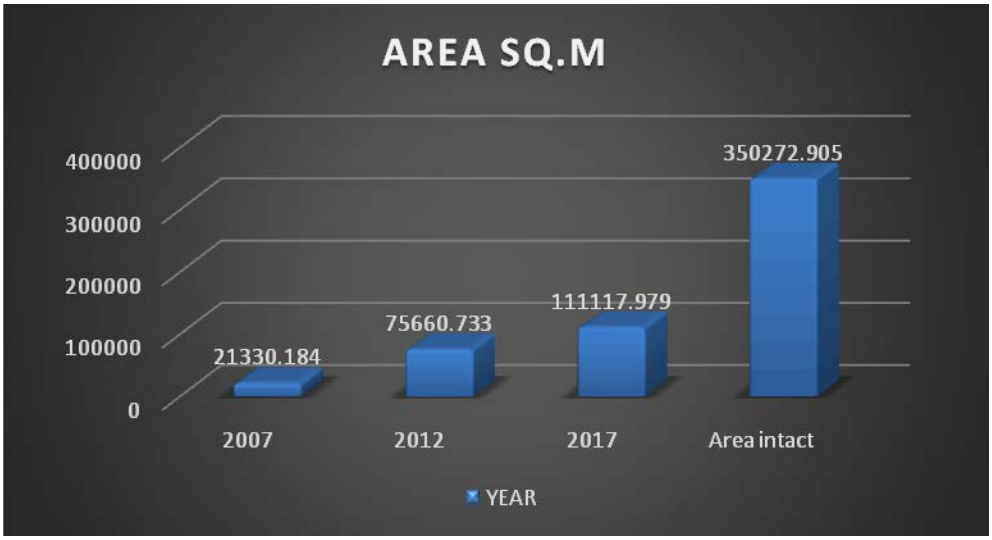

Figure 4.3 Bar chart showing level of built-up encroachment of 50m buffer ROW.

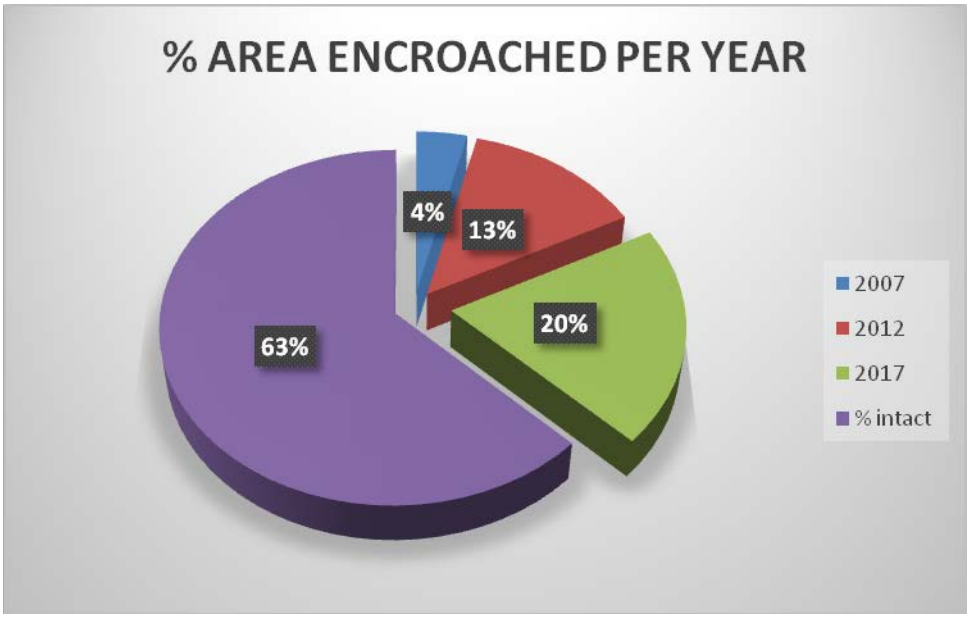

Figure 4.4 Pie chart showing Percentage Area Encroached on 50m buffer ROW.

VI. Research Findings

The result presented above has proved the justification and necessity of this research work. The rate and speed of building encroachment is relatively high. The total area of ROW under study for 50m buffer is 558,381.804sq.m. The research findings from the results above shows that a total area 21,330.184sq.m, 75,660.733sq.m and 111117.979sq.m where encroached in the year 2007, 2012 and 2017 respectively with a percentage encroachment of 3.82%, 13.55, and 19.90% for the year 2008, 2013 and 2017. The overlay of the Electricity Transmission line ROW on the aerial photographs shows a very high and alarming building encroachment. The ground truth survey also tells the level of building encroachment with serious business activities going on in several positions of the Electricity Power line ROW such as timber market, welding and fabrication workshops, caravans for difference purpose of business, motor mechanic workshop etc.

VII. Conclusion

The completion of this study has demonstrated the justification and relevance of geospatial assessment of structures on Electricity Transmission Grid ROW using ground truth survey and remote sensing techniques. Remotely sensed data offers an alternative and precise measurement of object characteristics on the earth's surface and provides a more synoptic view to remote Terrain. Conclusively, the obtained spot image data sets were effectively utilized to obtain the results of the research objectives which show the standard 50m Electricity Transmission Grid ROW as recommended by TCN and NEC. Remote sensing technique should be employed for yearly map updating as a means of monitoring ROW encroachments. Finally, this study recommends an immediate and total removal of structures and business activities on the ROW of the study area and other areas of ROW encroachment across the nation to forestall future damage and loss of life and properties.

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