GEO-SPATIAL ANALYSIS OF TELECOMMUNICATION MASTS AND COMPLIANCE LEVEL OF OPERATORS TO REGULATIONS IN AWKA, ANAMBRA STATE, NIGERIA

BY

Anaso G.U.*, Sawa, B.A. and Akpu, B.

Department of Geography and Environmental Management,
Ahmadu Bello University Zaria-Nigeria.
*Corresponding Author's Email: graceanaso@gmail.com

ABSTRACT

The telecommunication sector in Nigeria is a prominent and very profitable sector of the economy. The presence of multiple network service providers have brought about healthy competition between these operators which have directly had an impact on the growth of this sector. Telecommunication base stations which are important structures for telecommunication are observed to be distributed around many cities and localities around the country. While these are indications of good network coverage, it is pertinent to ensure that these structures are properly located in the best available sites where they pose minimal health risks and duly conform to national standards. The study therefore aimed at analysing the locational pattern of telecommunication masts and their conformity to National Communication Commission (2009) 5m setback in Awka, Anambra state. The seven wards of Awka made up the spatial scope for the study. Geographic coordinates of the identified masts were obtained using a handheld GPS. The nearest neighbor analytical tool in ArcGIS was used to determine spatial pattern of masts. Five meter buffers were created around masts to assess their locational conformity with the set standards of the NCC. Thirty-eight masts were identified in the area of which 3 were inactive and 10 were shared by multiple service providers. The result of the nearest neighbor analysis revealed a random distribution with a Z-score, p-value and nearest neighbor ratio of -1.036417, 0.300007, 0.912116 respectively. The 5m buffer of masts from the nearest residential property revealed that 52.63% of masts fell outside the buffer zone, thus conformed to the standard while 47.36% did not conform to the standard. The study therefore recommends that the NCC carries out proper checks to ensure that service providers pay strict attention to locational standards to ensure minimal risk impact on human health and environment.

Key words: Compliance level, Network operators, Spatial distribution, Telecommunication masts

INTRODUCTION

Telecommunication is a strong compelling force of socio-economic development of cities around the world. This technology has made the transfer of all forms of media possible, faster and easier over long distances through wires, radio, optical and electromagnetic systems. The introduction of Global System for Mobile communication in Nigeria in 2001 presented an era of exciting

possibilities to many Nigerians who took advantage of this rapidly growing sector. By mid-2002, there were approximately 2.27 million subscribers throughout Nigeria and this figure has since risen to over 143.05 million (National Bureau of Statistics, 2015). Nigeria currently has four major GSM service providers namely MTN, GLO, Airtel, and 9mobile (formally Etisalat). According to the NBS (2015), MTN is at the top of the subscribers' preference list with 61.21 million subscribers (42.8%), GLO with 21.0%, while Airtel and 9mobile have 20.5% and 22.3 million (15.7%) subscribers respectively.

The increase in the number of GSM users has emphasized the need for telecommunication network providers to service the needs of its fast growing users for effective communication (Olukolajo, Ezeokoli and Ogungbenro, 2013). In order to provide optimal network coverage, many telecommunication stations are located in close proximity to their target users. Telecommunication stations and cellular telecommunication masts represent part of the infrastructure required for effective communication system. Telecom masts according to Hart, Jackson, Akpee and Moka (2012) are typically tall structures designed to support antennas (aerials) for telecommunications and broadcasting, they are among the tallest man-made structures. A typical telecommunication mast tower consists of a frame of steel beams with height ranging between 25 and 55meters and a concrete base of approximately $144m^2$ (12x12m). Antennae, transmitters and receivers are mounted on the body of the structure. These antennae receive high frequency radio waves from cell phones. The ranges of these antennas vary from distances as short as 1.5 to 2.4km to distances as long as 48 to 56km. A power source is provided with other accessories, all fenced either by block wall or steel poles and wire depending on the service providers (Hart, Jackson, Akpe and Moka, 2012).

The erection of telecommunication masts is practically indispensable for the transfer of high volume data with guaranteed security and quality (Antonelli, 1991). This perhaps, accounts for the increase in number of telecommunication masts around many residential areas especially in emerging cities. In cities and communities with little or no knowledge of the effects of locating telecommunication masts, the siting of masts in residential neighborhoods is often welcomed due to the financial benefits that come from the sale or lease of such lands. For cellular phone service providers, an important criterion when locating a base station cell site is finding a site that provides the best possible coverage in the area. Also desirable is a location where there will be little or no interference with other existing cells in the area (Bond, Mun, Sakornvanasak and McMahon, 2003).

Dalil, Yahaya, Umar and Abd'razack (2016) associated a number of environmental issues to the introduction of this technology. These include the indiscriminate siting and erection of base trans-receiver stations all over Nigeria. A conservative estimate of over 20,000 base trans-receiver stations are scattered around the country. Base station capacity is a major issue that the telecommunication companies are faced with at present, thereby leading to creation of the National Communication Commission (NCC, 2014).

A popular issue of discourse on telecommunication relates to environmental health and safety impact. There is often the question on how close a mast should be sited to properties in residential neighborhoods to provide optimum network coverage with minimal health and environmental risk. Certain bodies such as the World Health Organization (WHO) and National Environmental Standards and Regulations Enforcement Agency (NESREA) stipulated a minimum setback of 10m while the Nigerian Communication Commission (NCC) approved a

minimum setback of 5m away from residential properties. Ogboru (2015) stated that this contradiction in standards brought about confusion on which standard was to be adhered to by service providers in Nigeria. The NCC however won this argument, laying claims to its staunch responsibility of overseeing the affairs of the telecommunication industry and hence retained its 5m setback regulation. Ogbonna, Okoye and Eleazu (2016) examined the compliance of GSM service providers with the established guidelines for mounting base transceiver stations and masts in Abia State, Nigeria. The study revealed that only 43.2% of masts complied with set-back standards from residential properties. This paper therefore set out to assess the spatial distribution of telecommunication masts and the compliance level by the network operators to the regulations of the Nigerian Communication Commission (2009) directives on siting of masts in Awka, Anambra State, Nigeria.

THE STUDY AREA

Awka is located within Latitudes 06° 11' 40" - 06° 18' 20" North of the Equator and Longitudes 07° 01' 25" - 07° 08' 30" East of the Greenwich Meridian (see Fig. 1). The town is divided into two major sections which include; the Ifite-Senior section which comprises four Igbo groups (Wards) namely Ifite-Awka, Ayom-na-okpala, Nkwelle and Amachalla. The other section known as Ezinato Section consists of three groups namely; Amikwo, Ezi-oka and Agulu. Although most of Awka town territory lies in Awka South LGA, it however slightly extends into Awka North LGA.

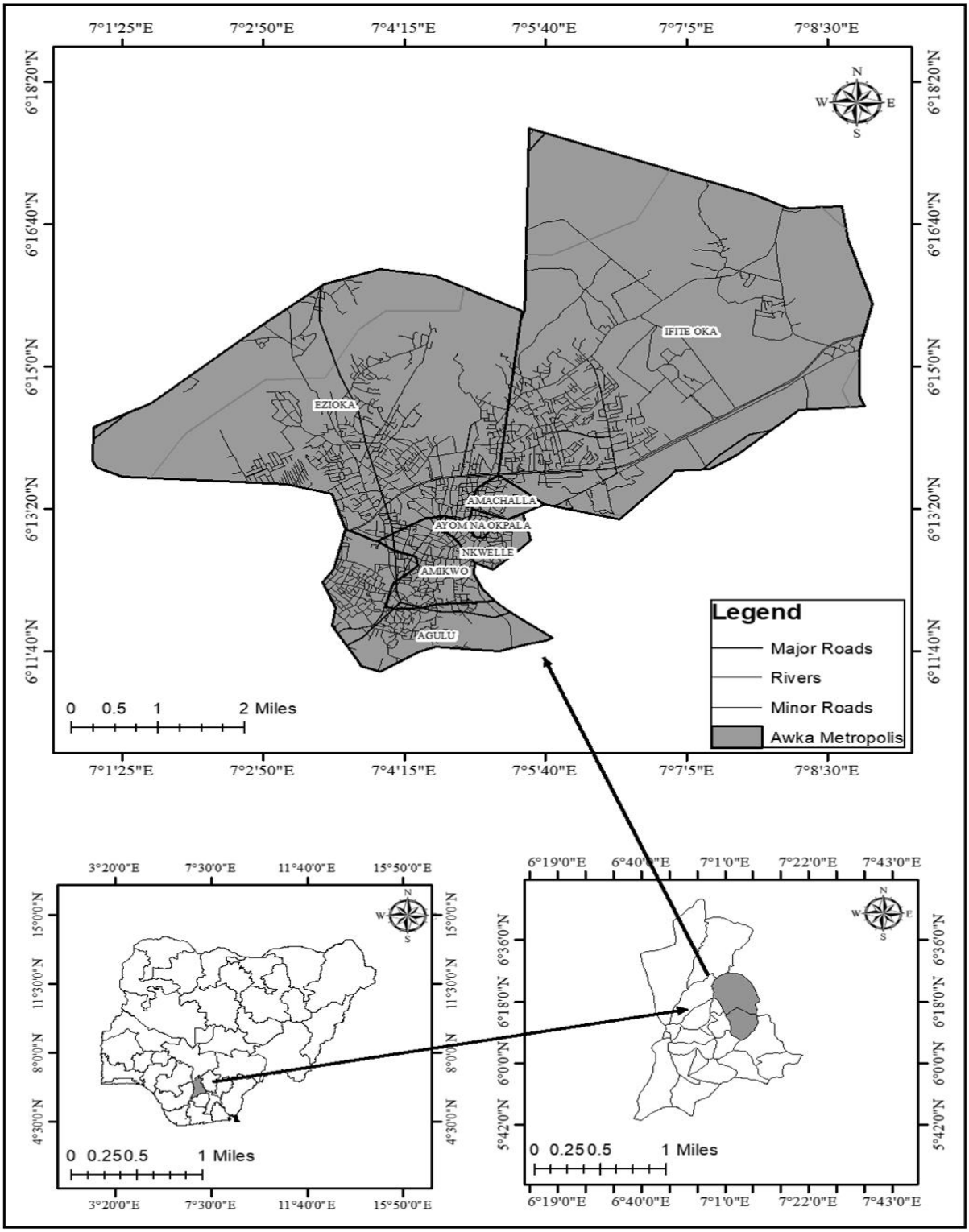

Figure 1. The Study Area
Source: Modified from the Administrative Map of Awka LGA

The climate of Awka falls within the tropical rainforest climate zone of Nigeria and experiences two different seasons brought about by the southwestern monsoon winds from the Atlantic Ocean and the northeastern dry winds from across the Sahara Desert. The Koppen-Geiger climatic classification identifies the climate of the area as 'A_w', which signifies a Wet-Dry tropical climate. The temperature in Awka is generally between 27 and 30 degrees Celsius from June to December but rises to between 32˚ and 34˚ Celsius between January and April (Nzoiwu, Ezenwaji, Enete and Igu, 2017). Awka's vegetation falls within the rain forest zone which is originally comprised of tall trees with thick undergrowth and numerous climbers however, pressure on land in form of agriculture and commerce has largely reduced the vegetation here to wooded savanna (United Nations Human Settlements Programme (UN-Habitat), 2009). There are three soil types in the area which include alluvial, hydromorphic and Ferrallitic soils. The estimated population of people living in Awka during the 2006 national census is 86,593 (NPC, 2007).

The formal sources of employment in the territory are instituted on Education, Administration and Banking. Agriculture and industry have contributed little to the economy of the city however; the informal sector which mainly consists of storekeepers, petty traders, blacksmiths, roadside mechanics and other skill inclined professions have contributed mostly to the economy (Ezeabasili, Okoro and Okonkwo, 2014). Multiple hotels, construction firms, petroleum and allied companies, pharmaceuticals and telecom industries are notable in the area.

MATERIALS AND METHODS

The data for this study were obtained through primary and secondary sources. Primary sources of data included the use of a Garmin handheld GPS and a distance measuring mobile app. The GPS was used in collecting X and Y coordinates of the masts while the measuring tool calculated the distance (in metres) between each mast and the nearest rental property in the study area. This information as well as mast operators' ID were documented at these sites. The secondary sources of data include the administrative ward map of Awka which was obtained from the office of the National Population Commission and satellite images of Awka which were retrieved from Google Earth and Open streetmap.

The geographic coordinates of masts obtained with GPS, the ownership and distances from properties were imputed and saved in Microsoft excel as a comma delimited file (csv format). This file was imported into ArcGIS 10.4 software where they were overlaid on the Administrative ward map of Awka. The Nearest neighbor analysis tool in ArcGIS was then used to determine the spatial pattern of the masts. A nearest neighborhood ratio of <1 indicates a clustered pattern, a value of 1 indicates a random pattern, while a value >1 indicates a regular or dispersed distribution (Getis and Ord, 1998).

To calculate the percentage of compliance, the frequency of complying and non-complying masts (based on their distance from nearest buildings) were compiled and presented in tables.
Buffers of 5m were created around masts to display which masts had buildings which fell within 5m buffer while symbology was used to differentiate between complying and non-complying masts.

RESULTS AND DISCUSSION

A total of 38 masts were identified in the area belonging to multiple service providers. The ownership and addresses are presented in Table 1.

Table 1: Geographical Location of Masts in Awka

Mast	Address	Freq	Percent
MTN	Onwurah Strt, Ringroad,GI. Nwigbo Strt, Ozu Ayim strt, Ichie Rd, 20. Zik Ave, Amaechi Strt, Ijomah Strt, Orogbo lane, Anaku Strt, E.Obiakor strt, Ifite Road	12	**31.5**
GLO	Nwasuife Strt, Secretariat Rd, R.Caeli Rd, 55. Zik ave, Aguegbe strt,Ifite Rd, Oganiru Est, Ifite Rd.	8	**21**
AIRTEL	Awuenyinagu Strt, Alomese Strt, Ifite road (1), Ifite rd (2)	4	**10.5**
9MOBILE	Ichie road	1	**2.63**
Shared Masts	Nwasuife Strt, Amaku Hosp, Nodu Okpuno, Ndianefo Close, Ifite Rd, Ifite Mkt, Okpandu Strt, Judiciary Rd, N.Nwobuchi Strt, Ifite Rd.	10	**26.3**
Inactive Masts	D.Opara Crescent, Zik Avenue, Ikechukwu maternity	3	**7.89**
Total		**38**	**100**

Source: Authors' Analysis, 2019

It was observed that out of the 38 masts in Table 1, only 35 (92%) were active of which 12 were managed by MTN, 8 by GLO, 4 by Airtel and 1 by 9mobile. It was observed that 10 masts were jointly utilized by these service operators, while 3 were inactive or not in use by any service provider at the time of data collection. MTN was observed to have the highest number of masts with 31.5%, followed by the shared masts with 26.3%, GLO with 21%, Airtel with 10.53%, inactive masts made up 7.89% while 9mobile had the least number of mast structures, occupying only 2.63%.

This finding supports the report of the NBS (2015) which ascertained that MTN had the highest number of subscribers in Nigeria. The sharing of masts by multiple service providers is often viewed as a measure to reduce the cost of erecting and maintaining individual masts especially in highly populated areas where land is unavailable. The spatial location of masts within the study area is displayed in Figure 2.

Figure 2: Spatial Location of Masts in the Area
Source: Authors' Analysis, 2019

The result of the nearest neighbor analysis is displayed in Figure 3 and Table 2. From Table 2, the expected mean distance between masts is 0.0032 meters. The observed mean distance is 0.0029 meters. The Nearest Neighbor Ratio is 0.912116, which indicates that the pattern of distribution of the masts is neither clustered nor dispersed but indeed 'Random'.

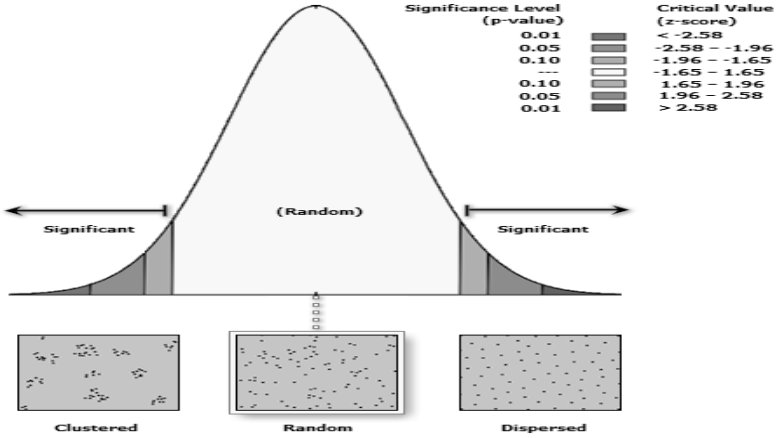

Figure 3: Spatial Pattern of Masts in Awka

Table 2: Results of NNA

Nearest Neighbor Ratio	0.912116
p-value	0.300007
z- score	-1.036417
Observed Mean Distance	0.0029
Expected Mean Distance	0.0032

Source: Author's Analysis

The random pattern further indicates that service providers rarely employ a definite spatial plan or technical threshold standard to guide telecommunication transceiver station locations in the study area. This further reverberates the findings of Nuhu (2016) who observed in a study that telecommunication masts in Kaduna North LGA were randomly distributed where the mean distance of masts to residential areas was less than 1km.

Compliance of Telecommunication Mast to Planning Regulations

NCC Regulations on Location of Telecommunication Base Station

According to Nigerian Communication Commission Act of 2009 on the siting of telecommunications towers and masts, where towers in excess of 25m in height are permitted, they should be placed at a minimum setback of 5m distance to the nearest demised property, excluding the fence. Following this setback directive, masts structures which are located less than 5m from the wall of a residential building are said to not comply while those located 5m and above are said to comply. The distances of masts from the nearest residential buildings were analysed and the results is presented in Table 3 to show their levels of compliance and non-compliance.

Table 3: Compliance and Non-compliance of Network Providers to NCC 5m Setback

Network	**Complied**		**Not Complied**		**Total No. of Masts**	
	F	%	F	%	**F**	**%**
MTN	4	10.52	8	21.0	**12**	**31.5**
GLO	6	15.78	2	5.26	**8**	**21.0**
AIRTEL	3	7.89	1	2.63	**4**	**10.52**
9MOBILE	1	2.63	0	0.00	**1**	**2.63**
SHARED	5	13.15	5	13.15	**10**	**26.30**
INACTIVE	1	2.63	2	5.26	**3**	**7.89**
TOTAL	**20**	**52.6**	**18**	**47.4**	**38**	**100**

Source: Author's Analysis, 2019.

The result in Table 3 revealed that the total level of compliance was 52.6% where GLO network provider had the highest compliance of 15.78%, shared masts followed closely with 13.15%,

MTN with 10.52%, Airtel with 7.89% while 9mobile and inactive masts had 2.63% compliance each. Furthermore, the result also indicated that the network providers had a total non-compliance level of 47.4% with MTN leading this category by 21%. It was followed by shared masts with 13.15% non-compliance, GLO and inactive masts did not comply by 5.26% each while 2.63% Airtel masts did not comply. This supports the findings of Dalil et al (2016) which disclosed that MTN network was the biggest violator of NCC 5m setback regulations in the Federal Capital Territory, Abuja. It also validates the findings of Odunola, Jelili and Asani (2015) which discovered that most MTN masts were erected very close to residential areas without adhering to the minimum standard setback as specified by the NCC.

The compliance level of masts across wards are displayed in Table 4. The result revealed that 31.5% of the masts in the area were located at Ifite-oka of which 23.6% conformed to regulations. Furthermore, out of the 18.4% masts located at Amikwo, 2.63% complied while 15.78 did not comply. Similarly, 15.78% of masts were seen at Ezioka of which 10.52% complied and 5.26% did not comply. The masts at Nkwelle constituted 10.52% of masts and had a compliance and non-compliance of 5.26% and 5.26% respectively. Five masts were observed at Agulu which constituted 13.15% of total masts and had a compliance and non-compliance of 5.26% and 7.89% respectively. Conclusively, Amachalla and Ayom na okpala had 5.26% of masts each which had compliance and non-compliance levels of 2.63% and 2.63% each respectively.

It can be inferred from this result that Ifite was the ward with highest concentration and compliance of masts while Amikwo had the highest non-compliance.

Table 4: Level of Compliance of Service Providers Across Wards in the Study Area.

N	Ifite			Amikwo			Ezioka			Nkwelle			Agulu			Amachalla			Ayom na okpala			Total Mast compliance			
	F (%)	C	%	F (%)	C	%	F (%)	C	%	F (%)	C	%	F (%)	C	%	F (%)	C	%	F (%)	C	%	F	%	C	% (c)
M	3	2	5.26	2	0	0.0	1	0	0.0	1	0	0.0	4	2	5.26	0	0	0	1	0	0.00	12	31.5	**4**	**10.52**
G	3	3	7.89	1	0	0.0	2	2	5.2	1	1	2.6	1	0	0.00	0	0	0	0	0	--	8	21.0	**6**	**15.78**
A	2	2	5.26	1	0	0.0	0	0	-	0	0	-	0	0	--	1	1	2.6	0	0	--	4	10.5	**3**	**7.89**
9	0	0	0.00	1	1	2.6	0	0	-	0	0	-	0	0	--	0	0	0	0	0	--	1	2.63	**1**	**2.63**
S	4	2	5.26	1	0	0.0	3	2	5.2	1	0	0.0	0	0	--	0	0	0	1	1	2.63	10	26.3	**5**	**13.15**
I	0	0	0.0	1	0	0.0	0	0	--	1	1	2.6	0	0	--	1	0	0	0	0	--	3	7.89	**1**	**2.63**
T	**12 31.5**	**9**	**23.6**	**7 18.4**	**1**	**2.6**	**6 15.8**	**4**	**10.5**	**4 (10.5)**	**2**	**5.26**	**5 (13.1)**	**2**	**5.26**	**2 (5.26)**	**1**	**2.6**	**2 (5.26)**	**1**	**2.63**	**38**	**100**	**20**	**52.60**

Level of Non- compliance of Service Providers to NCC 5m setback across wards in the study area

	F (%)	N	%	F (%)	N	%	F (%)	N	%	F (%)	N	%	F (%)	N	%	F (%)	N	%	F (%)	N	%	F	%	N	% (N)
M	3	1	2.63	2	2	5.2	1	1	2.6	1	1	2.63	4	2	5.26	0	0	0	1	1	2.63	12	31.5	**8**	**21.0**
G	3	0	00	1	1	2.6	2	0	0.0	1	0	0.0	1	1	2.63	0	0	0	0	0	--	8	21.0	**2**	**5.26**
A	2	0	0.0	1	1	2.6	0	0	-	0	0	-	0	0	--	1	0	0	0	0	--	4	10.5	**1**	**2.63**
9	0	0	0.0	1	0	0.0	0	0	-	0	0	-	0	0	--	0	0	0	0	0	--	1	2.63	**1**	**2.63**
S	4	2	5.26	1	1	2.6	3	1	2.6	1	1	2.63	0	0	--	0	0	0	1	0	0.00	10	26.3	**5**	**13.1**
I	0	0	0.0	1	1	2.6	0	0	--	1	0	0.00	0	0	--	1	1	2.6	0	0	--	3	7.89	**2**	**5.2**
T	**12 31.5**	**3**	**7.89**	**7 18.4**	**6**	**15**	**6 15.8**	**2**	**5.2**	**4 (10.5)**	**2**	**5.26**	**5 (13.1)**	**3**	**7.89**	**2 (5.26)**	**1**	**2.6**	**2 (5.26)**	**1**	**2.63**	**38**	**100**	**18**	**47.34**

Source: Author's Analysis 2019.

KEY:

C - Complied S - Shared masts N - Non-compliance

M - MTN I - Inactive masts

G - GLO F - Frequency

A - AIRTEL T – Total

The Figures 4 to 9 display the locations of masts which conformed and did not conform to the NCC 5m minimum setback from residential properties across wards in the area.

Figure 4: Conformity of MTN Masts in the Study Area

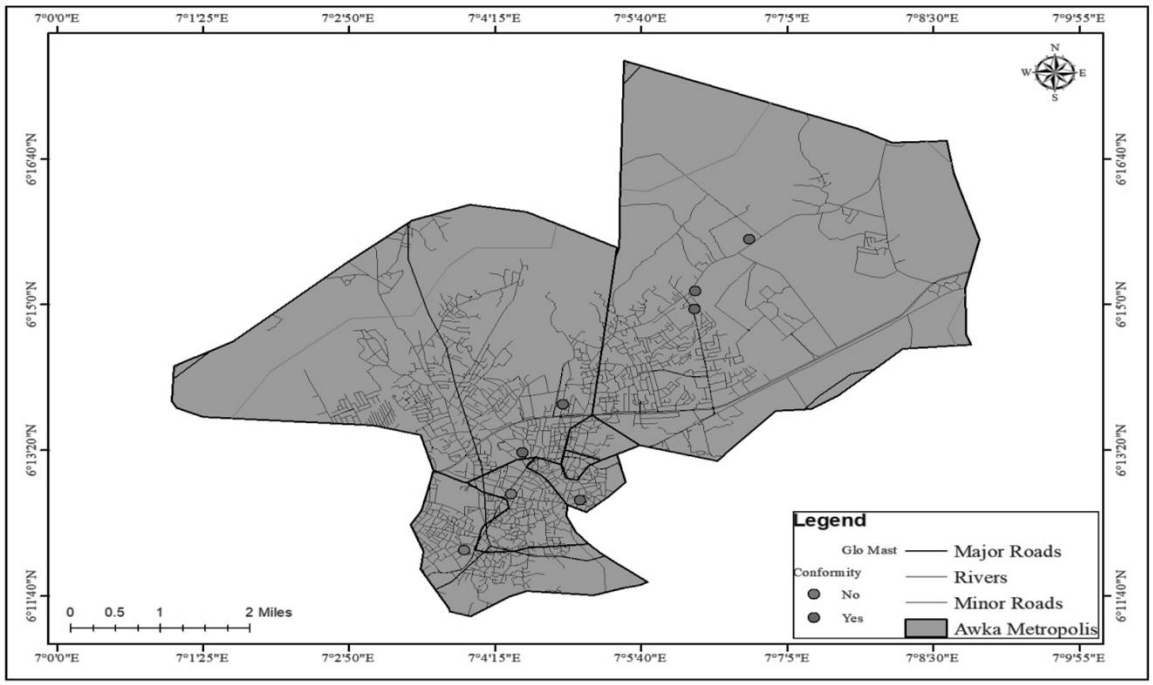

Figure 5: Conformity of GLO Masts in the study Area

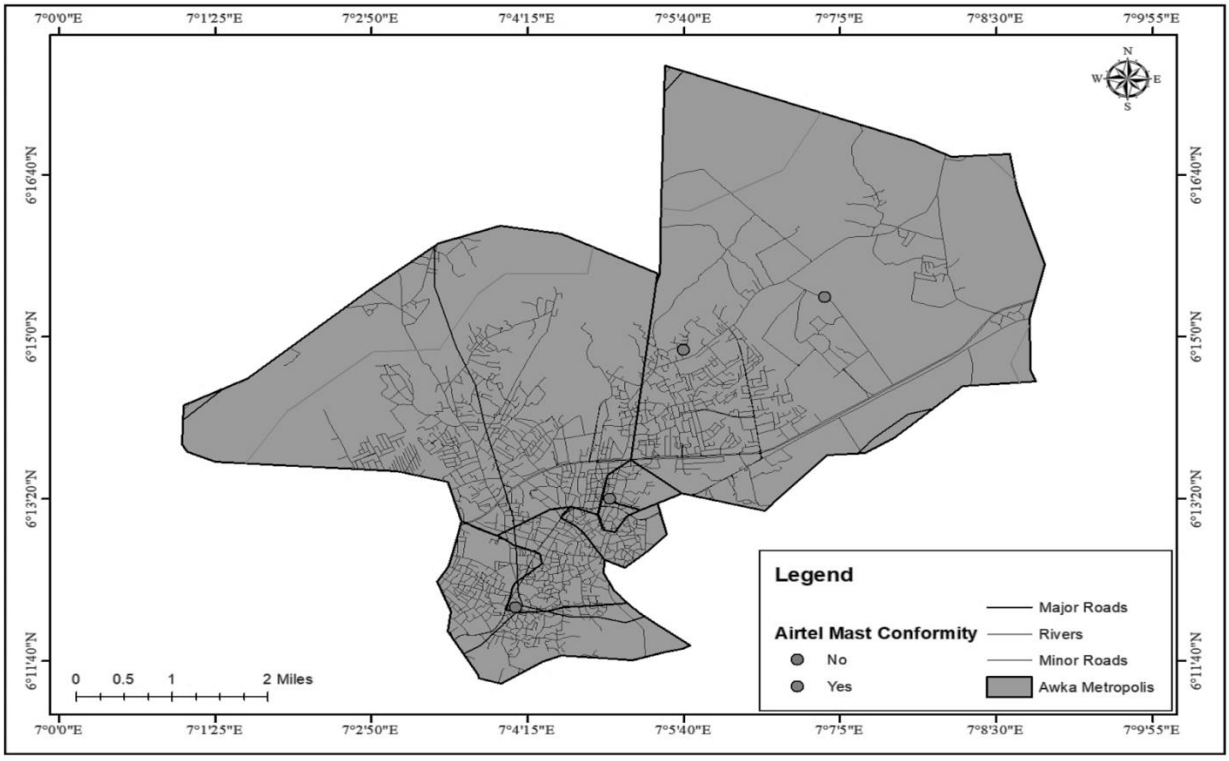

Figure 6: Conformity of Airtel Masts in the Study Area

Figure 7: Conformity of 9mobile Masts in the Study Area

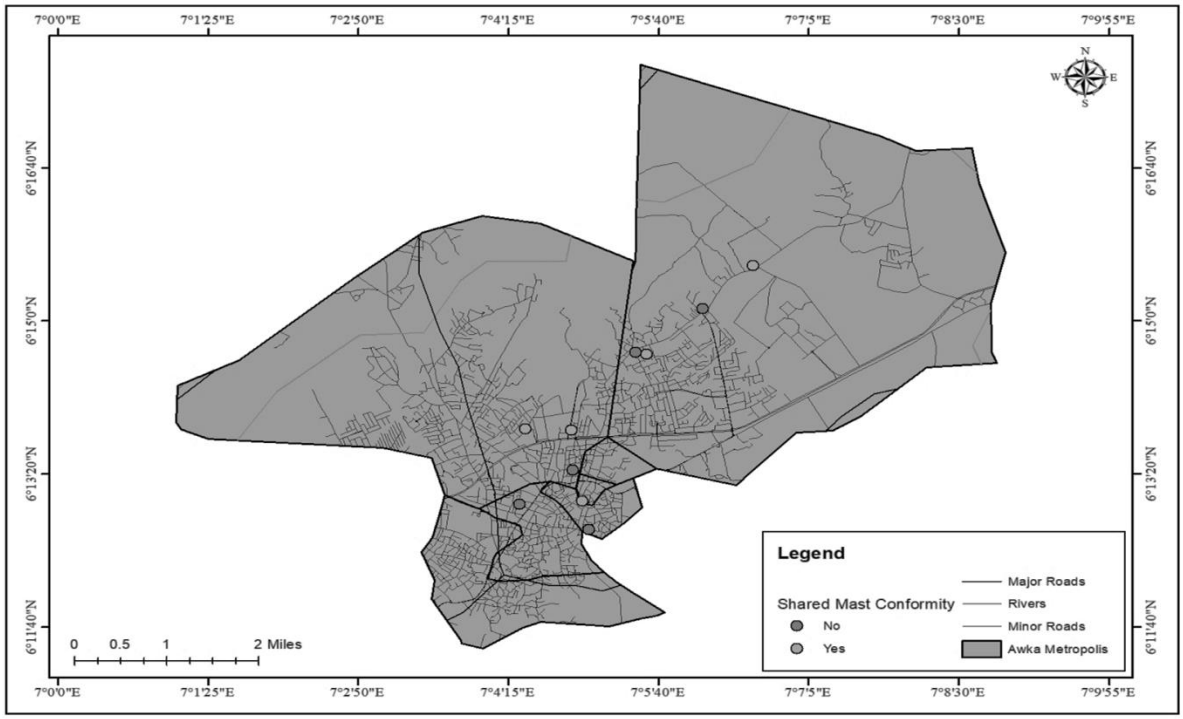

Figure 8: Conformity of Shared Masts in the Study Area

Figure 9: Conformity of Inactive Masts in the Study Area

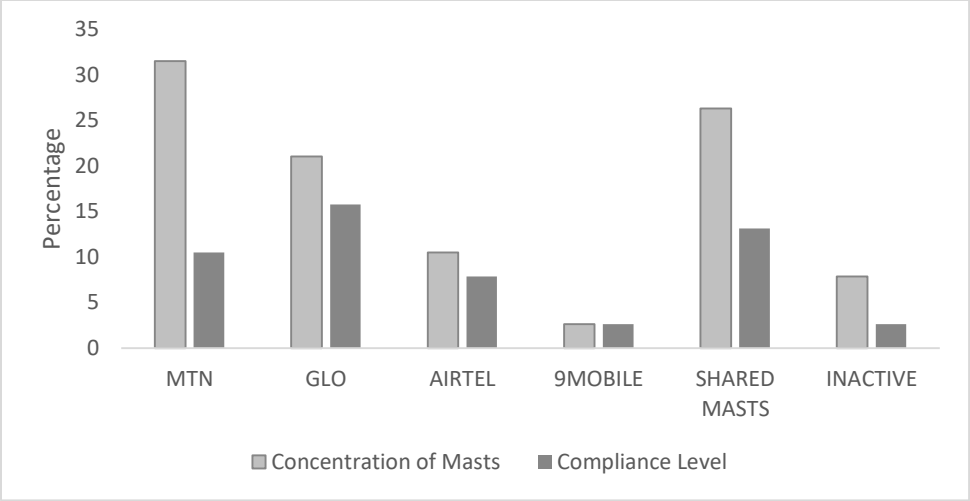

Figure 10: Compliance summary of Masts in the Study Area

CONCLUSION

The findings in this paper revealed that the thirty-eight telecommunication mast towers identified at Awka were randomly distributed. The compliance and non-compliance levels of the masts to the NCC 5m setback were 52.6% and 47.4% respectively. GLO masts constituted 15.78% of the complying structures, shared masts (13.15%), MTN (10.52%), Airtel (7.89%) while 9mobile and inactive masts had 2.63% compliance levels each. However, MTN accounted for 21% of the non-complying masts. Ifite area was observed to have the highest conformity of masts by wards with 23.6% while Amikwo area had the highest number of non-complying masts (15.78%).

Based on these findings, the study therefore recommends that the NCC carries out proper checks on both existing and proposed sites to ensure that service providers strictly adhere with locational standards. The sharing of masts should be further encouraged across urban areas in Nigeria as it also serves as a measure in reducing mast clustering. The study also hinges on the need for proper environmental planning with consideration for future telecommunication sites.

REFERENCES

Adamu, G. (2016). *An Analysis of Spatial Distribution of GSM Base Stations in Zaria Urban Area, Kaduna State, Nigeria*. An M.Sc. Dissertation, Department of Geography and Environmental Management, Ahmadu Bello University, Zaria.

Antonelli, C. (1991). *The Diffusion of Advanced Telecommunication in Developing Countries*. Development Center of the O.E.C.D; Paris. p. 111.

Bond, S., Mun, S, Sakornvanasak, P. and McMahon, N. (2003). The Impact of Cellular Phone Base Station Towers On Property Values. 9th pacific-rim Real Estate society conference, Brisbane, Australia 19-22. January 2003.

Dalil, M., Yahaya, A. A, Umar F.Y, and Abd'razack, N.T.A. (2016). Spatial Distribution of Telecommunication Base Stations and Its Environmental Effect On Residents of Federal Capital City Abuja, Nigeria. *Journal of Sustainable Development in Africa.* 18(3), 142-164.

Ezeabasili, A.C.C, Okoro, B.U. and Okonkwo, A.U (2014). Assessment of Water Supply Quality in Awka, Anambra State, Nigeria. *STECH, African Journal Online* 3(3), 81-93.

Ezeigwe, P.C. (2015). Evaluation of the Causes of Housing Problems in Nigeria: A Case Study of Awka the Capital City of Anambra State. *Journal of Economics and Sustainable Development.* 6(20), 87-93

Getis, A. and Ord, J. K. (1998*). Local spatial statistics: an overview in spatial analysis and modelling in a GIS environment,* edited by Longley, P. and Batty, M. John Wiley and Sons: New York.

Hart, L., Jackson K.P., Akpe D. and Moka E.C (2012). Landuse Planning and Telecommunication Facilities Location in Port Harcourt, Rivers State. *Research journal in Engineering and Applied Science.* 5(2), 184-189.

National Population Commission (2007). Population Census of the Federal Republic of Nigeria. Published by National Population Commission.

Nigeria Communication Commissions (2014): "*Industry information*" Available at http://www.ncc.gov.ng/index.php?option=com_content&view=category&id=65&Itemid=67 retrieved 02/05/2018.

Nigerian Communications Commission (2009). Guidelines On Technical Specification for the Installation of Telecommunications Masts and Towers. Nigeria: Nigerian Communications Commission

Nigeria Bureau of Statistics (2015):00 Nigeria Telecommunications Sector: Quarter 1 2015 summary report. Federal Republic of Nigeria. Nigeria Bureau of Statistics.

Nuhu, S. (2016). *Locational Pattern of Telecommunication Masts in Kaduna North Local Government Area, Kaduna State, Nigeria.* Unpublished MSc. Dissertation Department of Geography and environmental Management. Ahmadu Bello University Zaria.

Nzoiwu, C.P, Ezenwaji, E.E, Enete, I.C and Igu, N. I. (2017). Analysis of Trend of Rainfall and Water Balance Characteristics of Awka, Nigeria. *Journal of Geography and Regional Planning.* 10(7), 186-196.

Odunola, O.O, Jelili, M.O., and Asani, M.A. (2015). Telecommunication Mast Location and it's Health Implication for Residents in Ogbomosho, Nigeria. *Civil and Environmental Research Journal.* 7(9), 57-65.

Ogboru, T. (2015). NESREA and NCC Regulations on Telecommunication Masts: Implementing the Precautionary Principle. *Journal of Development Law and Policy*. 5 (1), 55-71.

Ogbonna C.G, Okoye V.U and Eleazu, E.I (2016). Telecommunication Masts/Base Transceiver Stations and Regulatory Standards in Abia State, Nigeria. *Journal of Sustainable Development*. 9(6), 46-57.

Olukolajo, M.A, Ezeokoli, N.B and Ogungbenro, M.T. (2013). Locational Effect of GSM Mast on Neighboring Residential Properties' Rental Values in Akure, Nigeria. *Academic Journal of Interdisciplinary Studies*. 2(3), 147-155.

Turletti, T., Bentzen, H. J. and Tennenhouse, D. 1999. Toward the Software Realization of a GSM Base Station. *IEEE J. on Selected Areas in Communications*. 17(4): 603-612

United Nations Human Settlements Programme (2009*). Structure Plan for Awka and Satellite Towns.* UN-HABITAT: Nairobi, Kenya.

Ujumadu, V. (2010, October 12). Community Petition NCC Over Telecom Mast. *Vanguard News*, retrieved on 4th July, 2018 from https://www.google.com/amp/s/www.vanguard ngr.com

Wale, A., Hakeem, B and Oluwafemi, O. (2011). Locational Analysis of telecommunication Infrastructure in Residential Neighborhoods of Lagos Metropolis. Proceedings Real Corp 2011 Tagungsband. Retrieved on January, 2017 from http://www.corp.at