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EVALUATION OF THE EFFECTS OF MTN ELECOMMUNICATION MASTS AND BASE STATIONS ON THE ENVIRONMENT OF ENUGU STATE

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Keywords:
Base, Masts, MTN, Stations, Telecommunication

Abstract
The study evaluated the effects of MTN telecommunication masts and base stations on the environment of Enugu State, Nigeria. The specific objectives are to; examine the spatial distribution of MTN masts and base stations; identify the effects of MTN telecommunication masts and base stations on the residences. Basic survey design and experimental were adopted for this study. A primary source of data was adopted for the study. The primary data were obtained from interviews, questionnaires, and geo-referencing. The population of this study comprises the three senatorial districts in Enugu state, which include Enugu North Senatorial District, Enugu West Senatorial District, and Enugu East Senatorial District. The total population is made up of 2,632,653. Taro Yamani formula was used to determine the sample. The sample is 400. The data were analyzed using ArcGIS 10.1 software. The statistical tools employed are: Tukey HSD and Games-Howell, Independent T-test, and ANOVA were used to test the hypothesis which compared multiple data of variance collected and its significant difference. The result revealed that there is a significant difference between the spatial distribution of MTN masts/base stations and population density in Enugu State, $t(857) = 46.516$, $p = 0.000 < 0.05$, $\omega = 0.43$, the Anova result of the significant difference between the effects of telecommunication masts and base stations and the residents within the study area is $DF = 2$, $F = 29.4$, $p = 0.000 < 0.05$, effect size $(\omega) = 0.25$. We concluded that MTN telecommunication masts and base stations have a significant effect on the environment. We recommended that Telecommunication companies should endeavor to key into the regulatory policy of co-location of infrastructure as recommended by NCC and NESREA.

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Introduction

The effects of information dissemination as well as seamless communication in Nigeria became a reality in 2001 with the introduction of global system mobile telecommunication (GSM) services by two telecommunication giants namely Mobile Telephone Network (MTN), and Affectionate Interested Respectful Tolerant Energetic and Loving (Airtel). However, the land tenure system as well as the fragmentation of land in Nigeria have hindered the ease of procuring land for the purpose of installing masts and base stations, especially in built-up areas where the concentration of subscribers is very high (Ogbonna, Okoye, and Eleazu, 2016). Various method were adopted for the purpose of obtaining suitable sites and avenue for the erection of the masts and base stations towards serving the populace for an efficient communication purpose. The choice of the sites for the said purpose depends on the population of the area, the elevation of the identified places on the earth surface relative to the surrounding area; direction of expansion of telecommunication service of the proponent; the need to preserve and conserve places and sites of monumental, architectural and historic importance (Omotayo, Akintayo, Olusola, Adeife, and Zachariah, 2022). However, the increase in telephone subscribers has brought about the proliferation of new base stations for better network coverage which led to the indiscriminate erection and location of masts and base stations across the country (Omotayo et al., 2022).

This has caused a number of environmental problems such as pollution (Pona, Xiaoli, Ayantobo, Narh, 2021), mixed land use and urban cramp to residents in these cities. This is reflected in the number of objections on installation of masts by residents in relation to planning (Ma, Jiang, Zhou, and Zhang, 2022). This rapid increase in the erection of mast has become public concern over the issue of health and safety risk for those living around the telecommunication base stations (Pona et al.,2021). The effects of mast on city dwellers can be complex. There are silent long-term problems that may affect the president's health. In United States for instance, masts have been associated with cancer, thyroid and prostate cancer. Occurrence like cancer of the lungs, prostate, breast, leukemia, lymphoma, and haemotopoletic cancer have been blamed on those living within 1-5km distance from mast in Dunganon (Underwood, Lyratzopoulos, Saunders, 2023).

There have also been issues related to the fact that some of the masts that are erected are not very strong structurally and there have been cases of towers that have fallen down to cause fatal accident and other nuisance to the environment. The vibration and noise from masts in the host neighborhood also impair the residents peaceful living (Ma et al., 2022). It is

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noteworthy to mention that because of the challenges associated with the operation of telecommunication, there has been an effort by Nigerian governments to promulgate laws and regulations to prevent, control and minimize the results of those challenges on the environment (Olanrewaju, 2016). In Nigeria, several laws were promulgated for the protection of the environment. These laws embody the Nigeria Communication Act of 2003, National Environmental Standards and Regulations Enforcement Agency (establishment) Act of 2007, Environmental Impact Assessment Act of 1992, Wattage Reform Act of 2005, Nigeria Airspace Management Agency (Establishment) Act of 1999, Nigeria Civil Aviation Authority (establishment) Act of 1999, Factories Act of 1987 and Nuclear Safety and Radiation Protection Act of 1995.

Currently, the Nigerian Communication Commission (NCC) and National Environmental Standards and Regulations Enforcement Agency (NESREA) are the 2 Agencies constitutionally authorized to control telecoms infrastructure within Nigeria. However, state agencies are currently insisting on playing additional role in regulating telecom activities since the impact is on their environment (Ogboru, 2015). Despite the implementation of these Acts, inappropriate location of masts and base stations is still on the increase in our towns and cities. More than 120 masts are built monthly on the average by the service providers (Ogbonna et al.,2016, Ogboru, 2015). Each service provider as at 2009 has about 3,000 masts across the country, most concentrating in urban areas. If 120 masts per month is anything to go by, then each operator would have added about 4,800 masts (Ahmad, Green, and Jiang, 2020). The Nigeria Communications Commission (NCC) has put the number of masts and base stations in the industry at 40,451 and one can imagine the enormous environmental crisis associated with the unhealthy installation of masts in our cities (Ariyoosu, 2017, Ogboru, 2015). This study therefore, intends to examine the effects of telecommunication masts and base stations on the environment of Enugu State.

1.2 Statement of the Problem

The rapid population growth resulting from urbanization and expansion of cities has resulted in continuous demand for mobile phones subscribers and consequent proliferation of masts and base stations telecommunication in most cities and towns around the globe. Masts and base stations are installed by service providers to ensure effective functioning of mobile telecommunication network (Bello, 2010; Donkoh et al.,2017). Studies have shown that there are adverse health effects when one lives or works in close proximity to telecommunication masts. At this present moment, the spatial distribution patterns of masts and base stations are clustered in major towns, but as population continues to grow so will the number of subscribers and more masts are going to be

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required to meet their demand for reliable coverage. Due to unstable electric power in Nigeria, electric power generating sets have become an integral part of the assemblage of the base stations and may result in the elevation of background noise levels within the location of the base stations.

1.3 Aim and Objectives of the Study

This study aimed at evaluating the effects of MTN telecommunication masts and base stations on the environment of Enugu State, Nigeria.

To achieve this aim, the following objectives were identified;

1. To examine the spatial distribution of MTN masts and base stations within Enugu state.
2. To identify the effects of MTN telecommunication masts and base stations on the residence of the study area

1.4 Hypotheses of the Study

The following hypotheses were postulated to guide the study:

1. There is no significant difference between the spatial distribution of MTN masts and base stations and population density in Enugu State.
2. There is no significant difference between the effects of telecommunication masts and base stations and the residents within the study area.

Review of Related Literature

2.1 Conceptual Review

Historical Development of GSM and Base Station

Global System for Mobile Communication (GSM) is a second-generation network of 2G digital mobile communication network system (Kuboye, Alese, and Fajuyigbe 2014). Before the establishment of GSM, the first communication network was analog. Liberg, Sundberg, Wang, Bergman, Sachs, and Wikström (2019), explained that GSM is a digital cellular phone technology based on time division multiple access (TDMA). It means that GSM is an open, digital cellular technology used for transmitting mobile voice and data services (Singh, and Singh, 2021). Mobile coverage has grew upon the issuance of digital mobile licenses (DMLs) to operators that initially deployed 2G technology to provide voice services and effectively covering greater than 89% of the World's population. The demand for internet access and availability of spectrum has stimulated the growth in 3G services which covers about 75% of the population.

Technologies can either be wire line or wireless, it is desirable that this layer of physical fiber infrastructure attains depth of capacity and pervasive coverage as even wireless technology requires fiber infrastructure (such as Fiber to the Base Station/Tower (FTTB) or Fiber to the Node (FTTN), by the FTTx approach) to deliver the robust mobile broadband (3G, 4G/LTE) services

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that support high-speed user access (NCC, 2020). The first generation (1G) wireless mobile communication system was a circuit-switched analog cellular technology developed in 1980s. It was used for voice services and was based on Advanced Mobile Phone System (AMPS) technology. The second generation (2G) wireless mobile communication system was a circuit-switched digital cellular technology and was introduced in late 1980s. It uses digital signals for voice transmission and has a speed of 64kbps.The bandwidth of 2G is 30-200KHz, providing services such as short message services (SMS), picture messages and multimedia message services (MMS). The third generation (3G) wireless mobile communication system was introduced in 2000. The goal of 3G systems was to offer increased data rates from 144kbps to 384kbps in wide coverage areas and 2Mbps in local coverage areas.3G offers advanced services to the users as compared to 1G and 2G.

The fourth Generation (4G) mobile system was introduced in the late 2000s and was all IP based network system. The main goal of 4G technology is to provide high speed, high quality, high capacity, security and low cost services for voice and data services, multimedia and internet over IP. The pioneer of 5G technology was South Korea offering a mobile hotspot for the first time in December 2018 (Massaro, & Kim, 2022). Although the 5G network is still under development, some countries, including China, the United Kingdom, and the United States of America, and a few other developed countries expect to deploy commercial 5G networks by 2025(GSMA, 2018). Likewise, the 5G network will significantly increase the capacity to handle massive simultaneous connections between virtually all smart devices of the future (Kang, 2020).

The operation of 5G will result in a strong and unprecedented electromagnetic field exposure for any living object or organism that stays or moves in an urban environment. It is important to point out that the 5G network is an RF-based technology that uses the electromagnetic spectrum (just like the 4G spectrum) to transmit information involving radiation (the emission of energy) (Bushberg, Chou, Foster, Kavet, Maxson, Tell, Ziskin, 2020). Telecommunication Base trans-receiver stations (BTSs) are designed to enhance communication radio-frequency network signals for the rapidly expanding digital telecommunication users both in urban and rural communities (Deevela, Kandpal, and Singh, 2023). The typical Base station consists of a telecommunication mast on which are installed radio frequency transmitters and receivers, powered by digital electronic boasters which are installed in shelters within the BTS site. A number of environmental issues have led to the introduction of this technology. The sitting of telecommunication masts and towers must take cognizance of the provisions of the Nigerian Communications Act and be guided by the provisions of the Guidelines on Co-location and

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Infrastructure Sharing issued by the Commission, in such a way as to minimize the number, protect, and promote public safety, and mitigates adverse visual impacts on the community.

Factors for Spatial Distribution of MTN Telecommunication Mast and Base Stations

The spatial distribution of MTN telecommunications masts and base stations in Nigeria involves several factors.

Ogboru (2015) commended NCC on their efficient regulatory compliance in the installation of MTN telecommunication masts and base stations. He emphasized that Operators need to adhere to the guidelines and regulations set by the Nigerian Communications Commission (NCC) for the installation of masts and base stations. Ahamed and Faruque (2021) explained that factors in choosing appropriate locations for masts and base stations are crucial. Such factors are population density, network coverage gaps, terrain, and proximity to power supply and fiber optic infrastructure need to be considered. Deevela, Kandpal, and Singh(2023), highlighted that access to reliable power supply, either through the grid or alternative sources like solar energy, is necessary for the operation of masts and base stations, while fiber optic connectivity is also essential for backhauling data (Macaulay 2016). According to Amponsah, Takyi, Asibey, and Amponsah (2023), securing suitable land for tower installation is important for appropriate negotiations, permits, lease with land owners or local communities, must be addressed for legal purpose. Choji, Rampedi, Modley, and Ifegbesan (2022) considered Environmental aspects such as potential effects on wildlife, ecosystems, and aesthetics should be evaluated. Environmental impact assessments may also be required. In the installation of MTN telecommunication masts and base station especial in local communities, there is need for local community engagement and addressing their concerns is crucial to gain their support and minimize potential conflicts during the installation process (Amponsah *et al.,* 2023). Ensuring the safety and security of the infrastructure, as well as the personnel working on the site, is important factor in the spatial distribution of telecommunication masts and base station. Ijabor *et al.,* (2023) added that measures to protect against theft, vandalism, and unauthorized access are factors considered in the installation of telecommunication masts in Delta State.

The Effects of Telecommunication MTN mast and base station

The effects of Telecommunication MTN masts and base stations are follows:

i. Human Health
ii. Plants, Animals, and Ecosystem
iii. Property Value

Human Health

The effect of telecommunication masts and Base Stations' radiation on human health is the

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subject interest as our mobile phones use electromagnetic radiation (EMR) in the microwave range. Balmori (2022), emphasized that as a result of dense installations of public mobile Base stations, additional electromagnetic radiation occurs in the living environment. Kıvrak, Yurt, and Kaplan (2017), opined that exposure to EMR is growing and becoming a serious health threat. They also pointed out the huge public health crisis looming from one particular threat: EMR from cellular phones, both the radiation from the handsets and from the tower-based antennas carrying the signals which studies have linked to development of brain tumors, and genetic damage (Kivrak *et al.,* 2017). Foster, Ziskin, Balzano, Bit-Babik (2018) revealed that residents are likely to be impacted negatively due to exposure to radiofrequency radiation and high sound intensity. It can cause thermal effects (heating of body tissues) and this may be detrimental to health if regulatory limits of exposure are exceeded.

Plants, Animals and Ecosystem

Vornoli, Falcioni, Mandrioli, Bua, and Belpoggi(2019) found that there are some indications that test animals become more sensitive to radiation after long-term exposure to electromagnetic radiation as seen in two of the critical experiments that contributed to the present SAR standards. Imam-Tamim *et al.,* (2016) revealed that the generators which are run for almost 24 hours a day in the base stations are the source of noise. The study also confirmed that an adverse effect of power generator(s) in a mast site located in residential areas is the massive vibration experienced by residents close to the Base Stations. Such vibration often becomes so much that nearby buildings start to vibrate including the floors of the house, the ceilings, windows, walls, and even the fence, leading to structural damage of the building.

Property Value

Landlords in Nigeria who own buildings close to telecommunications masts have observed a decrease in the value of their properties and a decrease in their patronage due to the presence of base stations, which generate a range of environmental concerns, including fumes and vibrations. Joyakporehwe, and Nathan, (2018) revealed a number of environmental, aesthetic, and safety risks associated with potential structural flaws in the vicinity of telecommunication masts and base stations. The primary reason for this is that the homes in the vicinity of the masts have been rendered in a dark hue due to the smoke generated by the base station. Pierson, Wood, and Driedger(2017) expressed that due to perceived fear of health hazards and possible collapse of the tall masts at any time without warning, properties close to masts are bound to lose attractiveness to prospective buyers or tenants, thereby losing value.

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2.3 Theoretical Review

The Health Belief Model

The Health Belief Model HBM is a theory that has been used since the 1950s to explain the reasons for people's decisions to or not to use preventive services provided by public health authorities. While the model has since been adapted to meet the current concerns in the field of prevention and detection, such as mammography screening and influenza vaccines, it is still based on the premise that people's beliefs about their susceptibility to disease or health problems, as well as their perception of the advantages of taking steps to prevent it, shape their willingness to take action. The Health Belief Model, developed in the 1950s by Rosenstock (1974), is a theory of health promotion that focuses on the assessment of health behavior through the examination of individuals' perceptions and attitudes towards disease, as well as the negative consequences of certain actions. This theory has become one of the most widely used and popular theories in intervention science, and is used to design interventions and prevention programs. The model was based on the concept of individual perception, modifiable factors, and, ultimately, the probability of taking action. Individual perception refers to the understanding and conviction of a person about their actions and the potential consequences. This includes the perception of susceptibility and severity. In the health field, susceptibility is the likelihood of a person having a specific disease or health condition. In the context of HBM, the perception of susceptibility is the perception of how likely a person's actions are to result in a detrimental health outcome.

The Theory of Reasoned Action

The Theory of Reasoned Action is a model of the prediction of behavior intent, which encompasses both the prediction of attitude and the prediction of behaviour. By separating behavioral intention from behavior, it is possible to elucidate the determinants of attitudinal influence. This theory was developed by Ajzen (1991), in response to the lack of correlation between attitude measures and the performance of voluntary behaviors.

Theory of Reasoned Action suggests that a person's behaviour is determined by his/her intention to perform the behaviour and that this intention is, in turn, a function of his/her attitude toward the behaviour and his/her subjective norm. The best predictor of behavior is intention. Intention is the cognitive representation of a person's readiness to perform a given behaviour, and it is considered to be the immediate antecedent of behaviour. This intention is determined by three things: their attitude toward the specific behaviour, their subjective norms, and their perceived behavioral control. The theory of planned behaviour holds that only specific attitudes toward the behavior in question can be expected to predict that behavior.

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3.0 Methodology

The researcher adopted basic survey, qualitative approaches and experimental designs. A basic survey design and experimental were adopted for this study because they satisfy the purposes of this research nature. The basic survey research design includes both descriptive and cross-section surveys. The survey enabled primary and secondary data collection on the site like (location and Geo-reference of masts and base stations; and distance away from land use). The qualitative design research was conducted through the systematic collection and analysis of data through the use of a structured questionnaire, while the experimental research design deals on the collection of ambient air quality, noise level, electromagnetic radiation and soil quality of the MTN masts and base stations. Simple random sampling was employed to select the residential compounds for sampling. Only the head of the households were sampled in each selected compound particularly those living 50m close to the masts and base stations. study was conducted by the researcher to assess the validity and dependability of the instrument. The participants were 40 randomly selected respondents from the population were administered the instrument.

The study was carried out in the seventeen local government areas of Enugu state. This is to enable the researcher have a holistic evaluation of the effects of MTN masts and base stations in the study area.

In this study, the sample size was statistically derived using Yaro Yamani method thus,

$$n = \frac{N}{1+ N\ (e)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where n = the sample size
N = the finite population
e = level of significance (5%)
1 = Unity (a constant)

The study population comprises households who were better placed to give answers to issues that relate to their household demographic characteristics, Location of Telecommunication Masts and Base Stations, and environmental effects in the study area.

Methods of Data Analysis

The following analytical techniques were used in the analyses of the field data. They are:

Image Geo-Referencing: The Digital Globe satellite imagery of the area was geo-referenced with the aid of ground control points using GPS. The image was geo-registered with the geographic coordinate system, WGS 1984 using the Geo-referencing tool bar of the ArcGIS 10.1 software. The image was later projected to projection coordinate system Minna Datum zone 32 using the projection/transformation tool in the ArcTool Box of the ArcGIS software.

Vector Data Creation: The satellite image was vectorized using the ArcGIS 10.1 software. The purpose was to transform the raster image into vector shape files, where the image was digitized under the following themes: the road networks and water bodies as polylines. Residential areas

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as polygon with each feature type having separate attribute. This facilitated the determination of the spatial distribution of the MTN masts and base stations.

Geo-spatial Database: A geo-database was created using the ArcGIS 10.1 software, this enabled subsequent of the analysis. First, the GSM base stations in Microsoft excel command delimited format with fields (column); X and Y locations, number of facilities, address, area, and corresponding records (row) was imported into the ArcGIS 10.1 software environment and exported into the Geo-database. Secondly digitized road networks, water bodies and residential areas from the satellite image were also exported into the Geo-database.

Thus, Nearest Neighbour Statistics (R) is estimated from a study using this formular;

$$R = \frac{ra}{re} \quad \text{Eqn (1)}$$

$$ra = \sum \frac{r}{n} \quad \text{Eqn (2)}$$

$$e = \frac{1}{2} \times \sqrt{d} \quad \text{Eqn (3)}$$

$$d = \frac{n}{a} \quad \text{Eqn (4)}$$

Where
ra= observed mean
re= expected mean
r= total distance between nearest neighbors
n= number of points
d= density
a = size of the area studied

When
R =above 2.0 it signifies regular/uniform/hexagon
R = 1-1.99, it signifies random
R = 0-0.99 it signifies clustered (agglomeration)

The data for the study were analyzed using both descriptive and inferential statistics. Tables, bar charts, and graphs were used to display the results of the analysis. The GPS was used to generate the coordinates of the masts and base stations in the study area while the measurement of radiation exposure by field power densities at the base of the masts and base stations was obtained by the radiation meter which measured the indicator for radiation exposure intensity. The measurements were taken at 50m from the base of each mast and base station. A radiation meter OCD, CDV – 717 Model CM3, KIPPS & ZONNEL. No 1: SER Victoreen Instrument was used for the measurement. The results were collated and analyzed using EPI-INFO version 6. Three statistical tools employed are: Tukey HSD and Games-Howell, Independent T-test, and ANOVA were used to test the hypothesis which compared multiple data of variance collected and compared its significant difference. On the other hand, the Independent T-test technique compared the difference between the effects of telecommunication masts and base stations and the residents within the study area. The pre-test

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of the instrument was carried out to establish the validity, and reliability of the data collection tools.

Data Presentation, Analysis and Discussion of Findings

4.1 Spatial distribution of MTN Masts and Base Stations in the Study Arae

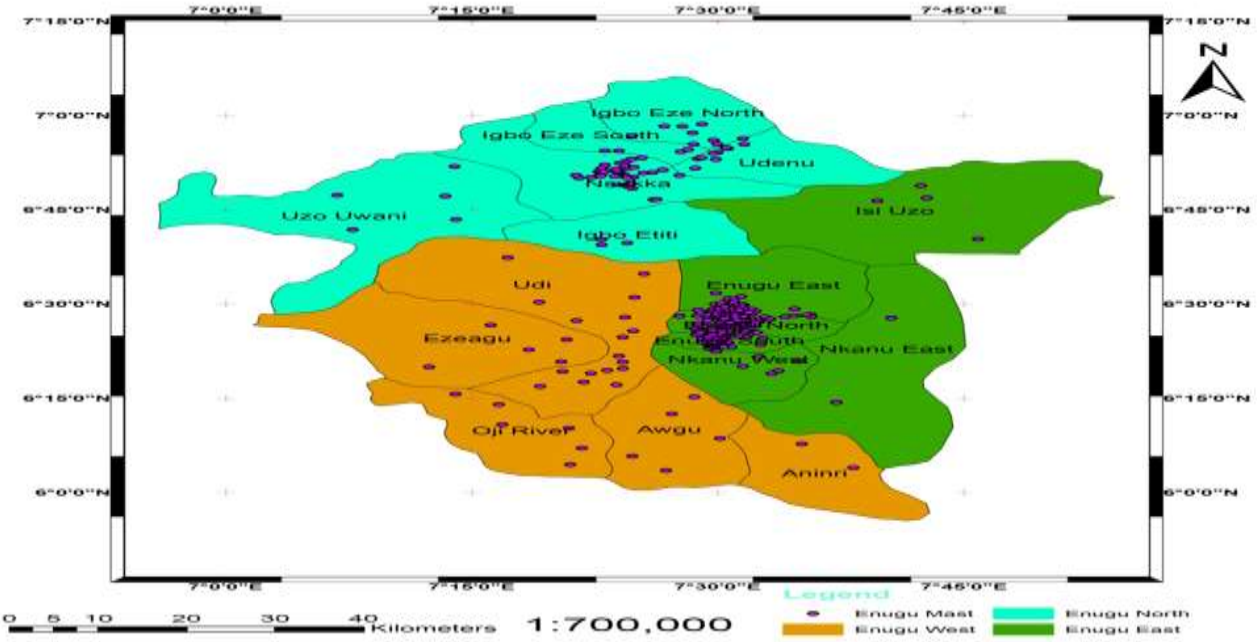

Figure 4.1: MTN Masts and Base Stations in Enugu Sate
Source: Fieldwork, 2023.

Figure 4.1 shows the spatial distribution of MTN masts and base station in Enugu State. There are Three
Hundred and Forty Seven (347) MTN masts and base stations in Enugu State. Two Hundred and Twenty Four (224) being 64.5% are found at Enugu East Senatorial Zone, Eighty Seven (87) 25.1% are located at Enugu North Senatorial Zone, while Thirty Six (10.4%) are found at Enugu West Senatorial Zone.

The spatial distribution of MTN telecommunication masts and base stations is clustered in the study area. This is based on the fact that it is densely populated and there are urban and commercial centers with high economic activities. The distribution pattern is to provide adequate network coverage, safety and security of the infrastructure; power supply and fiber optic connectivity.

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4.2 The effects of MTN telecommunication masts and base stations on the residence within the study area. This objective was achieved with the use of questionnaire instrument.

There are Three Hundred and Forty-Seven (347) MTN masts and base stations in Enugu State, Eight Hundred and three (803) houses within the MTN telecommunication masts and base stations, Two Thousand one Hundred and Ninety (2,190) copies of questionnaires were distributed, and Two Thousand, one Hundred and Sixty-Six (2,166) copies of the questionnaire were returned. The percentage of the copy's questionnaire returned was 98.9%.

Analysis of Respondents

Table 4.1: Respondents Living Near Telecommunication Mast and Base Station

Response	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Yes	188	72	113	131	142	134	89	190	182	188	142	99	48	144	45	49	46	92
No	12	27	36	19	8	15	11	5	7	1	7	1	2	3	5	1	4	8
Total	200	99	149	150	150	149	100	195	189	189	149	100	50	147	50	50	50	100

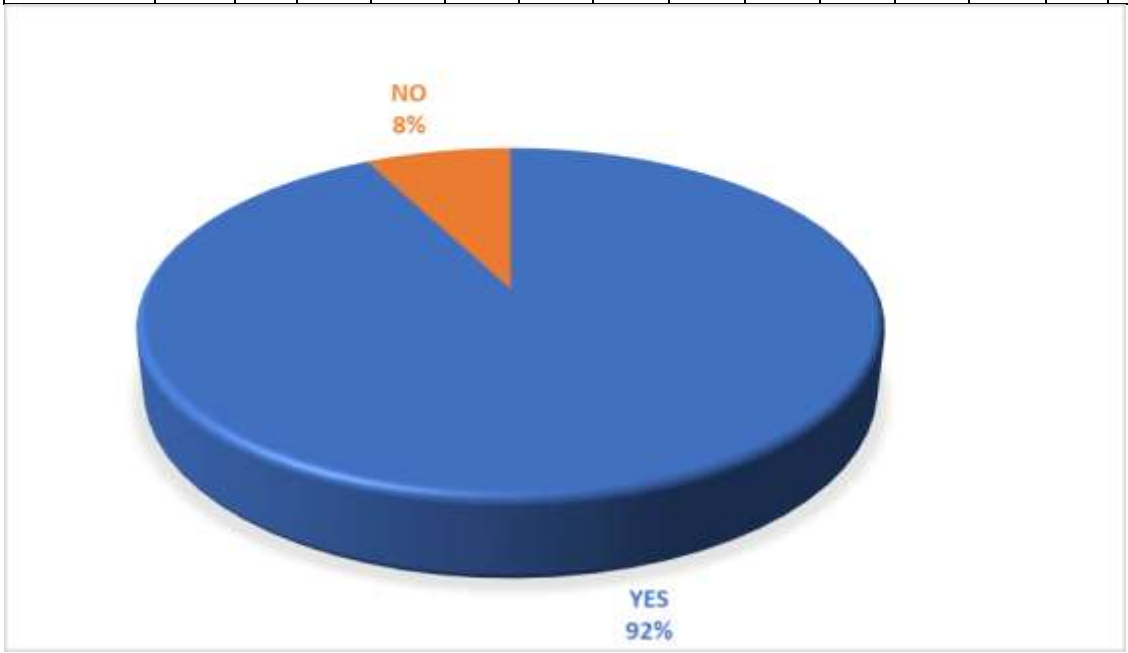

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Figure 4.2: The Response to Living Near Telecom Masts
Source: Fieldwork, 2023

Distance	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
1 – 5	17	4	10	30	21	22	10	41	46	2	41	20	13	12	13	7	14	14.9
5 – 10	33	21	36	42	22	49	8	80	66	80	47	17	16	48	0	17	8	27.2
10 – 20	21	24	41	46	42	31	14	13	63	41	32	33	2	53	27	12	13	23.5
20 – 50	58	31	32	14	40	18	22	18	8	14	18	14	10	15	4	5	8	15.2
51 – 100	52	14	27	8	10	18	17	20	2	10	0	14	6	15	6	5	0	10.3
100 & above	19	5	3	10	15	11	29	23	4	42	11	2	3	4	0	4	7	8.9
Total	200	99	149	150	150	149	100	195	189	189	149	100	50	147	50	50	50	100

Table 4.1 and figure 4.2 shows that majority of the respondents (92%) live near telecommunication masts and base stations, while 8% of the respondents do not live near telecommunication masts and base stations. The implication is that the result of their perception of the effects of spatial location of GSM masts could be regarded as reliable, and therefore, the information they provided is credible.

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Table 4.2: Distance to Mast Exposure in Meters

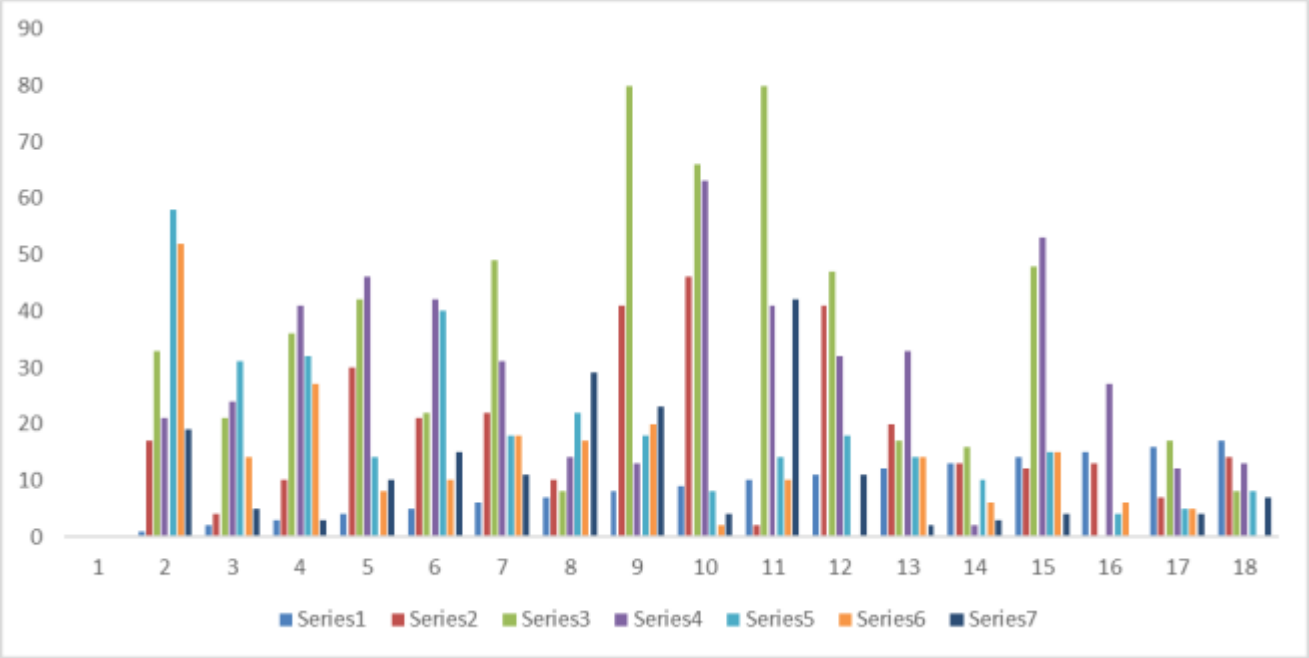

Figure 4.3: Response on Distance to Mast Exposure in Meters
Source: Fieldwork, 2023

Table 4.2 and figure 4.3 shows the distance of each mast exposure in meters. From the responds, it shows that 15%, 27% and 24% are located between 1 – 5 meters, 5 – 10 meters and 10 – 20 meters to exposure respectively while 20 – 50 meters, 51 – 100 meters and 100 & above are 15%, 10% and 9% respectively.

Table 4.3: Effect of Masts and Base Stations on Respondents

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Smoke	56	28	51	31	41	50	21	46	53	55	18	20	7	36	17	12	13	25.6
Noise	82	22	42	49	53	33	44	57	71	52	55	26	28	36	14	19	18	32.4

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Air Quality	24	10	18	22	47	21	14	27	27	61	39	41	6	38	8	12	6	19.4
Elec. Rad	18	29	13	33	3	28	10	47	6	9	22	8	9	20	5	3	6	12.4
No effect	20	10	25	15	6	17	11	18	32	12	15	5	0	17	6	4	7	10.2
Total	200	99	149	150	150	149	100	195	189	189	149	100	50	147	50	50	50	100

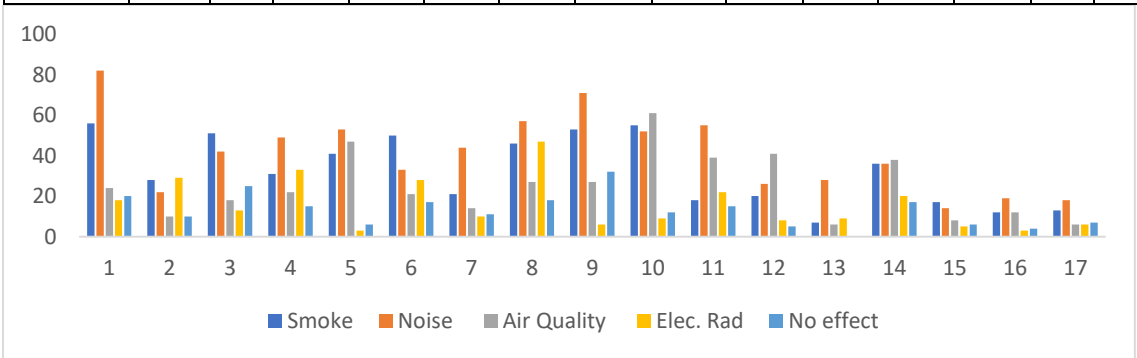

Figure 4.4: Response on Effect of Masts and Base Stations
Source: Fieldwork, 2023

Table 4.3 shows the responses on the perception of the effects of telecommunication masts and base stations. From the analysis, 32% of respondents indicated that they are affected by noise from the generator set, 26% and 12% are affected by smoke and electromagnetic radiation respectively. On the other hand, 20% claimed that it affects air quality within the area, while 10% of the respondent expressed there is no effect of telecommunication masts and base stations in the environment.

Table 4.4: Effect of MTN Mast and Base Station on the Environment

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Soil Pollution	36	25	47	31	12	28	24	44	61	48	26	14	20	41	9	6	17	22.6

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Noise Pollution	63	13	36	55	72	81	43	86	73	88	108	46	12	80	24	28	21	43
Smoke Emission	90	49	39	37	66	30	18	35	30	50	14	32	16	26	10	8	11	25.9
RF Emission	11	12	27	27	0	10	15	28	25	3	1	8	2	0	7	8	1	8.5
Total	200	99	149	150	150	149	100	195	189	189	149	100	50	147	50	50	50	100

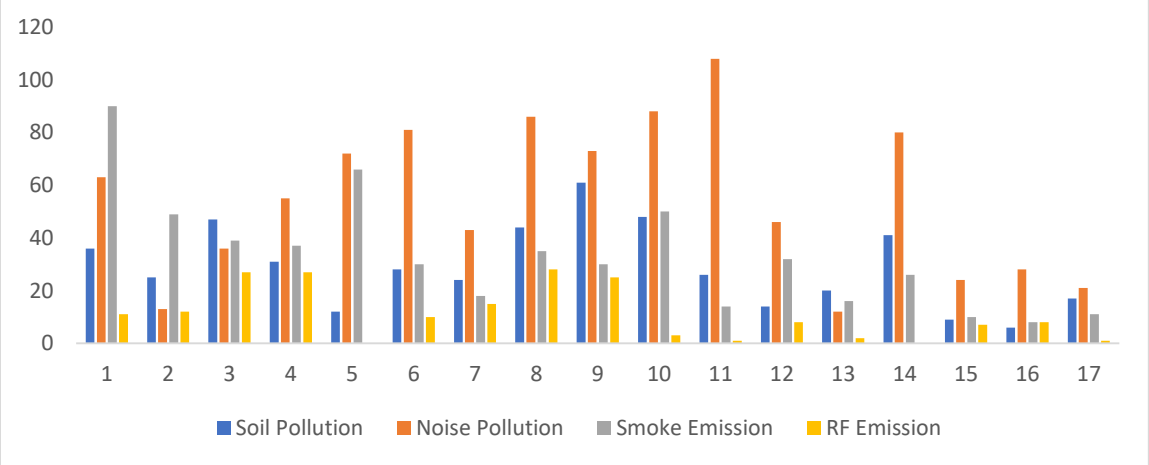

Figure 4.5: The Response on Effect on the Environment
Source: Fieldwork, 2023

Figure 4.5 shows that 43% of the respondents identified noise pollution as the major effect of the mast, 26% indicated smoke emission, 23% for soil pollution, while 8% opined for RF emission.

Table 4.5: Effect of MTN Mast and Base Station on Human Health

Health Effect	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%

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YES	166	82	146	146	140	146	98	190	188	180	142	100	49	144	50	42	50	95
NO	34	17	3	4	10	3	2	5	1	9	7	0	1	3	0	8	0	5
Total	200	99	149	150	150	149	100	195	189	189	149	100	50	147	50	50	50	100

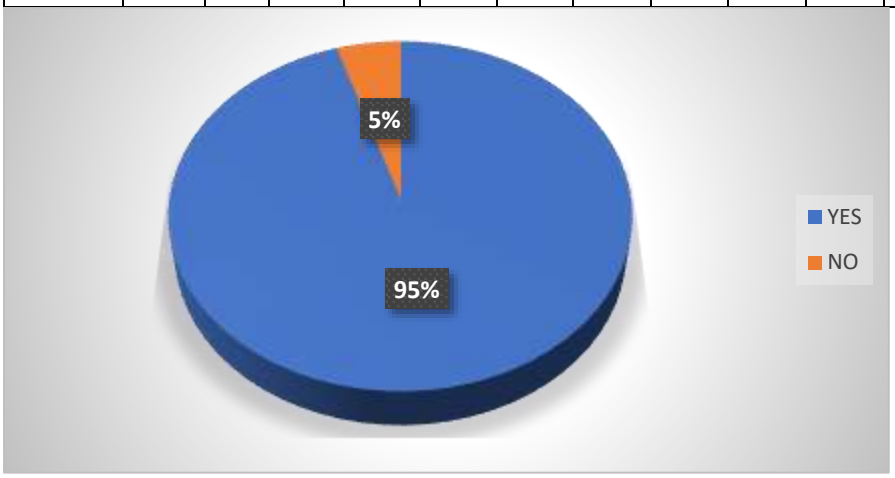

Figure 4.6: Response on Effect on Human Health
Source: Fieldwork, 2023

Table 4.5 shows the effect of MTN mast and base station on human health. This study sought to know the opinion of the respondents on the effect of telecommunication masts and base stations on human health. The result shows that an overwhelming majority of the respondents (95%) agreed that telecommunication masts and base stations have effects on human health, while 5% do not belief that telecommunication masts and base stations have negative effects on human health.

Table 4.6: Effects of MTN Mast and Base Station on Human Health.

Health Hazard	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	%
Hearing Disorder	36	18	59	62	37	66	27	66	48	51	64	20	14	40	18	15	8	30

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Respiratory Problem	14	12	25	30	22	12	10	23	25	22	12	7	6	10	8	8	5	11.6
Sleep Disorder	100	41	51	46	64	48	54	70	81	88	45	57	26	86	16	27	22	43.1
physical harm	15	17	8	4	5	14	4	10	0	7	6	4	0	0	0	0	1	4.4
None	35	11	6	8	22	9	5	17	32	21	22	12	4	11	8	0	14	10.9
Total	200	99	149	150	150	149	100	195	189	189	149	100	50	147	50	50	50	100

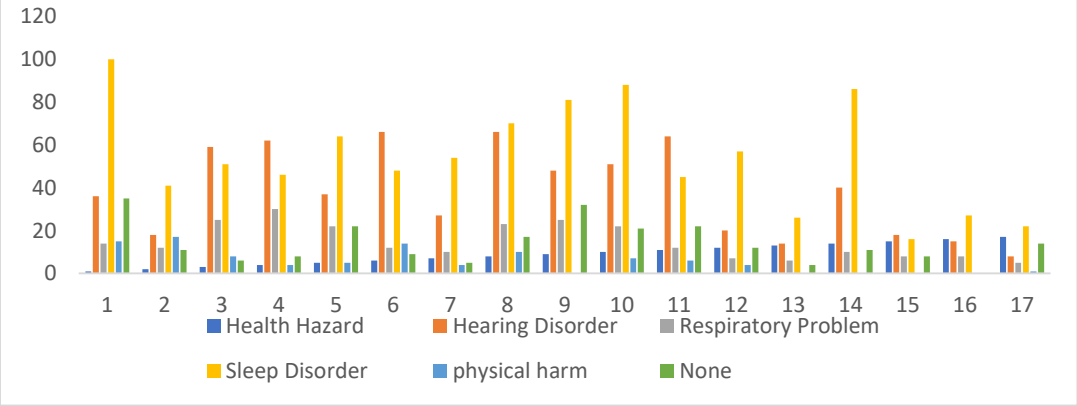

Figure 4.7: The Response on Effect on Human
Source: Fieldwork, 2023

Table 4.6 shows the response of the effect of MTN mast and base station on human. The majority (43%) pointed that MTN mast and telecommunication base station causes sleep disorder, 30% went for hearing disorder, 12% explained that it causes respiratory problem, 11.6% expressed that there is no effect of MTN mast on human while, 4.4% opined it causes physical harm.

5.1 Summary of Findings

There are Three Hundred and Forty-Seven (347) MTN masts in Enugu State and these masts are clustered in Enugu East Senatorial Zone. The percentage location of MTN masts and base stations between the senatorial zone are 10.4%, 25.1%, and 64.5% for Enugu West Senatorial Zone, Enugu North Senatorial Zone and Enugu East Senatorial Zone respectively. The study

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revealed a high concentration of MTN masts in areas with high concentration of people and residential building like in Enugu North LGA, Enugu South LGA and Enugu East LGA. In accessing the threat of the telecommunication mast, the respondents (88%) emphasized that the mast is a threat to their health while 12% opined that they do not see any impact of the mast on their health. This study revealed that most of the MTN masts and base stations are erected very close to residential areas without the minimum standard setback of 5m and 10m as specified by the National Communication Committee and National Environment Standard Regulation Agency (NESREA) respectively. This implies that people living around these masts and base stations are at risk of diseases emanating from these waves. There is a significant difference between the spatial distribution of MTN masts and base stations population density in Enugu State. The study revealed that there is a significant difference between the effects of telecommunication masts and base stations and the residents in the study area.

5.2 Conclusion

The increasing number of telecommunication masts and base stations located in Nigerian cities has led to some environmental problems such as pollution, mixed land use and urban cramp to residents in some cities. The study revealed that there is Three Hundred and Forty-Seven MTN masts in Enugu State and these masts are in a clustered pattern. The greater percentage of the masts is concentrated in Enugu North, South and East. The noise generated from the masts and /base stations are above the permissible limit for residential and mixed residential. This study revealed that most of the MTN masts and base stations are erected very close to residential area without the minimum standard setback of 5m and 10m as specified by the National Communication Committee and National Environmental Standards Regulations and Enforcement Agency (NESREA) respectively. This implies that people living around these masts and base stations are at risk of diseases emanating from electromagnetic radiation. This shows that there is significant difference between the effects of telecommunication masts and base stations and the residents in the study area.

5.3 Recommendation

Based on the findings of this work, we recommend the following:

1. The construction of telecommunication masts and base stations can alter the visual landscape, particularly in natural or scenic areas. However, efforts are often made to integrate these structures into the surroundings to minimize their visual impact.
2. There is need for continuous sensitization of the public by the relevant authorities on the harmful effects associated with the telecommunication industry.

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