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RESEARCH ARTICLE

ANALYSIS OF THE GEOSPATIAL RELATIONSHIP OF GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS BASE TRANSCEIVER STATIONS TO BUILDINGS IN UMUAHIA MUNICIPAL, ABIA STATE NIGERIA. (GIS AND REMOTE SENSING)

[1]Peter Chibuike, C., [2]Alozie M. C. and [2]Ezirim, O. N

[1]Department of Environmental Resource Management, Abia State University, Uturu.
[2]Department of Geography and planning, Abia State University, Uturu
[3]Department of Urban and Regional Planning, Fed. Poly. Nekede, Owerri.

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ABSTRACT

This study spatially analyzed the distribution of GSM Base Transceiver Stations (BTS) in Umuahia Municipal Council, Abia State, Nigeria. The Base Transceiver Stations were identified and GPS coordinates taken. Buffer analysis and proximity analysis was done to determine the BTS that was erected in line with Nigerian Communication Commission (NCC), Nigeria Environmental Standard and Regulation Enforcement Agency, (NESREA) and World Health organization (WHO) standards. These Base stations were mapped using NCC, NESREA and WHO standards for locating GSM Base Station; BTS must be erected 5 meters and 10 meters away from residential building. Spatial data of the GSM Base stations (BTS), Quickbird Satellite image of Umuahia Municipal Council, field survey, Geographic Positioning System (GPS), record from various BTS owned by the various service providers in Nigeria were used for the study. The criteria for the location and distribution of the base station masts were also tested using the 5m, 10m, 15m and 20m buffer zone tests. The result revealed 61 GSM Base Stations in the study area, 6 was not in line with NCC Standard of 5 meters, 22 was not in line with NESREA and WHO while the remaining 32 conformed with these standards. Proximity analysis was shown as maps and tables within the study area. It was also observed that some service providers were found to have violated the standards by locating their facilities close to where people live. The spatial distribution of these facilities within the residential areas also exposed such areas to the effect of electromagnetic radiation and fumes from the generators at the Base Stations and subsequently leading to several diseases. Regulatory agencies should keep checks on service providers and make sure they adhere to standards when constructing BTS.

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INTRODUCTION

A revolution in wireless communication began in the first decade of the 20th century with the pioneering developments in radio communications. Telecommunications, also known as telecom, is the exchange of information over significant distances by electronic means and refers to all types of voice, data and video transmission (Adamu, 2016). This is a broad term that includes a wide range of information transmitting technologies such as telephones (wired and wireless), microwave communications, fiber optics, satellites, radio and television broadcasting, the internet and telegraphs (Adamu, 2016). Telecommunication was defined as a technology whose domain is communicating from a distance by (Tarmo, 2003). It includes mechanical and electrical communications.

Corresponding author: **Peter Chibuike, C.,**
Department of Environmental Resource Management, Abia State University, Uturu. Nigeria

The communication system has evolved from traditional, mechanical to electrical form using increasingly more sophisticated electrical systems (Tarmo, 2003). A Base Transceiver Station (BTS) is a piece of equipment that facilitates wireless communication between User Equipment (UE) and a network. They are equipped with electronic equipment and antennas that receive and transmit radio frequency (RF) signals. All communication that carry out by cell phones are associated with the near base stations through radio frequency (RF) waves. Radio frequency (RF) wave is a form of energy in the electromagnetic spectrum between FM radio wave and micro wave. As people make multiple use of cell phone, the signals are transmitted back to the base station (Isabona, 2015). The radio frequency (RF) waves produce at the base station are given off into the environment, where people around can be exposed to the radio frequency (RF) radiation produced at the process. At a very high level, the radio frequency (RF) radiation is dangerous to the body

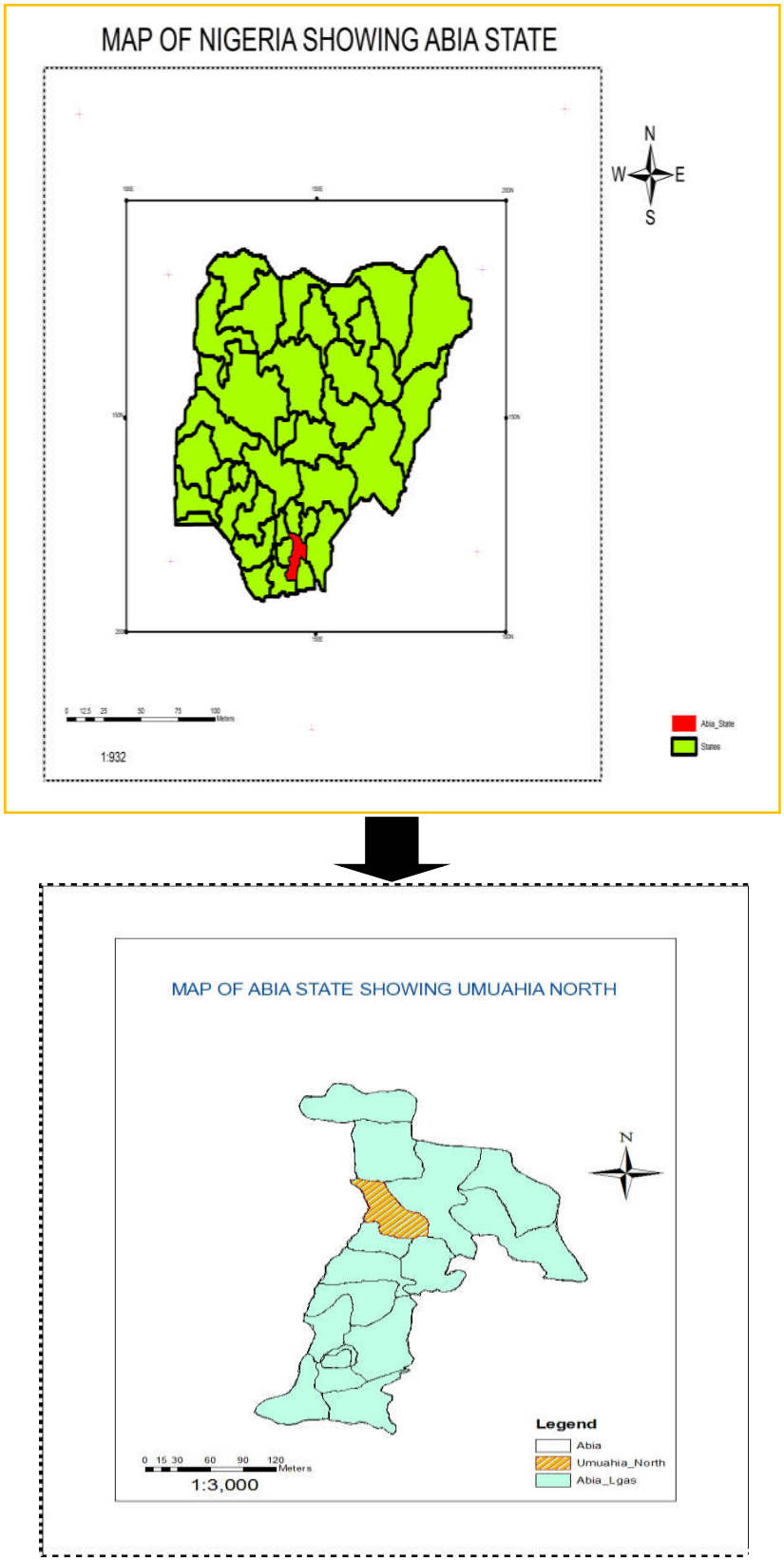

Figure 1. Location Map

tissues; it can heat the exposed body's tissues rapidly (thermal effect) (Baan, 2011). In the western world, the use of commercial land based cellular mobile telephony has increased dramatically since the first services appeared in the beginning of the 1980's, especially with the introduction of the digital GSM 900/1800 systems in 1990's. Firstly, deployed in Finland in December 1991 (Geneva, 1992).

As of 2014, it has become the global standard for mobile communications with over 90% market share, operating in over 219 countries and territories. 2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described as a digital, circuit-switched network optimized for Constitution and Convention of the International Telecommunication Union, Annex

(Geneva, 1992) voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution, or EGPRS). Today, GSM has become a global, regional and local system for communications. The History of Global System for Mobile Communication (GSM) in Nigeria is traceable to the deregulation of the Telecommunication industry which gave birth to the GSM Revolution from the year 2001 till the present (11 years now) under the civilian administration of President Olusegun Obasanjo, GCFR. Since then the Global System for Mobile Communication (GSM) has witnessed a phenomenal growth in the number of subscribers for barely less than a million to over 100 million subscribers. Before the advent of Global System for Mobile Communication (GSM), the Nigeria Telecommunication Limited was saddled with the responsibility of providing means of communication basically the Landline which was bedeviled by gross inefficiency and corruption. GSM has contributed positively in boosting economic activities in Nigeria. It has also improved the quality of living of Nigerians. Thanks to GSM, Nigerians now enjoy services like mobile TV, POS (electronic payment), affordable internet services, mobile tracking services, cheaper international calls, internet banking, and mobile banking. However, ten years on, the quality of GSM services are not as efficient as supposed.

Cross connections and dropped calls are now very common. Poor quality of BTS materials which causes network fluctuation is very common in Nigeria. In addition, there are is this problem of indiscriminate construction and siting of BTS around residential buildings without considering the health and environmental implications of that. In line with these facts, the mobile phone operators and government authorities have consistently insisted that radiations from BTS are not dangerous than any other radio signal (WHO. (2001). However, it is not advisable to live close to BTS. Also, a survey carried out by (Ayinmode, 2014), on the people living close the BTS with different health related issues like depression, sleeping disturbances, headache, memory loss, cancer, blood pressure. Finding shows that the people were affected with the above ailment. Hence, Nigerian Communication Commission NCC and Nigeria Environmental Standard and Regulation Enforcement Agency, (NESREA) have stated the setback between communication base station and the nearest building infrastructure as 5 m and 10 m respectively (Nigeria Mobiles World (2013). Also World Health Organization (WHO) standards for siting BTS starts that it must be sited at least 10meters away from residential building. In spite of this, service providers still go contrary to these standards. Therefore, this study will evaluate the proximity BTS and Buildings in Umuahia Municipal with a view to provide information on the level of compliance with the stated regulated standards.

Study Area

Umuahia is located along the rail road that lies between Port Harcourt to Umuahia's south and Enugu to its north. It has an area of 245 km² and a population of 220,660 at the 2006 census (Nnadozie, 2014). Umuahia is well known as being an agricultural market center. It is also a railway collecting point for crops such as yams, cassava, corn (maize), citrus fruits, and palm oil and kernels. Umuahia is located in the south-eastern part of Nigeria. It lies between latitudes 5º 33' 20'' N and longitude 7º 28' 52''E. It is bounded to the north by Isuikwuato LGA, to the north-east by Bende LGA, to the south-east by Ikwuano LGA, to the south by Isiala-Ngwa North LGA and shares a common boundary with Imo state to the west. The study area is situated on the coastal plain geographical zone which is the greatest and largest of the geographical zones in South-Eastern Nigeria covering 27.5% of the area, close to the outcrops of sandstones and shale of the Bende-Ameki group of geological formations found to the east of the area. Located within the equatorial belt of Nigeria, the area is dominated by a tropical rainforest vegetation, and climate which is characterized by two distinct weather seasons: rainy and dry seasons. The area is characterized by a long dry season (November-March) and a longer rainy season (April-October). The mean annual rainfall is between 2,500mm to 3,100mm (Onyeka *et al,* 2008). The monthly mean temperature ranges from 25^0C to 32^0C, while mean relative humidity ranges from 60-90%. Highest and lowest monthly mean relative humidity is observed during rainy and dry seasons respectively. With the introduction of GSM in the new millennium, the need for space allocation for BTS for service providers became a problem. This led to the indiscriminate erection of BTS in the study area, as the BTS were erected in the available open space within the residential and commercial areas. There is need to evaluate the spatial location of BTS in the area in relation to buildings in order to provide information for safety of lives and property.

METHODOLOGY

This section describes the materials and methods that were applied in data acquisition, preprocessing, processing, presentation and analysis of data with a view to achieve the aim and designed objectives of the research. This allowed us to analyze and to draw conclusion on the proximity of mobile Telecommunication Base Transceiver Stations to Building in Umuahia.

Data collection

The primary data was obtained with the aid of a Global Positioning System (GPS) receiver, for mapping out the spatial location of the BTS in the study area while a high resolution image of the study area (secondary data) was used as a base map of the study area. The coordinate location of the BTS stations (Longitude, Latitude and Height) was obtained using the GPS receiver. The secondary data was used to extract road network and also to identify infrastructures that were located around the BTS in the study areas. The data extracted from the GPS receiver was processed using Geographic Information System (GIS). This includes plotting of the BTS coordinates on the satellite imagery (remotely sensed data) of the study area. Some of the spatial analysis preformed includes buffer at 5 meters, 10 meters, 15 meters and 20 meters radius from the BTS. Query was also performed at the respective buffers to identified residential infrastructure that were within the parameters.

Data processing

This involved the processing, extraction and analysis of relevant spatial and attribute information about the study area from satellites images. The following steps were employed:

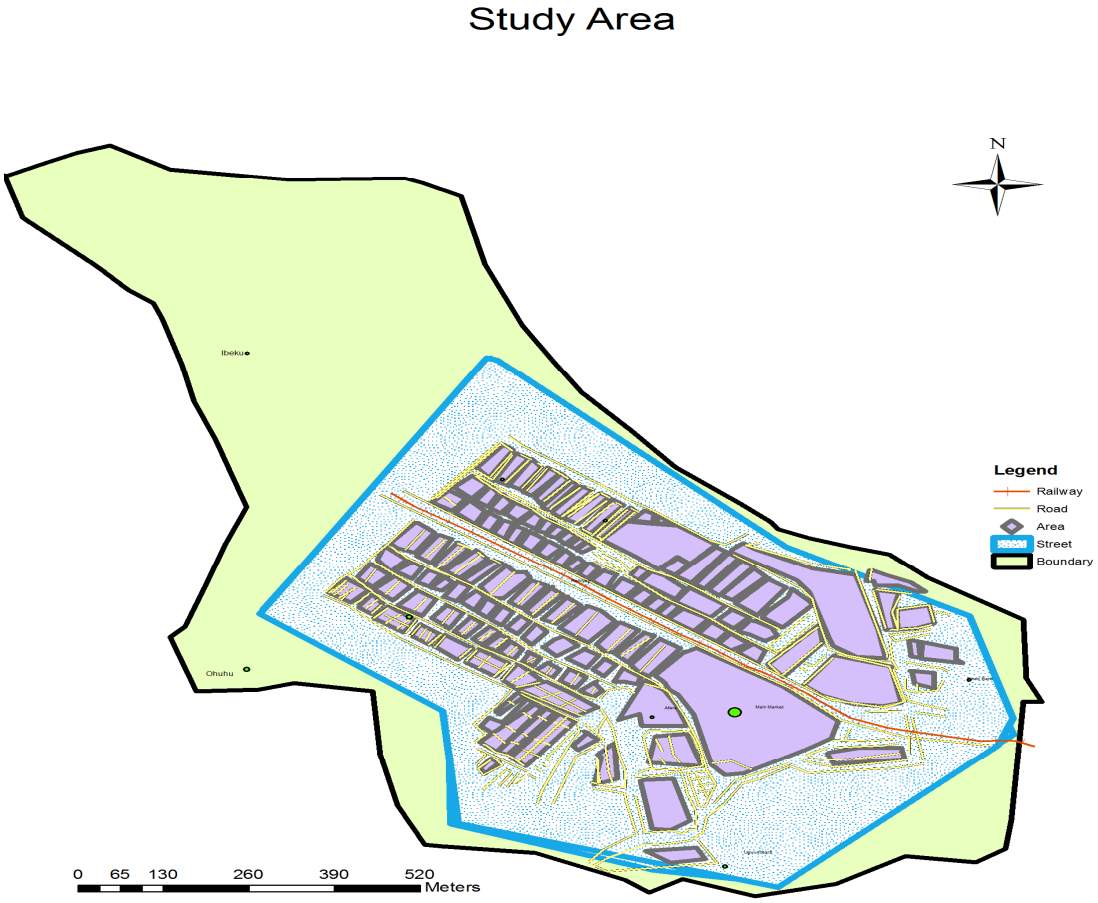

Figure 2. Umuahia Municipal

Image Geo-referencing

The Quick bird Satellite image of the area was geo-referenced with the aid of Ground control points, the places were visited to confirm their location and positions using GPS. The image was then geo-registered by creating a geographical coordinate system using zone 32 North datum to facilitate geo-spatial processing and analysis.

Vector Data Creation

The image covering the study area was utilized after Vectorization was performed through ArcGIS version 10.2 windows operating environment. The purpose is to transform the raster image into vector Shape files, where the image was digitized under the following themes: the Road networks, Railways and water bodies as Lines. Residential areas, as polygon data (i.e. lines, and polygon features) contained separate attribute tables.

Geo-spatial Database

A Geo-Spatial database of all the facilities was created for relevant Query Statements and subsequent analysis. Thus, all the necessary information for each facility was entered into its layer's attribute table and stored. This was achieved by adding required number of fields (columns) to the table and entering he data for all the facilities in their corresponding records (rows) in Microsoft Excel and imported into the ArcGIS 10.2 software environment.

RESULTS AND DISCUSSIONS

This section presents the results of the analysis of the data collected during the field work. The variables analyzed include coordinates of the BTS. This also has information like the address of the location of the Base Station. The raster and vector Maps for the study area were also presented.

Identifying and mapping the location of gsm base stations:

Below are the coordinates and the generic map for the study area at a glance. This showing the spatial distribution of GSM Base stations in Umuahia Municipal urban. Figure 4 displayed the spatial distribution of GSM Base Stations in the study Area. The study area was divided into seven council wards. Ossah ward, Ugwunchara ward, Urban 1 ward, Urban 3 ward, Afara ward, Amuzukwu ward, World Bank ward. It was observed that there was more BTS in Urban3 area than any other ward of the study area. Further analysis was carried out to find out the distance between the BTS and the nearest building (Near Neighbour analysis, proximity test and buffer test). All these analysis were done in the ARCGIS platform.

Distribution of Base Stations from Residential Areas

The buffering of 5m, 10m, 15m and 20m was created around the Base Stations in the study area to determine how near or far the BTS are from the nearest building. This was done within the GIS software environment, so that proximity analysis to the Residential areas was done.

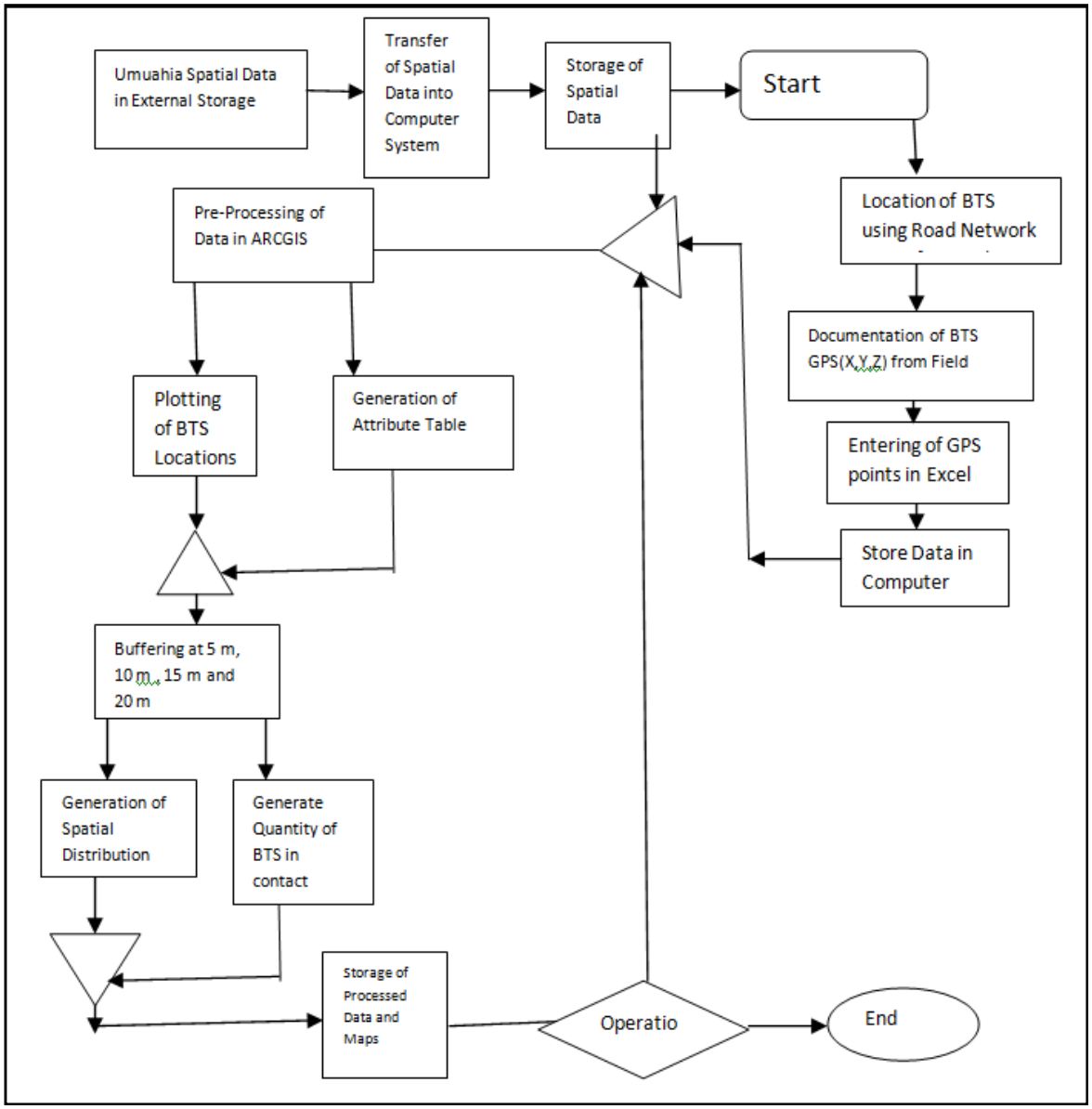

Figure 3. Cartographic Model of the Study

Proximity analysis was performed to know the number and percentage of BTS that conform to NCC, NESREA and WHO standards of 5 meters and 10 meters away from Residential area.

Proximity test: These locations were subjected to buffer analysis to determine the ones that conform to standards. According to the proximity analysis summarized in table3 below, some fall within the 10m buffer zone, therefore extremely disobeyed the WHO standards, others fall away from the 10m buffer zone conforming to standards by WHO.

In the proximity analysis performed and summarized in table 3 above, it was observed that 6 out of 61 BTS in the study area were found to be in buffer zone less than or equals 5 meters; this accounted for 9.84% of the BTS. 16 of the BTS fall within the range of 5 to 10meters accounting for 26.23% of the BTS in the study area. 14 out of the BTS fall within the range of 10 and 15 meters which is 4.92%. Finally, 22 of the BTS were in buffer zone of more than 20meters accounting for 36.06% of the study area. From the proximity test, the following observations were made;

- BTS that fall below 5 metres in the buffer analysis were BTS found inside building premises. The BTS share the same compound with the nearest building. This were mainly found in some places in Amuzukwu, World Bank, Timber road and The MTN mask in MTN office Aba road.
- BTS that were found in buffer area greater than 20meters in the buffer analysis were BTS built very away from residence buildings. Others were built in isolation. They were found in Ojukwu Bunker area, Market road, Afara, Umuokehi and Opet.
- They were more BTS in Urban 3 council of the study area than any other place. Figure 5 below has a clear picture of this.

Figure 5 shows the 7 council ward of the study area and number of BTS found in the area. The Green triangle represent the BTS and Nearest Building (NB) is represent by the red rectangle. From the map, Urban3 has the highest number of BTS, followed by Afara, World Bank, Ugwunchara, Ossah, Urban1 and Amuzukwu council ward in descending order.

Table 1. Spatial Location of The BTS in Umuahia Municipal

No.	Location	Easting	Northing
1	Mission Hill 1 (Shelton Hotels)	5.5361	7.483533
2	Mission Hill 2	5.535717	7.482617
3	Eziama Ossay by Behold He Cometh Church	5.5364	7.476017
4	Mgbaja Ossay (Mission Hill)	5.5349	7.469867
5	Ossay By Umuorichi	5.534967	7.46325
6	Ossay-Ibeku (2)	5.534033	7.46315
7	Ossay-Ibeku (3)	5.535117	7.463933
8	Okpara SQ by market RD	5.531567	7.48995
9	Onyemaobi Layout	5.535117	7.4892
10	Clifford RD by Ossay	5.538	7.492283
11	Uyo Str by Uzuakoli	5.538717	7.4948
12	Awolowo Str	5.540133	7.495433
13	Okuz Lane by Okigwe	5.541167	7.494317
14	Oji River by Clifford	5.542417	7.494733
15	Ekwurike Str	5.544267	7.495833
16	Ekwurike Str by Owerri RD	5.543483	7.497617
17	Umuokpara Str by Niger (Amuzukwu)	5.541283	7.500383
18	Oji River by Niger	5.541267	7.499617
19	Umuoke Amuzukwu	5.54615	7.5079
20	Bende RD by Police HQ	5.535767	7.506217
21	Bende RD (2)	5.535767	7.506217
22	Bende RD by Police ST	5.535367	7.508017
23	Nkata by Amaeke Junction	5.539183	7.51175
24	Nkata (2)	5.5402	7.512117
25	Ugba Nkata by BB Hall	5.534133	7.510867
26	50 Bende RD	5.534067	7.505233
27	Orlu Str by Niger	5.535383	7.4981
28	Igbere Str by Niger	5.538117	7.498583
29	Eze Ogbulafor str	5.530733	7.49805
30	Eze Ogbulafor str (2)	5.5319	7.501167
31	Aguiyinsi by Redeem	5.528267	7.503283
32	Macaulay Str	5.52345	7.495233
33	Ojike Str by I.K Junction	5.524217	7.493867
34	Ojike Str	5.527117	7.494167
35	School RD Prim. Schl	5.525783	7.4953
36	School RD by I.K Junction	5.522333	7.496183
37	Ministry of Justice	5.523333	7.500767
38	Vision Africa Radio	5.520683	7.50415
39	Secretariat RD	5.52505	7.510033
40	House of Assembly Junction by Intellectual Giant	5.5301	7.51135
41	Ibeto Cement	5.5178	7.502417
42	Opet by Ikwuano plaza	5.514167	7.501533
43	Umuokoro by Uhukobe	5.516283	7.5061
44	Umuohu by Conoil	5.517083	7.510183
45	26 Agbazuari Str by Police ST (World Bank)	5.51485	7.499267
46	Pat Mgbene Drive (World Bank)	5.5116	7.493617
47	Patorial Annex (World Bank)	5.507767	7.493917
48	Timber RD by Abia Line	5.505	7.4924
49	Low Cost RD by Agbama gate	5.503783	7.497867
50	Umuokehi Afara	5.498633	7.491483
51	Polycon Filling ST by Aba RD	5.500333	7.486817
52	Afara by Rosonace Prim. Schl	5.507417	7.480983
53	Ohubu Afara	5.5087	7.490467
54	MTN Aba RD	5.5119	7.489917
55	Umuobasi Afara	5.51535	7.4872
56	Afara	5.516	7.486667
57	Afara by Majestic (2 in 1)	5.517317	7.485833
58	Afara by Ojukwu Bunker	5.518633	7.482633
59	Afara by Umuobasi by Aba RD	5.51765	7.493317
60	Library Avenue by post Office	5.528417	7.490817
61	Market RD	5.529017	7.492833

Conformation to Standards

The Proximity analysis done through buffer zone analysis helped to know the BTS that conformed to standards of Nigerian Communication Commission (NCC), Nigeria Environmental Standard, Regulation Enforcement Agency, (NESREA) and World Health Organization (WHO). Recur, that the standard for NCC is at least 5meters away from the nearest building while NESREA and WHO is at least 10meters away from the nearest building.

From table 4 and 5 below a buffer 5meters was conducted as stated by NCC and buffer below 10 meters for NESREA and WHO standards. It is clearly shown that the residence that fall within the distances of 5m and 10m are vulnerable to electromagnetic radiation emitting from the GSM Base Stations in the entire district going by the WHO regulations. It has been deduced from the geospatial analysis that most service providers violate the standards issues by WHO which makes the inhabitants around GSM Base Stations at high health risk.

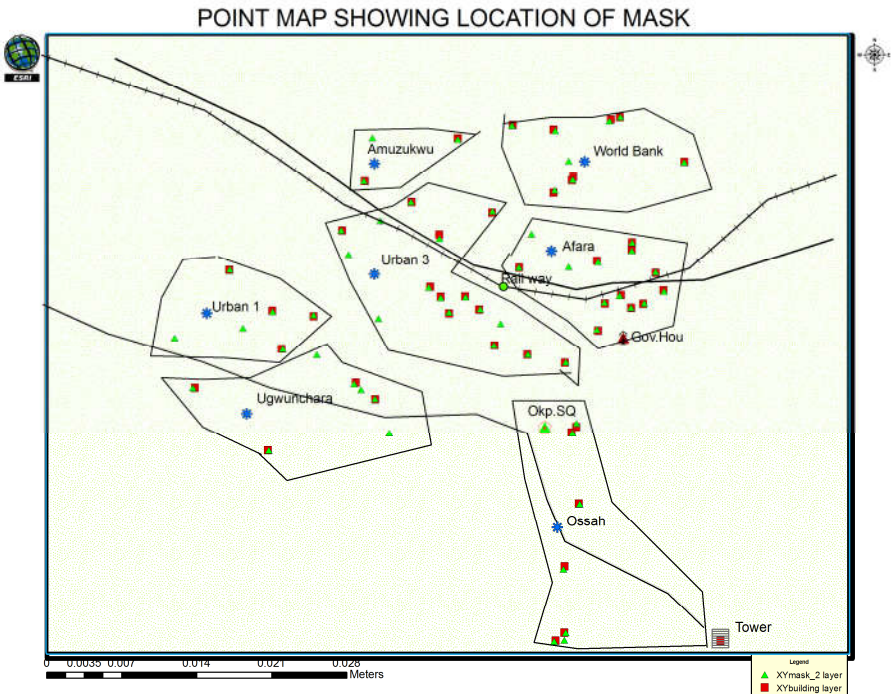

Figure 4. Point Map Showing BTS in Umuahia Municipal

Table 2. Spatial Distribution of BTS, Nearest Buildings and the Distance Between

No	Place	BTS Location		Nearest Building		Distance between BTS and (NB)
		Eastings	Northings	Eastings	Northings	Distance in M
1	Mission Hill 1 (Shelton Hotels)	5.5361	7.483533	5.536067	7.4832	37.04
2	Mission Hill 2	5.535717	7.482617	5.53565	7.482667	9,140
3	Eziama Ossay by Behold He Cometh Church	5.5364	7.476017	5.536317	7.47605	9.926
4	Mgbaja Ossay (Mission Hill)	5.5349	7.469867	5.535	7.47015	33.24
5	Ossay By Umuorichi	5.534967	7.46325	5.549533	7.4632	1620
6	Ossay-Ibeku (2)	5.534033	7.46315	5.53415	7.4632	14.14
7	Ossay-Ibeku (3)	5.535117	7.463933	5.534983	7.463917	15.00
8	Okpara SQ by market RD	5.531567	7.48995	5.531533	7.489917	5.257
9	Onyemaobi Layout	5.535117	7.4892	5.535017	7.48915	12.42
10	Clifford RD by Ossay	5.538	7.492283	5.538117	7.492183	17.08
11	Uyo Str by Uzuakoli	5.538717	7.4948	5.538767	7.494683	14.09
12	Awolowo Str	5.540133	7.495433	5.54025	7.495467	13.54
13	Okuz Lane by Okigwe RD	5.541167	7.494317	5.5412	7.494267	6.64
14	Oji River by Clifford	5.542417	7.494733	5.542333	7.494667	11.86
15	Ekwurike Str	5.544267	7.495833	5.544217	7.495917	188.2
16	Ekwurike Str by Owerri RD	5.543483	7.497617	5.5435	7.497533	9.487
17	Umuokpara Str by Niger (Amuzukwu)	5.541283	7.500383	5.5413	7.500383	1.89
18	Oji River by Niger	5.541267	7.499617	5.541267	7.499667	5.534
19	Umuoke Amuzukwu	5.54615	7.5079	5.546167	7.507933	544.9
20	Bende RD by Police HQ	5.535767	7.506217	5.535817	7.5065	31.81
21	Bende RD (2)	5.535767	7.506217	5.535683	7.506167	10.86
22	Bende RD by Police Station	5.535367	7.508017	5.53567	7.508018	1.49
23	Nkata by Amaeke Junction	5.539183	7.51175	5.539317	7.511883	20.94
24	Nkata (2)	5.5402	7.512117	5.54015	7.5121	5.869
25	Ugba Nkata by BB Hall	5.534133	7.510867	5.533967	7.51095	20.62
26	50 Bende RD	5.534067	7.505233	5.533983	7.505	27.43
27	Orlu Str by Niger	5.535383	7.4981	5.535283	7.49	67.52
28	Igbere Str by Niger	5.538117	7.498583	5.538	7.498683	72.87
29	Eze Ogbulafor str	5.530733	7.49805	5.530783	7.498033	5.869
30	Eze Ogbulafor str (2)	5.5319	7.501167	5.5313	7.50127	1.87
31	Aguiyinsi by Redeem	5.528267	7.503283	5.52825	7.50315	14.84
32	Maculay Str	5.52345	7.495233	5.523433	7.495317	9.487
33	Ojike Str by I.K Junction	5.524217	7.493867	5.524217	7.493783	9.297
34	Ojike Str	5.527117	7.494167	5.527033	7.494133	10.07
35	School RD Prim. Schl	5.525783	7.4953	5.525733	7.495333	39.10
36	School RD by I.K Junction	5.522333	7.496183	5.522467	7.496233	15.89
37	Ministry of Justice	5.523333	7.500767	5.5233	7.501117	8.56
38	Vision Africa Radio	5.520683	7.50415	5.520717	7.504117	370.8
39	Secretariat RD	5.52505	7.510033	5.525033	7.510133	11.23
40	House of Assembly Junction by Intellectual Giant	5.5301	7.51135	5.530183	7.511367	9.419
41	Ibeto Cement	5.5178	7.502417	5.5162	7.502521	20.34
42	Opet by Ikwuano plaza	5.567141	7.501533	5.56425	7.5015	321.5
43	Umuokoro by Uhukobe	5.516283	7.5061	5.516367	7.506067	10.03
44	Umuohu by Conoil	5.517083	7.510183	5.51736	7.5063	15.23
45	26 Agbazuari Str by Police ST (World Bank)	5.51485	7.499267	5.51483	7.499245	3.5

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46	Pat Mgbene Drive (World Bank)	5.5116	7.493617	5.511583	7.4935	13.09
47	Patorial Annex (World Bank)	5.507767	7.493917	5.50775	7.494	9.379
48	Timber RD by Abia Line	5.505	7.4924	5.505	7.4924	1.90
49	Low Cost RD by Agbama gate	5.503783	7.497867	5.503717	7.497817	9.192
50	Umuokehi Afara	5.498633	7.491483			Isolated > 300
51	Polycon Filling ST by Aba RD	5.500333	7.486817	5.500517	7.486817	20.46
52	Afara by Rosonace Prim. Schl	5.507417	7.480983	5.507333	7.480983	9.34
53	Ohubu Afara	5.5087	7.490467	5.5086	7.49045	11.28
54	MTN Aba RD	5.5119	7.489917	5.5118	7,489918	1.58
55	Umuobasi Afara	5.51535	7.4872	5.515517	7.4873	21.62
56	Afara	5.516	7.486667			Insolated > 300
57	Afara by Majestic (2 in 1)	5.517317	7.485833	5.51735	7.485767	8.175
58	Afara by Ojukwu Bunker	5.518633	7.482633			Isolated > 300
59	Afara by Umuobasi by Aba RD	5.51765	7.493317			Isolated > 300
60	Library Avenue by post Office	5.528417	7.490817	5.52845	7.490783	5.256
61	Market RD	5.529017	7.492833			Isolated > 300

Table 3. Proximity Test Table

Buffer zone	No. of BTS	% Occurrence
Buffer Zone ≤ 5m	6	9.84
Buffer Zone > 5m ≤ 10m	16	26.23
Buffer Zone > 10m ≤ 15m	14	22.95
Buffer Zone > 15m ≤ 20m	3	4.92
Buffer Zone > 20m	22	36.06
Total	61	100

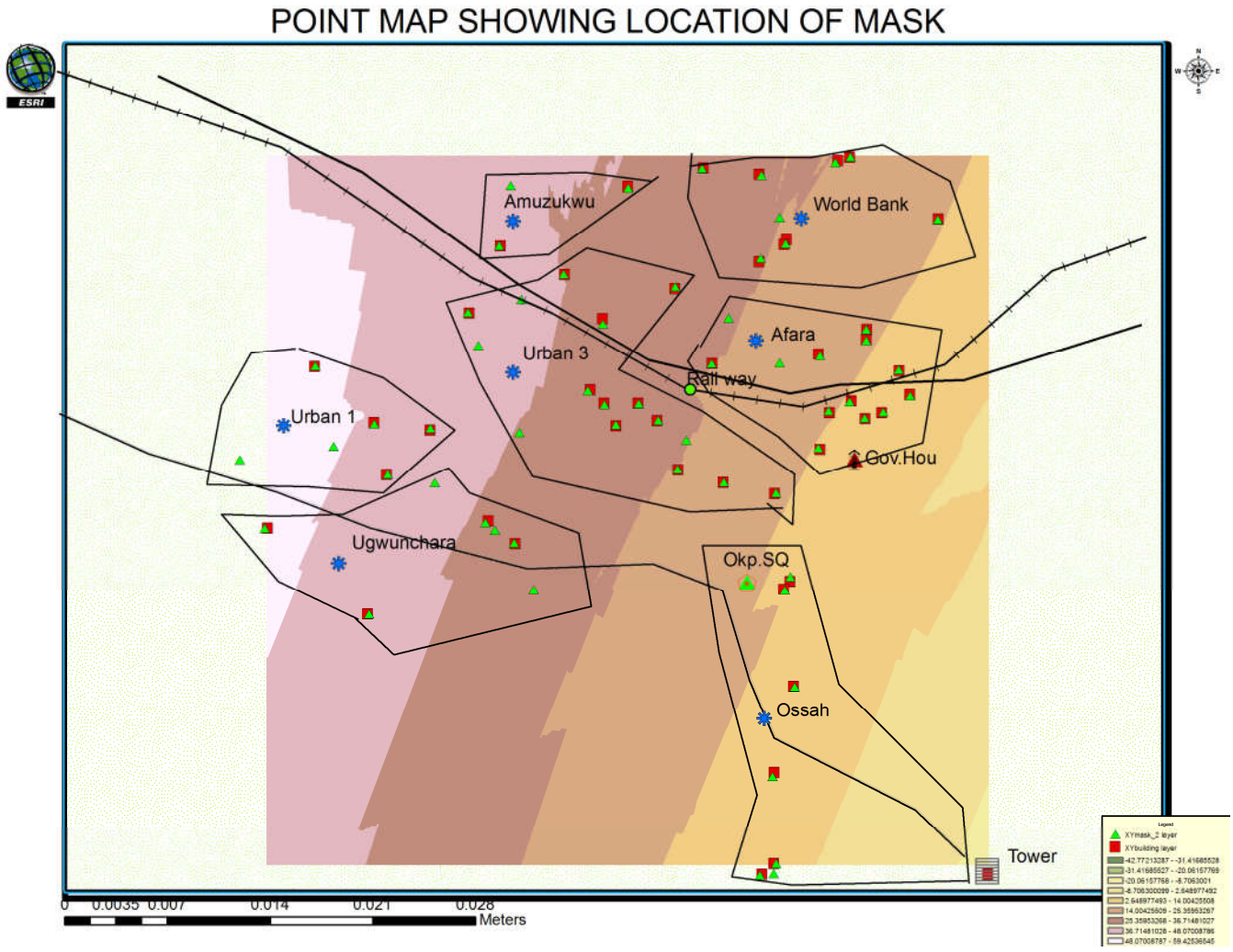

Figure 5. GIS Map showing BTS and NB in the Study Area

The analysis shows that approximately 36.07% BTS are closer to homes signifying non-adherence to the minimum standard of mast which is 5m for NCC and 10m as stated by the NESREA and WHO.

These areas that fall within the below 5 and 10 meters are considered risk locations in terms of the effect of electromagnetic radiation.

Table 4. Standard For NCC

For NCC		Percentage
<5	6	9.84
>5	55	90.16
Total	61	100

Table 5. Standard for NESREA and WHO

For NESEREA and WHO		Percentage
<10	22	36.07
>10	39	63.93
Total	61	100

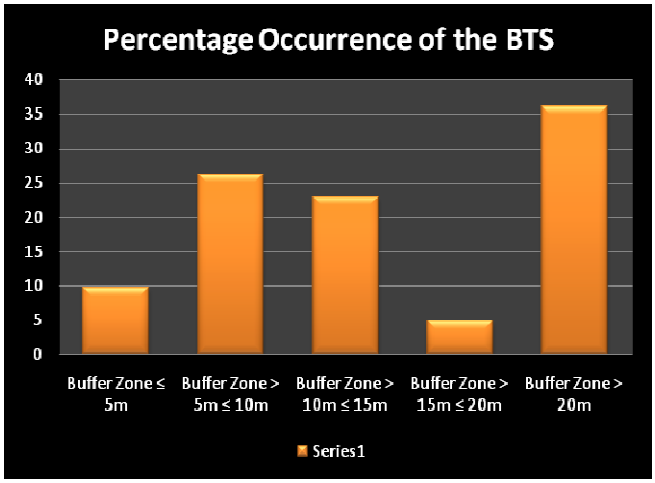

Figure 6. Percentage occurrence of the BTS in the difference Buffer Zone

It could be seen these areas are not in line with established standards in the proximity analysis. These areas are exposed to the effect of electromagnetic radiation emitting from the Base Stations and subsequently leading to early grave diseases, such fatigue, headache, decreased concentration, dizziness, local irritation, tumour induction, sperm motility, morphology and viability, cancer, especially brain tumour and leukaemia, viral and infectious diseases. Also the noise pollution caused by the generators used by these BTS can cause partial deafening of ear if it persists. The vibration from the mast may curse headache, sleeplessness and risk of brain tumor for people living around the area.

Conclusion and Recommendation

This study employed the use of GIS techniques (Buffering, Proximity and Neighborhood) analysis in mapping and analyzing the spatial distribution of GSM Base Stations in Umuahia Municipal Council, Abia State Capital, Nigeria. The study also examined the locational distance of each base station from Residential areas (educational, hospital, and child care centers). Findings revealed that out of the 61 GSM Base stations in the study area most of the land masts were 5m, 10m, 15m and 20m buffer zone tests and it appeared that 36.07% of the GSM Base stations did not met the Nigerian Communication Commission NCC and Nigeria Environmental Standard and Regulation Enforcement Agency, (NESREA), World health Organization (WHO 2007) standards of 5m and 10m distance to Residential areas.

Recommendation

The regulatory agencies should keep checks on service providers that violate the 5 and 10m of siting GSM Base stations away from residential areas as stated in the NCC, NESREA and WHO regulations for telecommunication and broadcasting standards, It has been deduced from the geospatial analysis that some service providers violate the established standards and located the facilities very close to where people lives. World health Organization (WHO), Nigerian Communications Commission (NCC) in collaboration with the National Environmental Standard and Regulations Enforcement agency (NESTRA) should shut down the facilities of the operator that do not comply with the set standard.

A law should be enacted to punish land owners who release their lands for the telecom operators for installing mast without obeying the minimum standards set.

REFERENCES

Adamu Gaddafi 2016. Analysis of Spatial Distribution of GSM base Stations in Zaria Urban Area, Kaduna State Nigeria. An M.Sc thesis submitted to the School of Psot Graduate Studies, Ahmadu Bello University, Zaria Nigeria.

Ayinmode, B.O., Farai, I.P. 2014. Evaluation of GSM Radiation Power Density in Three Major Cities in Nigeria, World Academy of Science, Engineering and Technology, *International Journal of Environment Chemical, Ecological, Geological and Geographical Engineering.*

Baan R, Grosse Y, Lauby-Secretan B, El Ghissassi F, Bouvard V, Benbrahim-Tallaa L, Guha N, Islami F, Galichet L, Straif K 2011. WHO International Agency for Research on Cancer Monograph Working Group, Carcinogenicity of radiofrequency electromagnetic fields.

Isabona, J, Ojuh O. 2015. Experiment Assessment of Specific Absorption Rate Using Measured Electromagnetic Field Strength in Benson Idahosa University and Environs, *American Journal of Physics,* Vol.4, No.2, 2015.

Nnadozie, O. 2014. The geographical location of Abia state and its local governments Pp 14

Onyeka, T.J., Owolade, O.F., Ogunjobi, A. A., Dixon, A.G.O., Okecghukwu, R., Bandyopadhyay, R. and Bamkefa, B. 2008. Prevalence and Severity of Bacterial Blight and Anthracnose Diseases of Cassava in different Agro-Ecological Zones of Nigeria. *African Journal of Agricultural Research,* 3 (4): 297-304.

World Health Organization 2007. Constitution and Convention of the International Telecommunication Union, Annex (Geneva, 1992)

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