

Space-Based Assessment of the Compliance of Gsm Operators in Establishing Base Transceiver Station (Bts) In Nigeria Using Abuja Municipal Area Council as Case Study

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Abstract: On the 16th of May, 2001, the first Global System for Mobile Communications: originally called Groupe Spécial Mobile (GSM) call was made in Nigeria, thereby opening communication among the teeming population in the country. Given the mode of operation of GSM technology, Base Transceiver Stations (BTS) are required for the provision of GSM services. Consequently, network of base stations were established in areas that enjoyed the GSM services all over Nigeria. However, studies have shown that exposure to GSM radiations are linked to health hazards such as fatigue, headache, decreased concentration, dizziness, local irritation, tumour induction, sperm motility, morphology and viability, cancer, especially brain tumour and leukaemia, viral and infectious diseases. Given these potential health impacts of BTS on humans, the National Environmental Standards and Regulations Enforcement Agency (NESREA) established guidelines for National Environmental Standards for Telecommunications and Broadcasting Facilities. The guidelines provided for the establishment of BTS within a minimum setback of ten (10) meters from the perimeter wall (fence) of residential/business premises, schools and hospitals. Similarly, where there is no perimeter wall (fence), the BTS must be at a minimum of twelve (12) meters from the wall of residential/business premises schools and hospitals. Consequently, using spatial analysis techniques, this study examined compliance of GSM service providers with the established guidelines for the mounting of BTS within three Abuja districts in the Federal Capital Territory (FCT); namely, Utako, Garki and Wuse. All the 119 BTS sampled in the study failed the 10m and 12m buffer zone tests. As a result, policy prescription was made on the way forward.

Key Words: Base Transceiver Station (BTS), Electromagnetic Radiation (EMR), Groupe Spécial Mobile (GSM) Mast, Geographic Information system (GIS).

I. Introduction

With technology rapidly advancing, people living within close range of mobile phone base stations have become increasingly concerned over the potential harmful effects of radio frequency radiation produced by these devices to their health (Kwan-Hoong, 2003). Emerging evidence suggest there could be some very serious health implications, most notably an increased incidence of cancer for people working or residing in the vicinity of mobile phone base station transmitter masts. Several surveys have found a variety of self-reported symptoms for people who live close to base stations. Connor in 2005 stated that the United Kingdom has allowed the highest output of radiation in the world. She also emphasized that the United Kingdom recently adopted lower levels of radiation by accepting guidelines set by the International Commission on Non-Ionising Radiation Protection (ICNIRP). However, the ICNIRP standard does not offer any form of protection other than from the heating effects of microwave radiation. In other words ICNIRP only protects your body from properties of high levels of elevated temperatures. A very substantial body of peer reviewed scientific research clearly shows many biological changes have already occurred. In 2005, a group of German doctors in Bamberg, Oberfranken wrote an open letter to the German Prime ministry explaining the evaluated medical complaints of 356 people who have had long-term radiation exposure in their homes from pulsed high frequency magnetic fields (from mobile phone base stations, from cord-less telephones, amongst others).

Waldmann-Selsam and Saeger 2005 stated that people living close to a mobile phone base station suffer from one or several of the following symptoms like sleep disturbances, tiredness, disturbance in concentration, forgetfulness, problem with finding words, depressive mood, ear noises, sudden loss of hearing, hearing loss, giddiness, nose bleeds, visual disturbances, frequent infections, sinusitis, joint and limb pains, nerve and soft tissue pains, feeling of numbness, heart rhythm disturbances, increased blood pressure episodes, hormonal disturbances, night-time sweats, nausea. A 2002 survey study by Santini et al. in France found a variety of self-reported symptoms for people living within 300 meters of GSM cell towers in rural areas, or within 100 m of base stations in urban areas. It should be noted that the health related symptoms were most frequently reported at a distance of 50 to 100 m, which fits perfectly to the area with the highest microwave

exposure in urban areas, where the main beam of the antennas usually hits the first houses. Fatigue, headache, sleep disruption and loss of memory were among the symptoms reported. Similar results have been obtained with GSM cell towers in Spain, Egypt, Poland and Austria. A second study carried out in Austria showed significant positive associations between the frequency selective measured electric field (GSM 900/1800) in the bedroom and cardiovascular symptoms (Santini et al, 2002).

There are however, significant challenges in conducting studies of populations near base stations, especially in the assessment of individual exposure. In many countries, most notably the US, Australia and New Zealand, the governments have all taken this issue sufficiently seriously at both national and local levels. This has led to an adoption of precautionary principles and introduction of policies of prudent avoidance which have effectively banned the erection of these masts from school buildings and residential areas and in other densely populated locations. The effects upon human health by exposure to electromagnetic radiation, from a biochemical view point, would appear to show ill health is caused by the displacement of electrolytes/ions within the body and by interfering with the body's natural way of communicating (neurological system) and maintaining homeostasis - balance. This weakens the defense mechanism of the body as the body expends energy attempting to redress this imbalance. We cannot get away from these electromagnetic fields because we live within their field of influence, the body will be unable to correct this electrical and biochemical imbalance. And as the science of Biophysics has proven that we only become ill when the defense mechanism of the body is weakened, it follows that we will undoubtedly become ill as a direct result of living or working within these electromagnetic fields. Dr David Carpenter, Dean of the State of New York School of Public Health in 1995 having been convinced that EMFs pose a health hazard, concluded there is statistical association between magnetic fields and cancer that goes beyond the shadow of reasonable doubt – "I think there is clear evidence that exposure to EMFs increases the risk of cancer". This is most clear with leukaemia and brain tumours. However, in residential studies, statistical significance increased for all kinds of cancers. A whole body of evidence that reproductive cancers are increased by exposure is beginning to evolve. With such conviction and realization of the health implications, President Bill Clinton in the USA, issued a formal memorandum in 1995, stating that Transmitter Masts should not be sited on schools or near residential areas. Also a German study found a threefold higher frequency of cancer among people living in the vicinity 400 m of a GSM base station compared to people living further away from the antenna. The frequency increased also the longer people had been exposed to the radiation (Eger et al, 2004).

Sometime in 2004, a Nigerian Professor by name Bola Osijo, Chairman of the Nigeria Nuclear Medical Council, warned that the erection of telecoms masts in residential areas was capable of causing cancer and other chronic diseases. She disclosed that about 50,000 Nigerians were being infected with cancer yearly before the advent of the telecommunications masts, and reiterated that the influx of the masts into the telecommunications industry and their erection in residential areas, had the propensity to increase cases of the cancer disease. She added a warning that should nothing be done to prevent indiscriminate citing of telecoms masts, more Nigerians will be afflicted with the scourge. She had stressed then that research carried out by her committee had come up with findings that masts emit radiation that are dangerous to human health and could easily result to cancer. She emphasized that the radiation from a source like the GSM masts affects human cells and in the long run result in cancer (Nkanga, 2007). This study is aimed at investigating the potential risk of Base Transceiver Stations (BTS), otherwise known as communication masts on human health.

1.1 Objectives

The specific objectives of this study are to;

- a) Identify and take inventory of the spatial distribution and pattern of BTS in the study area.
- b) Analyze the health hazards associated with the existing location of BTS.
- c) Identify possible areas at risk to electromagnetic radiation from BTS.
- d) Map out areas vulnerable to the health hazards related to electromagnetic radiation from BTS.
- e) Suggest and make recommendation to avoid risky money making health hazard.

1.2 Limitations of the Study

The study is strictly demonstrating how the Nigerian Earth Observation Satellite (NigeraSat-2) can be used to identify residential areas, schools and even hospitals that are vulnerable to possible electromagnetic radiation and thermal heating from Base transceivers station (BTS) but not the medical aspect. And again, this study is not measuring and quantifying the amount of radiation from Base Transceivers Station (BTS).

1.3 Justification of the study

Health is wealth – a popular saying. People living close and around a communication mast are regarded as vulnerable to Electromagnetic Radiation (EMR). Such people are susceptible to various chronic health hazards emanating from the radiation. The effects of EMR are usually not limited to humans within the radiation

emission area but also the different biodiversity and the environment as a whole. In recent times, the sale of spaces in residential and play grounds for the erection of BTS has become rampant in Nigeria generally. Telecommunication companies take advantage of the poverty level in the country by enticing resident owners with huge sum of money to give up part of their land for the erection of BTS in the compounds knowing the health implication. The health hazards from such erections raise serious concern as electromagnetic radio frequency signals emitted by these mobile phone towers (BTS) are linked to ill health and health deficiencies such as fatigue, headache, decreased concentration, dizziness, local irritation, tumour induction, sperm motility, morphology and viability, cancer, especially brain tumour and leukaemia, viral and infectious diseases among the people who live near the BTS.

The Nigerian Regulatory Agency responsible for the enforcement and regulation of such radiation standards, National Environmental Standards and Regulation Enforcement Agency (NESREA) appears not to be living up to its billing. Hence, there is need for this research so that we can protect our citizens from untimely deaths and build a sustainable future together with utmost consideration for the environment as well.

1.4 Study Area

Federal Capital Territory (FCT) is the home of Abuja, the capital of Nigeria. The territory was formed in 1976 from parts of former Nasarawa, Niger, and Kogi States and it is in the central region of Nigeria, bordered to the north by Kaduna State, to the east by Nassarawa State, to the south-west by Kogi State and to the west by Niger State. It lies between longitudes $6^{\circ} 20'E$ and $7^{\circ} 33'E$ of the Greenwich Meridian and with latitudes $8^{\circ} 30'N$ and $9^{\circ} 20'N$ of the equator. It occupies an area of about $8000km^2$. The FCT is located in the centre of the country in the guinea savannah of the middle belt. The geological formation of the FCT is basically basement complex formation and the soil structure of the area is thin with texture generally stony to gravelly sand with smaller occurrence of loam. Abuja in the FCT has two distinct seasons, namely the rainy season that begins around March and runs through October and the dry season which begins from October and ends in March. However, within these seasons is a brief harmattan season that is occasioned by the north east trade wind and the attendant dust haze, increased cold and dryness. Rainfall in the FCT reflects the territory's location on the windward side of the Jos Plateau while the monthly rainfall distribution intensifies during the months of July, August and September. The annual average rainfall of the FCT is 1221.2mm.

The largest indigenous group in Abuja are the Gbanyi (also known as the Gwari). The next largest indigenous group are the Koro. Smaller indigineous groups also inhabit the area, such as the Gade, Egbura, Gwandara, Bassa and the Gana gana. Being centrally located, Abuja is blessed with a mix of agricultural produce such as tubers and root crops of the south (yams, cassava, maize and plantains) and grain (sorghum, guinea corn and rice) of the north. The FCT has proven deposits of a wide range of mineral resources including marble, tin, mica, clay, wolfromite, tantalite and talc.

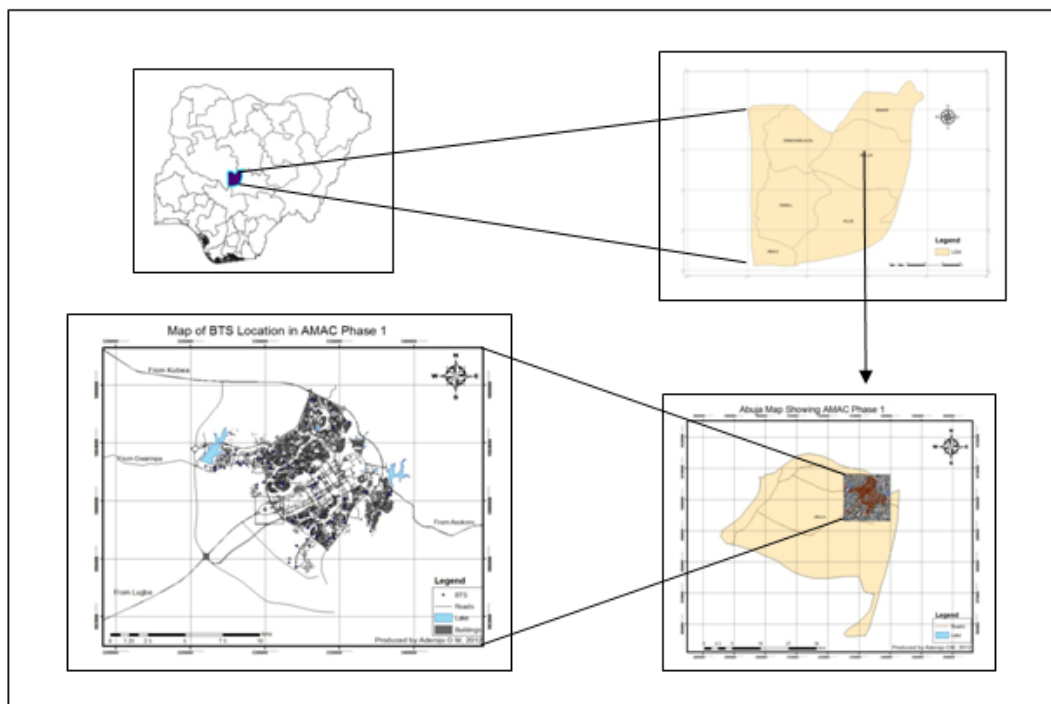


Fig 1.0: Abuja Municipal Area Council (AMAC) Phase I, FCT

II. Literature Review

2.1 Review of Global Standards on the siting of Base Transceiver Stations.

Health Canada's Safety Code 6, 2008 issued a guideline based on Thermal Heating and possible radiation, whereas some experts point to biological effects such that there is the stress factor of having masts to close to homes and schools. This guideline shows the appreciable distance that is allowed in locating a GSM mast to homes and schools.

Mast Height(m)	At Ground Level	First Floor Window (7.5m high)
15m	75-125m	30-80m
30m	175-225m	100-175m
45m	250-350m	150-250m

Table 1.0: Criteria for siting a BTS

2.2 Reviewed Study on Health implication of BTS in residential areas and schools.

- Ronni and Danny in 2004 carried out a study based on medical records of the people living within 350m of a long established phone mast, which showed a fourfold increase incidence of cancer compared with the general population of Israel especially among women.
- Santini et al.; Pathol Biol (Paris) in 2002 found significant effects on people living within 300m of mobile phone base stations and it was advisable that mobile base stations not sited closer than 300m to population.
- The New South Wales Minister for Education in 1997 stated "The Department of School Education objects to installation of mobile phone towers near schools, and that normally means within a radius of 500 meters. This objection is based on a policy of prudent avoidance". Since children spend more time at home than at school, it follows that this same prudent avoidance should apply to residential areas (Ash, 1995).

Based on literatures and other studies carried out, it is evident that possible health risk of residence / schools close to a Base Transceivers Station (BTS) are blurred vision, cancers, lung diseases, heart problem, headaches, migraine, nausea, tumors, lesions, childhood leukemia, sleep disorders, physical disabilities, dizziness, miscarriage and many more.

III. Methodology

a. Data Acquisition and Data Sources:

The data used for this study were obtained from both primary and secondary sources. The primary sources involved the use of GPS receiver to obtain the coordinates of Base Transceivers Stations (BTS) in the study area and also personal interviews with station engineers of MTN and Etisalat, guards at the BTS locations and also some inhabitants around the identified BTS locations. The secondary data used is a high resolution satellite imagery of the NigeriaSat-2 with resolutions 2.5m and 5m panchromatic and multispectral respectively. The imagery was obtained from the National Space Research and Development Agency (NASRDA), Abuja in 2013.

b. Geo-database design and database creation

Geo-database design was done based on the features of interest identified on the satellite imagery used. The identified features of interest were highway, minor roads and settlements. The database creation for the Base Transceiver's stations simply comprises of the followings; BTS coordinates (Northings and Eastings), Service provider's name, Residence type around the BTS location and Address of the BTS location.

c. Field Work

The study area was divided into districts to ensure accuracy and also avoid duplicating efforts.

- I. The use of a Global Positioning Systems (GPS) to obtain coordinates on all the location of the BTS in the study area.
- II. Personal interviews with the some MTN, GLO and Etisalat engineers, BTS guards and some inhabitants living around Base Transceivers Station in the study area to obtain information on the Base Transceivers Station itself.

3.4 Laboratory analysis

- i. Data processing (Georeferencing and on screen digitizing): Georeferencing of the satellite image was required so as to bring them to the same ground coordinates. The georeferencing of the satellite image was done using the ArcGIS software. The coordinate system of the datasets was projected to WGS 1984, Universal Transverse Mercator, Datum 100 Minna –Nigeria, Zone 32⁰N. The georeferencing was done with the selection of four X and Y coordinates tie points that are spatially distributed and points were added, and map was then rectified. GPS coordinates of BTS obtained during the field survey was plotted on the image. The creation of a personal geodatabase for each feature of interest was done in ArcCatalog extension of the ArcGIS 9.3. The digitizing process was done in the ArcMap environment for feature

extraction. Digitizing is the process of converting geographical features from an analogue or raster map into vector format.

- ii. Geospatial Analysis: The basic spatial analysis employed during this work was done using ArcGIS 9.3. Buffering operation was done at specific distance 10m, 20m, 50m and 100m. This was created around the BTS in order to determine the proximity level to residential areas, schools, hospitals and many more. Proximity analysis was equally performed via query to know the closeness level of settlements to BTS.

IV. Results and Analysis

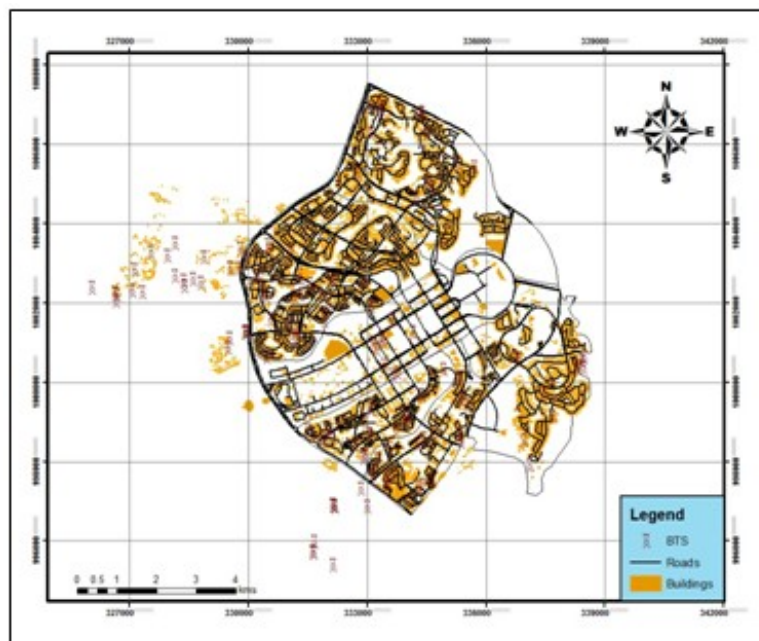
The table 2.0 shows the location and the service providers of identified BTS in Abuja Municipal Area Council (AMAC), FCT. This also has information like the address of the location of the Base Station, residential type and also elevation of the point in which the BTS is located.

	Northings	Eastings	Elevation (m)	Service Provider	Residential Type	Address of BTS Location
1	333775	997811	517	MTN & VISAFONE	Medium	Plot 289 Enugu street Gariki
2	333697	997650	517	MTN	Medium	Model primary school Gariki 2
3	333480	997478	518	ETISALAT	Medium	Gariki 2 police HQ
4	333467	997432	516	GLOBACOM	Medium	Gariki 2 police HQ
5	334278	997363	517	GLOBACOM	Medium	6 Sapete Street beside NURTW, Gariki
6	334372	997424	517	MTN	Medium	NSPMC qtrs Gariki 2
7	334625	997507	515	MTN	Medium	Ladoke Akintola boulevard way Gariki
8	333361	998494	517	MTN	Medium	AMMA center plaza Mohammedu Buhari way
9	332296	998724	516	GLOBACOM	Medium	50 Oro Ago Street
10	332316	997329	518	MTN	Medium	Plot 936 Gudu district legislative Qtrs off Ago
11	332139	996868	524	GLOBACOM	Low	Durumi hill
12	332149	996878	526	MTN	Low	Durumi hill
13	332125	996899	526	AIRTEL	Low	Durumi hill
14	332119	996903	526	VISAFONE & MULTI	Low	Durumi hill
15	332116	995389	484	GLOBACOM	Medium	Anon plaza 1085 gudu district
16	331617	995717	486	MTN	High	34 David Ejor crescent Gudu
17	331609	995722	483	ETISALAT	High	34 David Ejor crescent Gudu
18	331638	995980	493	GLOBACOM	High	195 Durumi 2 by pry school
19	332978	996868	494	ETISALAT	High	Apo legislative qtrs zone A (santosa park & Recreation)
20	333341	999382	520	AIRTEL	High	9 portacourt crescent Gariki off gimboya street
21	333349	999390	519	GLOBACOM	High	9 portacourt crescent Gariki off gimboya street
22	333522	999424	523	MTN	High	11 ikukwa street off gimboya
23	331828	998336	483	MTN	High	Area 1, Junction
24	331996	998351	482	VISAFONE	High	Shehu shaguro islamic center
25	332944	998988	483	MTN	High	Along J.S Tarika Street
26	333048	998709	491	MTN	Low	Shehu shaguro islamic center
27	332694	998429	466	MTN	Low	First bank Area 3 Gariki
28	333974	999141	510	ETI, MTN, VISA	Low	Mosque Area 8 Opposite Sterling Bank
29	334339	999677	511	GLOBACOM	Low	74 Enoka Anyanwu Street
30	334144	1001273	526	VISAFONE	Low	Federal Mortgage Bank
31	333625	1001381	509	MTN	Low	TOFA House CBD
32	333083	1001912	500	ETI, MTN, VISA, MULT	High	Torahim Abacha Estate Wuse Zone 4
33	332900	1002330	510	GLOBACOM	High	5 Port said Street
34	332140	1002564	497	ETI, MTN,	Low	15 Ziganchor street
35	331525	1002488	473	ETI, MTN, VISA, MULT	Low	Accra park Zone 5
36	331315	1002348	471	MTN	Low	Accra park Zone 5
37	331140	1002174	472	AIRTEL	Low	37 Kharoun street Zone 5
38	331198	1001305	488	GLOBACOM	High	Orange garden Zone 2
39	331797	1002258	489	ETI	High	Fire service station Zone 3
40	332000	1001963	492	ETI	High	7 idimba street wuse zone 3
41	331895	1001541	482	MTN	High	23 Abidjan street wuse zone 3
42	331275	1002730	474	GLOBACOM	High	Plot 2B Herbert Marcusey wuse zone 5
43	330486	1003471	513	MTN	High	Unity Park wuse zone 6
44	330508	1003352	498	ETISALAT, MULTILINKS	High	5 Nyala street wuse zone 6
45	331062	1003352	498	MTN	High	Cotonu crescent chinox guest inn zone 6
46	329983	1003119	480	GLOBACOM	High	23 Yaounde street zone 6
47	330164	1002886	473	STARCOM, GATEWAY	High	Total filling station zone 6
48	330289	1002614	473	AIRTEL	High	Chicken republic zone 6
49	330420	1002188	473	GLOBACOM	High	Copper house Zone 5
50	330323	1002249	481	MTN	High	Opp. Copper house, Zone 5
51	330335	1001581	482	MTN	High	plot 5 Michael Olopara street wuse zone 5
52	330443	1000648	483	GLOBACOM	High	33 lone crescent princess suite Zone 7
53	331219	1001089	488	MTN	High	Amusement park zone 1
54	331082	1001189	489	ETISALAT, AIRTEL, STARCOM, VISA, MULTI	High	Amusement park zone 1
55	329520	1002883	477	AIRTEL	High	Moses masjukodummi str, Golden astoria hotel Utako
56	329743	1002883	475	ETISALAT	High	B12,33 utako (Friday mosque)

57	329786	1003377	473	MTN	High	2 Bulkar Dipcharma str, Tashim O elias Utako
58	328845	1003156	480	MTN	High	plot 367 Augustus akoma way utako
59	327932	1003189	450	AIRTEL	High	plot 224 solomona way utako, Chida hotel
60	328119	1003522	444	MTN	Low	Behind, NHIS office utako District
61	328122	1002682	443	VISAFONE, ETISALAT, MTN, MULTILINKS, STARCOM	High	Opposite jabi park utako
62	328364	1002429	450	Pocom	High	B division Utako district command
63	328333	1002560	450	MTN	High	plot 6 anikiam str, Abraham plaza utako
64	328781	1002502	455	MTN	High	29 Fokotie ebo Crescent
65	328579	1002605	480	AIRTEL, MULTILINKS	High	26 A E Ekwuiziam Street Utako.
66	326619	1002251	453	MTN	High	9 mile Akhigbe street Utako
67	326648	1002209	457	MTN, MULTILINKS	High	1 Emmanuel Adiele str utako.
68	326632	1002049	458	GLOBACOM	High	Plot 693 obafemi awolowo way zone B4 Utako
69	326030	1002387	447	AIRTEL	High	Richard Akinjide street
70	327037	1002323	468	ETISALAT	High	16 Ebinu Ukinwa str, Jabi district.
71	327098	1002838	457	MTN	High	27 A Sheik Janna street
72	327523	1003287	464	MTN	High	9 Adams Chirona crescent
73	327297	1002270	461	MTN	High	Blk C1 sigma estate
74	329918	1001271	455	VISAFONE, ETISALAT, MTN, MULTILINKS	High	Wuye junction
75	329923	1001283	455	GLOBACOM	High	Wuye junction
76	329898	1001250	453	AIRTEL	High	Wuye junction
77	329496	1001120	452	AIRTEL	High	plot 111 Peace Heaven Wuye.
78	329464	1000879	459	MTN	High	Cassava Street Wuye plot 674
79	333124	997678	505	Unknown	High	CBN quarters
80	333251	998074	503	AIRTEL	High	IQ Academy school basin kabbu crescent
81	333545	998351	506	Unknown	High	On top of house 6 NISE close wuse
82	332916	998156	508	Unknown	High	Government science and technical college
83	332874	998083	507	MTN	High	Government science and technical college
84	334265	998431	508	Unknown	High	Plot 1350 Ahmadu Bello way gariki 2
85	334426	998601	512	MULTILINK	High	Cembo filling station gariki 2
86	334630	998741	508	MTN	High	Inside gariki supermarket
87	333716	998802	489	GLOBACOM	High	House 2 Ekot close Gariki
88	333981	999127	509	GLOBACOM	Low	Federal capital territory judiciary customary cork
89	334363	999682	517	GLOBACOM	Low	Tafawa balewa road,inside moneygram office
90	334904	1000320	519	MTN	Medium	Inside NTA head quarters
91	335280	1000126	525	Unknown	High	Area 2 District
92	335281	1000075	529	Unknown	Low	Mangal plaza Area 11 gariki
93	337092	997902	568	MTN	Low	Dapa biraye str, Near AIT office, Asokoro
94	336954	998542	571	MTN	Low	Justice fatal william Street , Asokoro
95	337674	999157	557	Unknown	Low	Mamman Nasir Street, Asokoro.
96	337457	999739	546	Airtel	Low	gwasigbe ayadema str, Asokoro.
97	338443	1000386	600	GLOBACOM	Low	By police station asokoro
98	338407	1000568	580	GLOBACOM	Low	By police station asokoro
99	338468	1000645	580	MTN	Low	By police station asokoro
100	338276	1000425	557	MTN	Low	Haile selassie street asokoro
101	338309	1000350	573	GLOBACOM	Low	Haile selassie street asokoro
102	336823	1000600	523	G cell	Low	plot 384, J F kennedy street Asokoro
103	336763	1000373	534	MTN	Low	plot 384, J F kennedy street Asokoro
104	331486	998821	501	Unknown	Low	African safari hotel limited areal
105	332049	998823	484	ETISALAT	Low	Drumac plaza Areal
106	333082	999341	491	Unknown	High	Number 4, borso street, on top of a two storey building, area 10, Gariki
107	333608	1000189	505	ETISALAT	Low	Close to chelsea hotel
108	333743	1000249	504	Unknown	Low	Annexa metro plaza
109	333423	1000446	498	Unknown	Low	Ahmadu abacha house
110	333211	1000843	496	Unknown	Low	Behind nicon plaza
111	333115	1001014	498	Unknown	Low	IGI central area

112	333345	1001138	501	Unknown	Low	Inside total office central area
113	333352	1001045	515	Unknown	Low	Behind total building Ajib building, central Area
114	333084	1006955	520	Unknown	Low	Ibrahim babangida way, Maitama
115	333320	1006980	570	MULTILINK	High	Tennese crescent, Maitama
116	333350	1006879	567	Unknown	Low	Ibrahim babangida bookoryard, Maitama
117	334351	1006803	553	Unknown	Low	Opposite Samsung building, Maitama Mpape junction
118	334348	1006810	548	MTN	Low	Mpape junction
119	335292	1005523	514	GLOBACOM	High	Inside model primary school Maitama
120	335688	1005435	501	MTN and AIRTEL	Low	Opposite Philippine embassy, Maitama
121	334475	1006257	549	MTN	High	Rams street, Maitama
122	333081	1006292	520	MTN, ETISALAT AND STARCOM	Low	Ahvan Sokko way, Maitama
123	332753	1005279	521	MTN	High	African Safari hotel, Lunakong street, Maitama
124	334214	1004674	521	MULTILINK	High	2507 inani estate, off british council, Maitama
125	334532	1005059	532	AIRTEL	High	Saleem guest house, Maitama
126	334623	1004951	498	MTN	High	Star Lake Close, House 6, skoonce crescent, Maitama

The figure 2.0 shows the spatial distribution of BTS in AMAC environs.



4.10 Existing Standards and Regulations on the siting of Base Transceiver Station in Nigeria

NCC guidelines of 2009 on the installation of telecommunications mast and towers state as follows;

- Telecommunications tower above 25m in height would not be permitted with districts delineated as residential.
- Where tower in excess of 25m in height are permitted, they should be placed at minimum setback of 5m distance to the nearest dismissed property, excluding the fence.

But in 2011, National Environmental Standards and Regulatory Enforcement Agency (NESREA) Abuja issued out a regulation in the National Environmental (Standards for Telecommunications and broadcasting Facilities) Regulations, 2011). This states that,

In respect to the Guidelines on Technical Specifications for the Installation of Telecommunications Masts and Towers issued by the Nigerian Communication Commission (NCC) and relevant guidelines by the National Broadcasting Commission (NBC), and the National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, (2007) (NESREA Act, 2007) on the siting of BTS, the following guidelines should be adhered to;

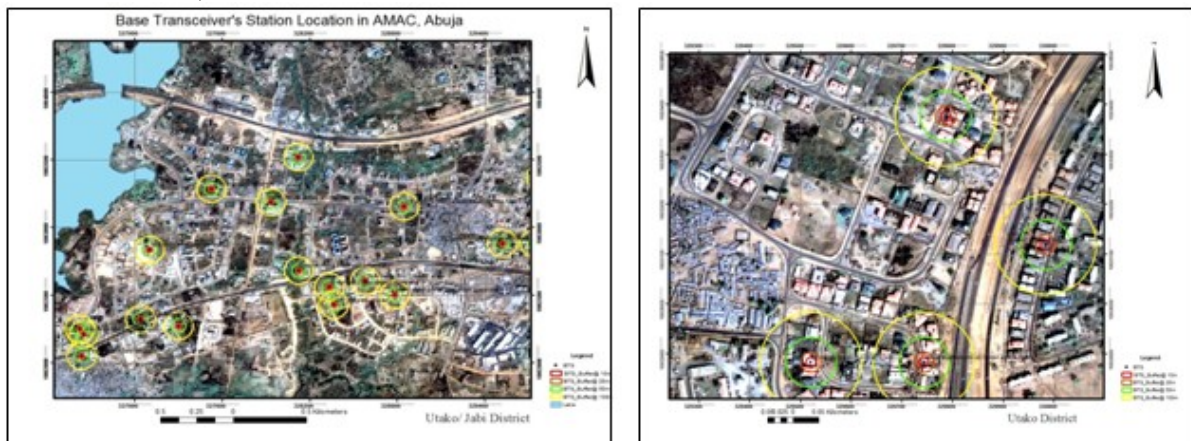
- BTS must have a minimum setback of ten (10) meters from the perimeter wall (fence) of residential/business premises, schools and hospitals to the base of the mast/tower; and
- Where there is no perimeter wall (fence), a BTS must be at a minimum of twelve (12) meters from the wall of residential/business premises schools and hospitals to the base of the mast/tower.
- Telecommunications towers above 25 meters in height would not be permitted within districts delineated as residential.

(Source: National Environmental (Standards for Telecommunications and Broadcasting Facilities) Regulations, 2011)

With these research carried out by various scientist from various countries, it has shown that the NCC, ICNIRP, WHO among others claims that radio waves from BTS have no health implications on human has to be looked into because people cannot continue to cope with what is detrimental to their health all in the name of technology and a wider coverage or reception. And again the NCC guideline and NESREA regulations did not take into account the Specific Absorption Rate (SAR) living organism beside BTS can attain before it is called detrimental to the body. No safe limit standards were put in place to actually check the radiation level in the living organism around BTS locations.

4.2 Geospatial and Statistical Analysis

The buffering of 10m, 20m, 50m and 100m was done around the Base Transceivers Stations (BTS) to be able to run a proximity analysis to BTS in the environs. Figures 3.0, 5.0, 7.0 show the buffered zones around BTS in Utako/Jabi, Wuse and Garki Districts.



Utako/ Jabi District

15 Base Transceivers Stations (BTS) are available in Utako district.
 1 BTS falls within the low residential area of Utako district.
 14 BTS falls within the high residential area of Utako district.

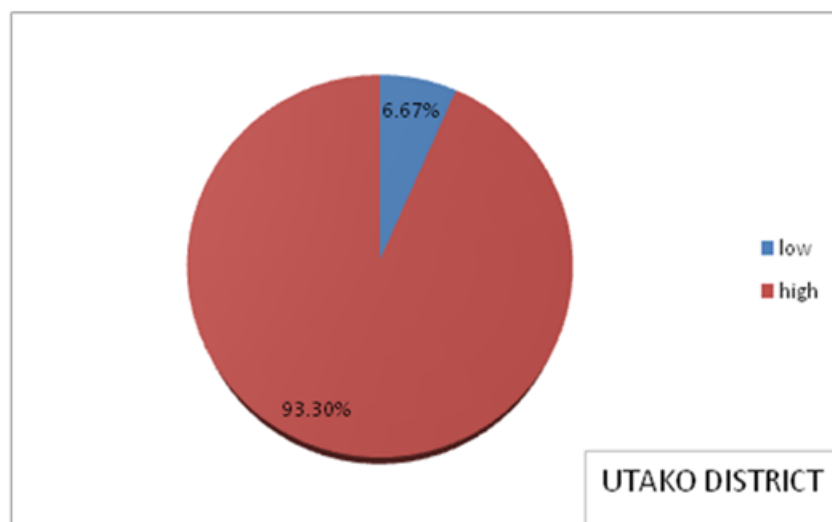


Fig 4: BTS % representation of Utako/ Jabi District

From the statistical analysis, 93.3% of the Base Transceivers Stations (BTS) available in the Utako district falls within the high residential area while 6.67% of the BTS falls within the low residential area of the Utako district. This shows many of the inhabitants living close to a BTS in Utako district are vulnerable to high risk of electromagnetic radiation from a BTS.

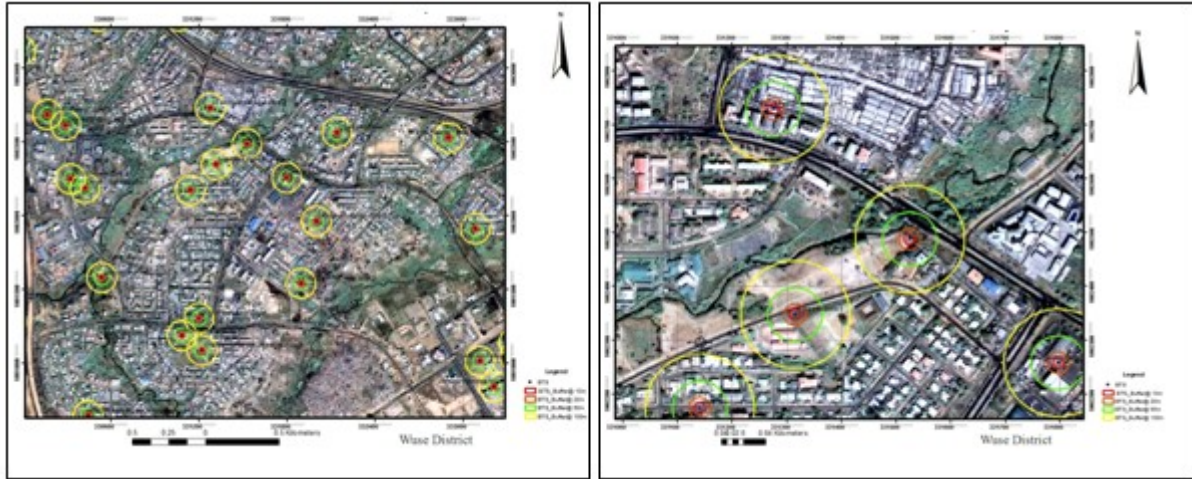


Fig: 5.0. BTS in Wuse District and Vulnerable settlements

Wuse District

29 Base Transceivers Stations are available in the whole of Wuse district. 4 BTS fall within the low residential area of Wuse district while 25 BTS fall within the high residential area of Wuse district.

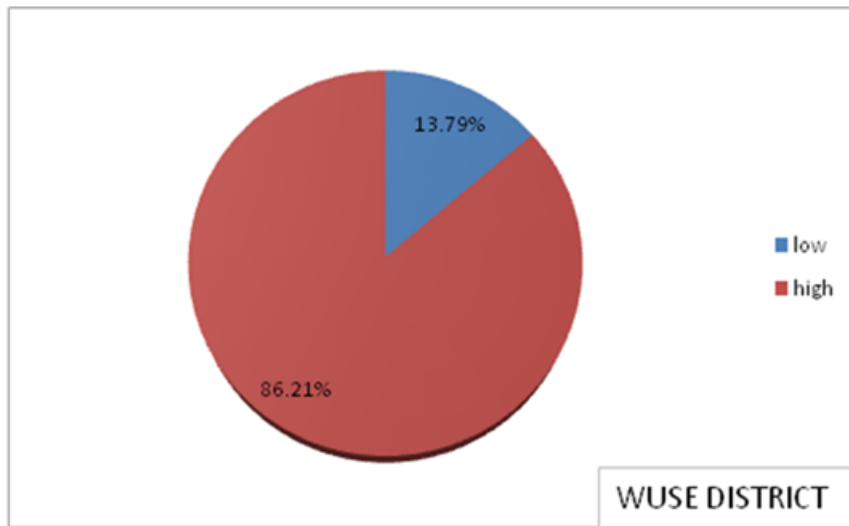
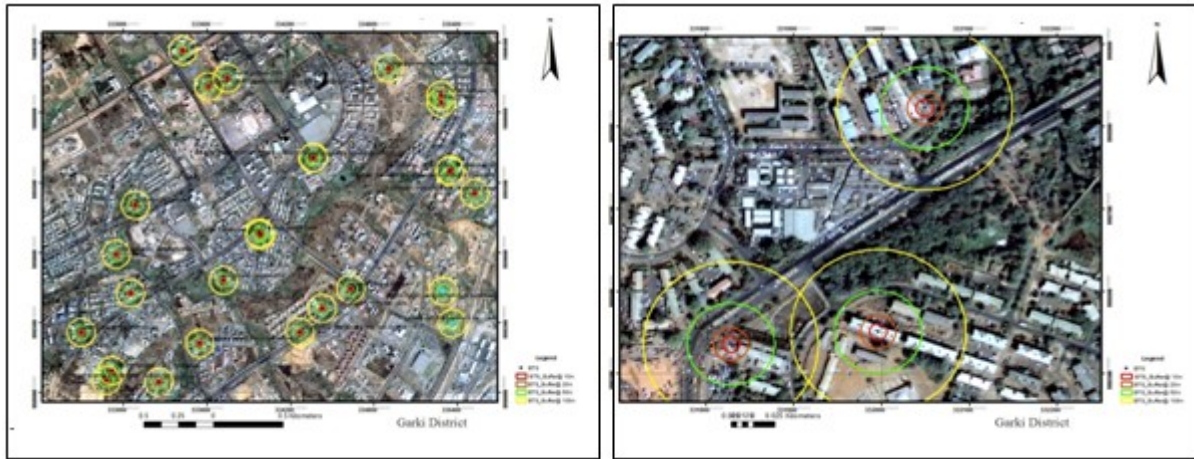


Fig 6.0: BTS % representation of Wuse District

From the statistical analysis, 86.21% of Base Transceivers Stations (BTS) available in Wuse district (Zones 1, 2, 3,4,5,6 &7) falls within the high residential area of the district while 13.79% of BTS falls within low residential location of Wuse district. This shows many of the inhabitants living close to a BTS in Wuse district are vulnerable to high risk of electromagnetic radiation from a BTS.



Garki District

31 BTS are available

- 10 BTS falls within the in low residential area
- 11 BTS falls within the in medium residential area
- 10 BTS falls within the in high residential area

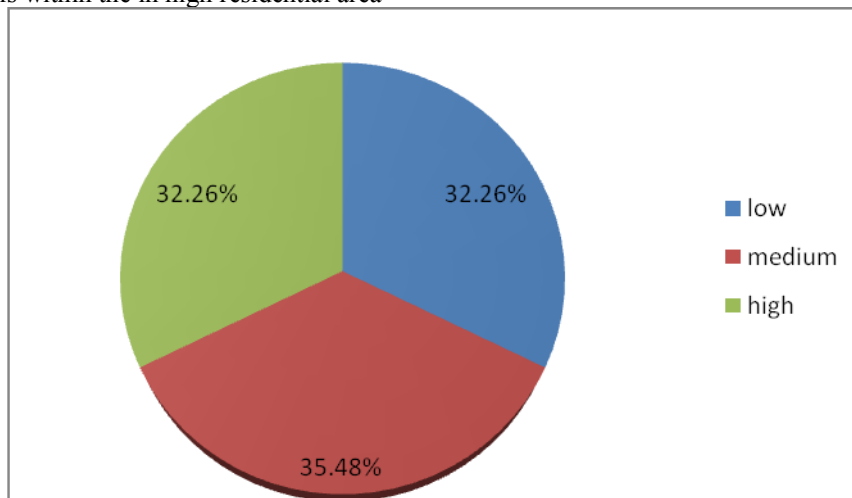


Fig 7.0: BTS % representation of Garki District

- Low residential location of BTS, 32.26% is within the Garki district
- Medium residential location of BTS, 35.48% is within the Garki district
- 32.26% of BTS available in Garki district falls within the highly residential area.

It shows that the inhabitants of this location are vulnerable to high risk of electromagnetic radiation from a BTS.

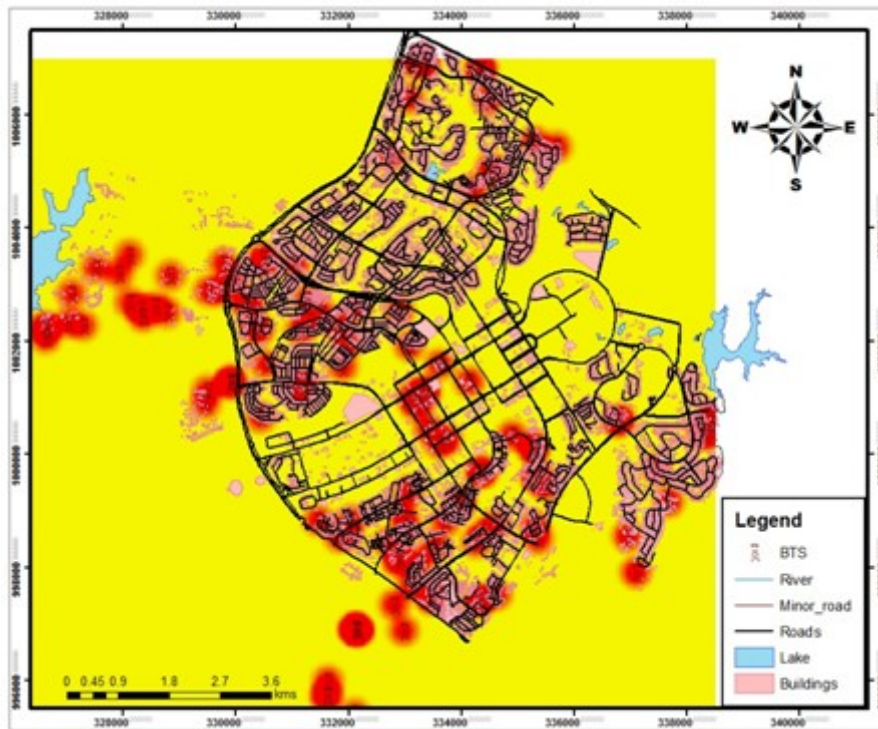


Fig 8.0: Settlement Risk Map in BTS location

V. Discussion

Based on the available guidelines, in Nigeria by NCC & NESREA, this simply states that no communication mast should exceed 25m height and at distances of 5m (NCC), 10m (NESREA) from a fence and 12m (NESREA) in areas with no fence. This has clearly shown that the residence that within distances 10m to 20m are vulnerable to electromagnetic radiation emitting from the Base transceiver stations BTS in the entire district going by the NESREA regulations. But in a broader view whereby some researchers went as far as a distance of 400m radius is a safe for siting BTS to homes, schools and hospitals, we have decided to at least create a radius of maximum 100m radius from a BTS to homes, schools and hospitals. The figure 8.0 is simply a map showing settlement at risk with respect to radiation from BTS using the NESREA standards of 10m. It has been deduced from the geospatial analysis that most service providers violate the standards issues by NESREA which makes the inhabitants around BTS at high health risk. This is still not enough according to researches carried out in developed countries and various types of complain of carcinogenic diseases, issues of miscarriages, necessary and many more as mentioned above was researched into. The buffer zones created around the identified BTS at 10m, 20m, 50m, and 100m is way below the distances of BTS to residential area causing health hazard in developed countries according to some researches. This study has simply shown that at the created buffer zones to check the proximity of residential areas, school and hospitals, which simply means that at 10m, which is the identified standard by NESREA, this BTS location still violets the max distance. Again viewing it from the ravened research point of view, 100m distance is even at risk to residential areas, schools, and hospitals. It was concluded that by statistics that

- 35.48% of BTS falls within highly residential areas in the Garki district.
- 86.21% of BTS falls within highly residential areas in the Wuse district.
- 93.30% of BTS falls within highly residential areas in the Utako/ Jabi district.

VI. Conclusion

In this study, geospatial techniques and statistics were integrated for mapping and analysis of Base Transceiver station (BTS) and also its risk to settlements around it. It was observed that out of the 126 BTS stations sampled in the AMAC phase 1, 119 BTS sampled in the study failed the 10m and 12m buffer zone tests and only 7 BTS met the NESREA standards of 10m and 12 m distance to residential areas, schools and hospitals. It was clear that the 7 BTS that met the NESREA standards were located on Durumi hills, Accra Park in Wuse, Zone 5 and on Ibrahim Babangida way, Booloyard, Maitama. All these BTS belong to MTN, Visafone, Etisalat, Multi-link, Globacom, and Airtel.

VII. Recommendation

There should be proper awareness on the possible health risk on people living close to a Base Transceivers Station (BTS). The regulatory agencies should keep checks on service providers that violate the 10m and 12 m of siting BTS away from residential areas as stated in the NESREA regulations for telecommunication and broadcasting standards.

The regulatory agencies should also invest in R&D in order to confirm all others studies and complains about electromagnetic radiation and thermal heat causing health problems so that a more reasonable buffer zone for BTS siting will be issued as a regulation to service providers.

Acknowledgements

Our appreciation goes to the National Space and development Agency (NASRDA), Abuja for facilitating and supporting this research with data (NigeriaSat 2 imagery and other logistics) that helped in the course of this research. We also use this opportunity to thank the Director of Strategic Space application, (NASRDA) Dr Halilu Shaba, and the head of Hazards and Environmental Management, Strategic Space application, (NASRDA) Dr Godstime James for mentoring and supporting us during this research.

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