

Perception of Effects of GSM Infrastructure on Human Health in GOMBE, Nigeria

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Abstract: The deployment of communication infrastructure in Nigeria in recent times have been massive as a result of ever increasing demand for wireless mobile phone services especially in Nigerian urban areas. The market for mobile telecommunication is very big and it is a major economic driver in many countries including Nigeria. The resultant effect of this growth is that our urban centers have witnessed unprecedented erection of mast by different service providers (Globacom, MTN, Etisalat, Celtel, etc) to accommodate phone users with little regards to standards, health, safety and environment, a concern for the general well being of the teaming population. This has become an eye sore to urban planners with attendant health hazards from radiation, power generating plants and Radio frequencies (RF) aerials. The objectives of the study are i) to identify the location/distribution and number of existing GSM masts by service providers in Gombe metropolis, and ii) to determine residents perception of the effect of spatial distribution of Global System for Mobile telecommunications (GSM) infrastructure on human health and the environment in Gombe metropolis. Data was collected through personal observations, interviews and questionnaire administration to residents. The findings will help to clarify issues as regards the potential harmful effects of GSM mast located in built up areas and health implication on the inhabitants. It will also serve as a guideline in determining how masts can be accommodated within built areas.

Keywords: GSM, Gombe metropolis, health, infrastructure, mast, Nigeria.

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I. Introduction

Wireless digital telecommunication, internet and information communication technology have revolutionized the world. The impact of information technology can be felt in all economic and social activities in every conceivable manner. The convergence of all forms of communications on the digital playfield is opening up immense new possibilities of achieving speed, versatility and space-time interdependence (Chakraborty and Mathur, 2009). With the deregulation of the telecom sector by the Chief Olusegun Obasanjo administration in 2001, most especially the much touted granting of licenses to GSM service providers and setting in motion the privatization of NITEL, Nigeria witnessed a phenomenal increase in the citizens' access to telephone (Tella, Amaghioyeodiwe and Adesoye, 2007).

The resultant effect of this growth is that our urban centers have witnessed unprecedented erection of masts to accommodate phone users, with little regards to standards, health, safety and general wellbeing of the teaming population. This has also become an eye sore to urban planners and a threat to the general wellbeing of the inhabitants of where these masts are located.

The choice of suitable sites for the erection of telecommunications masts and base stations depends 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, among other factors (Omole, 2006).

GSM base stations in Gombe metropolis have been noticed to be located in densely populated residential areas, in close proximity to educational and health facilities and some were erected side-by-side thereby having a higher tendency of overlap of radio frequencies (RF), detrimental to health.

The objectives of the study are i) to identify the location (and number) of existing GSM masts in Gombe metropolis, and ii) to determine residents perception of the effect of spatial distribution of Global System for Mobile telecommunications (GSM) infrastructure in Gombe metropolis with the view of making proposals which will minimize the potential harmful effects of RF on human health, improve safety of lives and

properties around the base stations, and visual appeal. The findings will help to clarify issues as regards to potential harm of GSM mast located within the circumference of other land uses and its health implication on the inhabitants. It will also serve as a guideline in determining how masts can be accommodated within built areas.

II. Literature Review

Given the strategic importance of mobile telecommunications masts system, Public perceptions of their spatial distribution revolve around issues bordering on health risks, as well as; safety, visual impact/aesthetics, and effects on property value viz-a-viz mast density, location, height, and difficulty associated with camouflaging of masts.

Safety with regards to GSM base stations and towers can be seen from two perspectives: The first pertains to the restriction of access to sites by un-authorized persons, which in most cases has been reduced due to the erection of a perimeter fencing round the site, but most importantly, the fear of physical injuries arising from defects in construction, installation and maintenance of the masts. Cases are rampant of falling masts on houses and other personal properties and public utilities in Nigeria. For example, earlier in March 2016, a tragic story was posted on Information Nigeria about a telecommunications mast mounted in a residential area of Odukpani near Calabar that collapsed after a brief rain storm, killing two people, and injuring another three persons, and destroying several houses and properties on its path (Egesi, 2011). A similar incidence played out in 2011 in North Bank, Makurdi where a Globacom masts fell down as a result of unprecedented mechanical fault, destroying properties worth millions of naira. A retiree residing in Makurdi has called for the relocation of an MTN mast erected about 10 meters away from his house, because of hazard posed by the mast (Nigerian News-world Magazine, 2011). The Vanguard of May 2009, carried the complaint of an Ibadan based banker on danger to his life and family from a massive MTN mast erected beside his house which started tilting towards his house after it was completed in January 2009. Sometimes in 2012, an antenna dish with a diameter of 1.5m pried itself free from a massive Etisalat mast in Pantami area of Gombe and plunged down from a height of over 40m. No casualty was recorded. Such incidences might have prompted Hon. Kingsley Chinda (Rivers/PDP) to sponsor a bill seeking tougher action on the location of telecommunications masts by service providers on the floor of the House Representatives.

The second perspective relates to the significant concerns raised about possible health effects from exposure to radio frequency electromagnetic fields (Wolf and Wolf, 2004). As a result of the on-going debates about health implications of RF emissions, literatures abound stressing the correlation between GSM base stations and its effects on health. Many of these studies were carried out at different places around the world. For instance, a study in Spain indicates an association between radiation, headache, nausea, loss of appetite, unwellness, sleep disturbance, lack of concentration and dizziness (Navarro et al, 2003). Also cardiovascular symptoms have been associated with field strength of RF in a study in Austria (Kundi, in Horst et al, 2004).

Akintola *et al.*, (2009) conducted a study in Lagos to show that proximity and duration of mast radiation is directly proportional to hazard effects. The study related headache, skin irritation, anxiety, sleep disorder and weight loss to people living within 200m of GSM masts. In Israel, Wolf and Wolf (2004) also revealed increased incidence of cancer in those living within 350m radius of a cell phone transmitter station.

There are evidences that show the possibility of some health effects that are associated with living in close proximity to GSM base stations (Bolaji and Idowu, 2012). Most GSM base stations in most Nigerian cities are close to residential buildings. Concerns are heightened given the non discriminatory manner in which GSM base stations are sited in close proximity to residential homes, hospitals and schools which increases exposure level in such environment (Otitolaju, et al 2010).

The London Borough of Hounslow set up an Independent Expert Group on Mobile Phones (IEGMP) to examine the health effects of GSM base stations. The group published its report called the Stewart Report (named after its Chairman William Stewart) in 2000, concluding that there is no general risk of living near a base station. It however recommended a 'precautionary limit' approach to control and monitor transmitter safety zones (IEGMP, 2000).

According to Bolaji and Idowu (2012), radiation levels may have an increasing pattern within 30-150m, and as one moves away from 200m radius of the base station, the exposure may begin to have a reducing pattern. Similarly, the South African National Department of Health has also recognized the need to create a precautionary zone or an exclusion zone around base stations based on the fact that Radio frequency emissions are highest at source, close to the antennae, and diminish with increased distance from the source (Kundi, 2002).

Further more, there are also concerns about negative visual impacts created by GSM masts and base stations which are a ubiquitous feature in urban areas. These border on the adverse impact of their location on visual amenities of the area (visual pollution) or because they would be sited in residential areas, schools or hospital grounds or in conservation areas. These concerns raise issues of environmental sustainability and compatibility.

Another area of concern is on the economic effect of citing of mast close to residential properties. It has been observed that proximity of telecom masts to a residential property adversely affects the market value of such property to the detriment of the owner (Michael et al, 2013: Omo-Ettu, 2011).

From the literature review, it is clear that the main concern arising from the location of GSM masts are their impact/effects in relation to 1) safety 2) health 3) visual/aesthetics impact/effects and 4) effects on property value. However, details on Spatial Distribution of Global System for Mobile Telecommunication (GSM) Infrastructure in Gombe Metropolis can be found in Gwary *et al.*, (2016).

III. Methodology

Data Required

The types of data used for this study relates to socio-economic profiles of the respondents, their geographical location in relation to GSM masts and residents' perception of the effects of the masts.

Data Collection

A total of 300 structured questionnaires were used to collect data on the residents' perception of the impact of GSM masts on human health and general wellbeing of the environment. The questionnaires had three parts (A, B and C): the part A contains questions on the bio-data of the respondents while part B contained some structured questions as well as a few open ended questions and part C contained questions meant for the service providers.

Furthermore, the instrument were self-completed by the respondents except for few respondents (who could not read and write) who were assisted by the investigator and research assistant on the spot. This probably explains the high rate of return of the instruments.

The questionnaires were administered to residents especially those residing within 700m radius of GSM masts using Systematic Random Sampling whereby a questionnaire was administered in one out of every three households. Statistical tools of simple percentages were used to analyze the data. The data obtained were tabulated to give a pictorial representation of the data for an easy understanding of the relationship existing between the variables.

IV. Results And Conclusions

This section presents and discusses the findings from the research questions raised.

Distribution of Masts by Service Providers

Investigation was carried out to find out the distribution of GSM base stations by service providers in Gombe metropolis. The result is shown in table: 1

Table 1: Distribution of GSM base stations by service providers

Operator	Number of mast	Percentage
MTN	16	24
Airtel	18	27
Etisalat	13	19
Globacom	17	25
Mtel	3	5
Total	67	100

Source: Field survey, 2014

From table 1, it can be seen that out of the total 67 masts in Gombe metropolis, Globacom has 17 masts (25%), Etisalat has 13 masts (19%), Airtel has 18 masts (27%), MTN has 16 masts (24%) while M.tel has 3 masts (5% , although not functional) in Gombe metropolis.

Bio-Data Information

The bio-data information of the respondents was sought. Questions asked were on gender, marital status, educational qualification and age of the respondents. This information was presented in table 2.

Table 2: Bio Data Information Summary

Sex	Number of respondents	Percentage Distribution
Male	240	80
Female	60	20
Total	300	100
Marital status		
Single	75	25
Married	210	70
Other	15	5
Total	300	100

Educational Qualification		
Degree/HND	67	22.3
NCE/ND	129	43
Senior school certificate	78	26
FSLC	26	8.7
Total	300	100
Respondents' Age		
21-30	43	14.3
31-40	170	56.7
41-50	63	21
51 above	24	8
Total	300	100
Return Rate		
Number administered	300	100
Number returned	300	100

Source: Field survey, 2014

The results in table 2 shows that 80% of the respondents are male, while 20% were female. However, 25% of the respondents were single, while 70% are married, and 5% fall under a class designated as others, consisting of widows/divorcees. In respect of highest educational qualification, 22.3% of the respondents have a first degree/HND, 43% are NCE/ND holders, and 26% are senior school leavers while 8.7% are holders of First School Leaving Certificate. The result also reveals that 56.7% (majority) of the respondents' age is within the range of 31-40 years. The rate of return of the instrument was to 100%.

Respondents Living Near a GSM Base Station

Response was sought on the proportion of respondents living near a GSM base station.

Table 3: Respondents living near a GSM base station

Item	Number of respondents	Percentage Distribution
Yes	184	61.3
No	116	38.7
Total	300	100

Source: Field survey, 2014

It can be seen from table 3 that majority of the respondents (61.3%) live near a GSM base station, while only 38.7% of the respondents do not live near a GSM base station. 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.

Number of Masts near Respondent's House

Response was sought to know the number of mast(s) near each of the respondent's place of residence and the result obtained is shown on the table 4.

Table 4: Number of masts near respondents' house

Item	Number of respondents	Percentage Distribution
One	127	42.3
Two	25	8.3
Three	32	10.7
None	116	38.7
Total	300	100

Source: Field survey, 2014

From responses represented in table 4, a sizable proportion of the respondents live near a GSM base station. As can be seen above, 42.3% of respondents live near a single mast, 8.3% live near two GSM base stations while 10.7% live in close proximity to three GSM base stations. On the contrary, 38.7% of the respondents do not have a GSM base station near their dwellings, while 19% are under the health threat of mast overlap.

Ways in Which GSM Base Stations Affects the Respondent

The question of how GSM base stations affects the respondents was asked and their responses varies as can be seen on the table 5.

Table 5: Table showing ways in which GSM base stations affects the respondents

Item	Number of respondents	Percentage Distribution
Noise	188	62.7
Pollutants	51	17
Smoke emission	28	9.3
No effect	33	11
Total	300	100

Source: Field survey, 2014

Table 5 shows the responses on respondents' perception of effects of noise, pollutants, smoke emission, or otherwise (i.e no effects) which may result from base stations. However, 62.7% of respondents indicated that they are affected by noise from the base stations, while 17% of respondents indicated that they are affected by discharge of pollutants such as spent oil and spilled diesel.

On the other hand, 9.3% of the respondents claim to be affected by smoke emission from power plants, while 11% maintained that they are not affected at all by any pollutant or emission from the GSM base stations.

Perception of Threat from GSM Base Stations

Question was raised on whether the respondents think that GSM base stations pose any threat to them and the result obtained is presented in table 6.

Table 6: Perception of threat from GSM base station

Item	Number of respondents	Percentage Distribution
Yes	272	90.7
No	28	9.3
Total	300	100

Source: Field survey, 2014

Table 6 shows that majority of the respondents (90.7%) indicated that the GSM base-stations poses threat to them, which is contrary to the 9.3% of respondents who indicated that GSM base stations posed no threat to them.

What Do You Fear Most About GSM Base Stations?

The respondents were asked what they fear most about GSM base stations, and their varied responses can be seen in table 7.

Table 7: Respondents fear about GSM base stations

Item	Number of respondents	Percentage Distribution
Mast collapse/fall	148	49.3
Pollution	100	33.3
RF emission	47	15.7
Other (insecurity)	5	1.7
Total	300	100

Source: Field survey, 2014

Table 7 shows that 49.3% the respondents, identified mast collapse/fall as their greatest fear, which is closely followed by fear of pollution as indicated by 33.3% of the respondents. In addition, 15.7% of respondents indicated that they are more fearful of RF emissions from the masts and base stations, while 1.7% of the respondents indicated that they are afraid that the masts may be potential target for insurgents in the event of an attack.

Do you think GSM Base Stations exert negative effects on the environment?

This study sought to know if the respondents think that GSM base stations affect the environment negatively and their divergent opinions can be seen on table 8.

Table 8: Do you think GSM Base Station have negative effects the environment?

Item	Number of respondents	Percentage Distribution
Yes	265	88.3
No	35	11.7
Total	300	100

Source: Field survey, 2014

As can be seen on table 8, it is clear that an overwhelming majority of the respondents (88.3%) agree that GSM base stations have negative effects on the environment, while 11.7% of the respondents do not believe that GSM base stations have negative effects on the environment.

What do you think is the effect of GSM Base Stations on the environment?

When asked what they think is the effect of GSM base stations on the environment, the respondents gave various answers which is shown in table 9.

Table 9: Perception of effect of GSM base station on the environment

Item	Number of respondents	Percentage Distribution
Petrochemical wastes	142	47.3
Noise emission	74	24.7
RF emission	63	21
Smoke emission	21	7
Total	300	100

Source: Field survey, 2014

From table 9, it can be seen that 47.3% of respondents are of the view that release of petrochemical wastes and pollutants is the major effect of GSM base stations on the environment, while 24.7% of the respondents indicated that noise emission is the main effect of GSM base stations on the environment. However, RF emission was cited as the main effect of GSM base stations on the environment by 21% of the respondents, while smoke emission is seen as the least likely effect on the environment judging by responses of 7% of the respondents.

Do you think GSM Base Stations have effects on Health?

With regards to above question, the respondents answered in the affirmative as shown in table 10.

Table 10: Perception of effects of GSM base stations on health

Item	Number of respondents	Percentage Distribution
Yes	181	60.3
No	53	17.7
Not sure	66	22
Total	300	100

Source: Field survey, 2014

With regards to effects of GSM base stations on health, table 10 shows that 60.3% of the respondents agree that GSM base stations have effect on human health, while 17.7% of the respondents are of the opinion that GSM base stations do not have any effect on health. On the other hand, 22% of respondents indicated that they are unsure whether GSM base stations have any effect on health or not.

What Health Hazard/illness does GSM Mast Pose to You?

This question was further asked to determine the respondents' perception of hazards or illness that they felt GSM mast posed to them. The result is shown in table 11.

Table 11: Health hazards/illness posed by GSM base station

Item	Number of respondents	Percentage Distribution
Hearing disorder	36	12
Respiratory disease	15	5
Sleep disorder	53	17.7
Physical harm	161	53.7
None	35	11.6
Total	300	100

Source: Field survey, 2014

Table 11 shows that 53.7% of the respondents (majority) expressed physical harm as the greatest hazard they felt from GSM masts, while 17.7% of respondents attribute their sleep disorders to the sitting of a GSM mast near them.

In addition, 12% of respondents attribute their hearing disorders to being around GSM masts on a daily basis, while only 5% of respondents attribute their respiratory ailments to GSM masts. On the other hand, 11.6% of respondents claim they are not affected at all by GSM masts.

Do you think GSM masts distort visual appeal?

Response was sought on whether the residents think GSM masts distort visual amenities. The results are shown in table 12.

Table 12: Respondents perception of distortion of visual appeal by GSM base stations

Item	Number of respondents	Percentage Distribution
Yes	176	58.7
No	124	41.3
Total	300	100

Source: Field survey, 2014

Table 12 shows that majority of the respondents (58.5%) indicated that GSM masts are a nuisance to sight, as against 41.3% of the respondents who do not agree that GSM masts are a nuisance to sight.

In What Other Ways has GSM Masts affected You?

Answers to this question vary from person to person. While some of the respondents have something to say about the way GSM masts have affected them, others do not. Some of the respondents complained of seepage from the base stations especially after heavy rains flowing into or near their homes which they claim led to the death of their domestic poultry. Another respondent claimed the mast was erected across a water channel which resulted in diversion of water flow into his household.

What are the Common Environmental Problems from your site?

In the course of oral interviews with some key staff of the various service providers, the study sought to know the common environmental problems associated with base stations within the metropolis from the various operators. Some of the common environmental problems they stated are outlined below:

- a. Noise emissions from power generating sets.
- b. Carbon monoxide from generator exhaust.
- c. Oil and fuel spills.

Have you ever received any complaint about the location of your mast?

The operators were asked if they have received any complaint from the residents about their base stations.

Table 13: Complaint from the public about GSM masts/base stations

Operator	Response
MTN	Yes
Globacom	No
Celtel	No
Etisalat	Yes

Source: Field survey, 2014

What was The Nature of the Complaint?

The nature of the complaints based on the operators ranged from complaints about fumes and noise emission from power generating sets, as well as loose piece of metal on the mast that is making so much noise when it strikes the mast especially on windy days.

V. Summary, Conclusion And Recommendations

The study set out to determine 1) residents’ perception and 2) investigate the number and spatial distribution of GSM masts by service providers in Gombe metropolis with the view to making proposals that will minimize the potential harmful effect of RF on human health, improve safety of lives and properties around base stations and enhance visual appeal.

The study revealed that the total number of GSM masts in Gombe metropolis is 67. However the breakdown are as follows; Globacom has 17 masts, accounting for 25%, Etisalat has 13 masts accounting for 19%, Airtel has 18 masts, accounting fo 27%, MTN has 16 masts accounting for 24%, while Mtel has 3 of the masts (although not functional) accounting for 5% of masts.

In addition, the study revealed that the GSM masts were erected within residential areas and majority of people are not comfortable living close to the mast citing risk of accidental collapse, radiation emission, public health concern and environmental pollution are the major factors perceived by the residents.

Furthermore, the study revealed that the residents perceived that the special location of the mast have introduced some changes into the environment as a result of petrochemical wastes, noise from power generating sets, RF and smoke emissions from GSM base stations and negative visual impact which the residents perceived may adversely affect human health and the environment.

Based on the findings, the following recommendations were proffered;

1. Masts that have been found to be located especially in high density residential areas should be dismantled and moved to the outer fringes of the residential areas.

2. Solar energy should be used as alternative source of power to reduce emissions of smoke, pollutants and noise coming from base stations.
3. Overlap of RF fields was attributed to the location of masts close to each other forming a cluster of masts. This health hazard could be remedied if the Planning Authorities in Gombe State could partner with the NCC and NESREA to ensure that the NCC provisions for co-location and infrastructure sharing are enforced by operators of GSM cum base stations.
4. To avoid location of masts close to critical facilities such as schools or hospitals, the Gombe State Planning Authority should not grant approval to applications for GSM masts sites that may fall within the vicinity of such critical facilities.
5. Government should review approved development rights for the erection of base stations located less than 15meters. Those found to be in conflict with the surrounding should be revoked and that the location of all new base stations should be subjected to the normal approval/planning process.
6. The M.tel masts that have been out of commission for over five years should be decommissioned as stipulated by Chapter 5 Paragraph 4a of NCC guidelines (2009) and Section 6 of NESREA regulations which states that where a tower has not been used for a continuous period of three years, it may be deemed to have been abandoned, hence The NCC shall issue the service provider notice of removal.
7. There should be public consultation to seek the consent of the residents before any GSM mast/base station is erected in any community.

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