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LOCATION ADEQUACY OF TELECOMMUNICATION MASTS AND RESIDENTS LIVABILITY IN OSOGBO, NIGERIA

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ABSTRACT

The study investigates the location adequacy of telecommunication masts and residents livability in Osogbo Local Government Nigeria. The inventory of mast in the study area was taken, the location analysis of mast and the effect of the masts and its location on residents was done.

The study enumerated 35 masts located in different locations in the study area and random sampling (balloting) was used to select 12 masts in different locations. With cognizance to the acceptable standards, four zones were marked using 3m, 5m, 10m and 20m radii. for zones 1 to 4 respectively. The number of houses in each concentric zone formed the size of sample. Thus, a structured questionnaire was administered on 10 residents using systematic sampling. Correlation analysis was used to test the relationship between building-mast proximity and residents' livability.

Most masts were observed to be built very close (<10m) to residences. These houses were observed to experience high disturbance due to noise from the mast, vibrations, fumes from mast generator and pollution. Health problem like headache and sleep disorder due to noise and vibration from mast, respiratory disease were also observed among such residents. Property value decline and reduced patronage were experienced by landlords of the houses closest to mast. The study therefore recommends that planning authorities should be involved in the development of masts. The study also solicited an integrative approach to the technological development especially in areas requisite to human habitation. Policy makers, service providers, users and environmental managers should synergize together to make the technology in our environment suitable.

KEYWORDS: Environmental Livability, Residents' Health, Telecommunication Mast, Osogbo, Nigeria

INTRODUCTION

The scale of transportation and communication in our cities today is still struggling to beat the sizes of the cities; no wonder the saying that 'despite all the means of movement, the problem of the city is still how to move' (Owen, 1969). The optimal functioning of any urban center is greatly dependent on transportation and communication that corresponds to its scale. Thus, the world is rapidly moving towards an economic system that heavily depends on continuous and ubiquitous availability and dissemination of information (Akwule, 1992). The teeming urban population and its propensity to trigger serious transportation problems justify the affinity for effective communication devices like the Global System of Telecommunication (GSM); the use ofwhich dates back to some two decades in Nigeria, when about 2000 lines were rolled out by three operators in only three cities of the country. The service providers would maximize their productivity and profit when a large population within a relatively small space can pay for their services. Thus, the service has since

then been extending to cities and noticeably sensitive to high level urbanization for economic reasons.

Erection of telecommunication masts is practically indispensable for the case of high volume data transfer with guaranteed security and quality (Antonelli, 1991). They support antenna at a reasonable height to transmit and receive waves (Alleman, 1989). This accounts for the preponderance of the masts in the areas requisite for human habitation. Cities and communities with little or no literacy on the essence and consequences of sitting communication masts embraced GSM, and the sitting of the mast becomes freelance; so long it satisfies the operators and if they can pay for the site. This rapid growth in the erection of mast in recent years has been accompanied by public concern over the issue of health and safety risk. This is attributed to microwave radiation and the adverse visual amenity aspect of sitting these masts. The test carried out by the National Radiological Protection Board Scotland (NRPBS, 2000) shows that the long exposure to this microwave radiation has adverse effect on the health of people and this is due to the sitting of mast in Residential areas. Erection of mast therefore poses unprecedented risks to residents and regular users of the facilities.

Nigerian Telecommunication sector is one of the fastest sectors in the country and this is so much evident by the number of Telecommunication masts that are being installed from time to time. Masts are proliferated partly because of the multiplicity of service providers and business non-cooperative syndrome. GSM is almost a perfect market grooming a stiff competition between various operators among which are MTN, GLO, Etisalat, Starcom, Mtel, Multilinks and so on. These are different competing service providers who have the same target population. This suggests the proliferation of masts belonging to each; dotting the cities at several points to provide service coverage for as many residents as possible.

More than 120 masts are built monthly on the average by the service providers (Punch, 2009). The service provider as at 2009 has about 3,000 masts each across the country, most concentrating on urban areas (Punch, 2009). As at the year, each provider has more than 14,000 live masts in Nigeria. Today, the number of live mast can only be imagined. If 120 masts per month is anything to go by, then each operator would have added about 4, 800 masts (Nwokoro, 2000).

The effects of mast on city dwellers can be complex. There are silent long term problems that may affect the resident health. In united state for instance, masts have been associated with cancer and other grave illness. Occurrence like cancer of the lungs, prostate, breast, leukemia, lymphoma and haemotopoletic cancer has been blamed on living within 1-5km distance from mast in Dunganon (Abdel et al, 2007). There have also been issues related to the fact that some of the mast that are erected are not very strong and there have been cases of towers that have fallen down to cause fatal accident and other nuisance to the environment. The vibration and noise from mast in the host neighborhood also impair the residents peaceful living (Bortkiewitz, 2004).

Much more therefore need to be understood. Are the effects of live masts borne by their location close to residences or its concentration? What distance buffer would be necessary for the purpose of mitigation? What lessons would town planning and city designers learn about sitting communication mast within cities? These and other relevant questions are the thrust of this paper. This paper therefore assesses the location characteristics of telecommunication mast in Osogbo, Nigeria with a view to understanding its implication for planning, health and convenience of residents towards sustainable living in urban centres.

MATERIALS AND METHODS

The study relied on both the primary and secondary data. Quantitative and qualitative data were used. Masts were enumerated on the basis of the city areas and a total of 35 masts were enumerated forming the frame of sample. The study used a multi-stage sampling procedure. Out of the 35, 12 masts (34.3%) were sampled pro-rata across the service providers; using balloting system of random sampling. This ensured equal representation.

With the aid of Rasta map, four perimeter circular zones were established marking the ones that are 3m, 5m, 10m and 20m radius close to each mast. The number of houses found within each of the four radii zones forms the size of sample for the questionnaire survey regardless of the name of the service provider. Houses in the study area were therefore sampled purposively. The first sampled building in each radius was the first house after which every other houses were selected. Hence a total of 210 houses were sampled and an adult representative responded to the questionnaire. The types of data collected are:

The number and types of mast, the location of the mast, year in which it was erected, health condition of the residents in relation to the mast in the study area: existence of illness, predominant illness, duration of illness and interval of illness and environmental condition of the area in relation to the mast location: property value decline, reduced patronage e.t.c.

Chi square was used to explain the difference in the livability characteristics of residents who live in the different zones and Pearson's correlation was also used to explain the relationship between resident's proximity to and length of stay with mast and their livability.

Telecommunication Policies and Planning Applications

The telecommunications policies and its planning application are as follows:

- The planning authority must be informed before any free standing proposals and structures on a new ground. The planning authority should then:
    - Consider if the development of the mast is possible in the area.
    - Considers if creating a mast in the area will not cause future problems.
    - Provides alternative sites if the proposed area is rejected.
- Planning authority should consider if there will be environmental benefit if two or more mast is located very closely to each other.
- An Environmental impact assessment/ audit must be prepared by the telecom operators to monitor development process.
- The planning authority should be provided with sufficient information or notification before any development commences.

Location Guidance of Telecom Mast

- Mast should be erected 10m and above from residential, educational, hospital, child care centers and nursing homes

- Mast should not be erected on farmlands because of its effect on the crops
- The height of a mast that is below 15m does not require planning permission only that the necessary authority should be notified before its erection.
- Masts should be discouraged from being sited within villages because of its health sited within villages because of its health effect on the aged. The key to the sensitive locating, sitting and design of telecommunications equipment in rural areas is an understanding of the area landscape (Diaz 1977).
- The best opportunities for the sitting of masts are:
    - Railway land, Large traffic junctions, Recycling Areas, Waste water treatment works, Industrial/General Business Areas, Some wooded areas, Land adjacent to electric pylons.
- Mast should not be located in
    - Areas of wild land, Local wildlife sites, Open parkland, Peat lands, Principal tourist Routes, Residential Areas (Wang, 2007)

Mast should not be situated in the above areas is because of the adverse effect it has on various amenity and lives.

Health Implication of Telecommunication Mast

The rapid growth in the use of mobile phone in recent years has been accompanied by public concern over the issues of health and safety risks attributable to microwave radiation and the adverse visual amenity aspect of the sitting of telecommunication masts (Santini, 2003). The remit for researching the possible hazards associated with radiation which includes microwaves, RF radiation and electromagnetic radiation (Ruediger, 2009). The National Radiological Protection Board had said that there is radioactive exposure from mast which may be microwave radiation, electromagnetic radiation and RF radiation. The electromagnetic radiation emitted from masts on the height and type of mast but the wave ranges from $50w/m_2$ and $200w/m_2$. Some waves emitted by some masts are not hazardous but most masts emit more than $100w/m_2$ which is said to be hazardous if human being stays around the mast for a long time (Abdel-Rassoul, 2007).

According to the Abdel-Rassoul (2007) the short effect of these waves causes actual burn to the skin, nausea, vomiting and diarrhea while long exposure can cause epilepsy, short term memory, sleep disorder, increase in leukemia, and speed of cancerous growth which might lead to death. He also stressed further that micro waves emits high radioactive frequency which causes damage to children's brain. Also, noise, vibration and fumes are generated from the standby power generators positional at the telecom base station. The noise causes pollution to the environment and this causes partial deafening of ear if it persists. Fumes from the generator emit carbon monoxide which may block the respiratory organ when inhaled in large quantity and this may result to death. The vibration from the mast may curse headache, sleepless night and risk of brain tumor for people living around the area.

RESULTS AND DISCUSSIONS

Inventory of Mast

There were more MTN masts (45.7%) in the area. This is followed by Glo (20%), Airtel (17.14%). Multilinks and Starcommshas 8.57% each O'net has 2.86% of the total masts in the area. The radiations coming from these masts

according to radiologist are electromagnetic waves, RF radiation and infrared. These radiations are capable to cause: epilepsy, leukemia and different types of cancer. This implies that residents living very near these masts are at risk of this waves which might reduces their health condition after a long period of time.

Location Characteristics

Table 1: Distances of Houses to Masts

Zone	1	2	3	4
Radius	3	5	10	20
%	26	36	23	16

Source: *Author's field survey, 2013*

The minimum safe distance of buildings to the mast (10m) stipulated by NESTRA is adopted in this study. However to describe the scenario more clearly, there are two zones within the danger zone (i. e <10m) with radii of 3m and 5m respectively. The next zone observes the minimum standard and the last zone is assumed to be comfortably far from danger. The table shows that most buildings (62%, sum for zones 1 and 2) fall below the minimum standard. One may conclude that telecommunication industries hardly adhere to the minimum standards set for the sitting of masts by NESTRA. This implies that both in the short and long term, the livability of residents in the city is impaired by the location of these masts. Very many residents are sitting on a time bomb and after some time, repercussions of exposure to these dangerous waves may come.

To explain the degree of regularity, randomness or clustering, the nearest neighbor analysis was done. Distances between each of the 35 masts were measured. The perimeter of the entire area was measured all with the aid of rasta image through google earth software. The Rn value calculated was 0.33. This is far from 2.15, or 1 but tends towards zero. This implies that, there is a relatively high degree of clustering of the masts within the area. In other words, masts are sited close to each other when viewed against the background of the area perimeter. The implication of this can be much. Some buildings would fall within intersections of danger zones and may be prone to multiple effects that may accrue from mast. The window period may be hastened and the effects of the rays from the masts be felt sooner than expected especially on residents in the houses within intersection of danger zones.

Plate 1: Glo Mast Very Close (6ft) to a Building 10m in than OtanAyegbajustreet, Alekuwodo area Osogbo

Plate 2: MTN Mast in between 2 Houses at Less in Uncle k Street, AlekuwodoOsogbo

The chi-square analysis was performed to test the difference in the distance between the masts and the buildings and then between the respondents rating of their area desirability across the zones. The result shows a significant difference

at 95% confidence level. This implies that, the difference between the zones, their distances to telecommunication masts as well as their desirability are statistically significant. Invariably therefore, there may be a relationship between the building's distance to mast and its desirability.

Mast Location and Residents' Livability

Many of the data here were collected in ordinal scale. Hence, it became needful to re-scale the data using the Likhert scaling method. The resulting scale is interval which enables a succinct discussion of comparison and further parametric analysis. The problems identified in the study are grouped into physical, health and environmental perceived problems.

The analysis shows that most masts are closer to homes signifying non-adherence to the minimum standard of mast which is 10m as stated by the National Environmental Standard and Regulations Enforcement agency (NESTRA). Houses closet to mast were observed to be experiencing high disturbances due to noise, vibration and fumes from the mast and mast generators which causes diseases like sleep disorder, headache and respiratory diseases. The major factor responsible for the sub standard location in the study area is greediness of land owners, bribery and ineffectiveness of planning authorities and political influences.

Table 2: Scaled Severity of Problem and Diseases

Physical Problems				
Problem	3m	5m	10m	20m
Noise	278	229	104	33
Vibration	294	208	65	35
Fume	145	142	66	35
Pollution	194	191	91	46
Health Problems				
Disease	3m	5m	10m	20m
Diarrhea	189	140	73	39
Headache	219	187	118	47
Insomnia	226	175	102	46
Ear problem	167	137	55	30
Leukemia	86	80	45	30
Respiratory disease	125	117	64	34
Cancer	97	154	95	32
Environmental Perceived Problem				
Problem	3m	5m	10m	20m
Property value decline	206	189	98	34
Poor patronage	203	186	91	37
Reduced Private development	173	156	64	28
Vegetation destruction	118	106	64	28
Livestock destruction	98	96	55	28
Decrease in environmental quality	193	147	63	30

Source: *author field 2013*

The problems scaled are found to be more severe in areas closer to the mast compared to other areas. Mathematically it may be said that the listed problems varies inversely with distance to the erected masts. The severity of almost all the identified problems was found to be higher in the zone closest to the mast and the problems were observed to decrease outward the circle across zones 1 to 4. This further suggests that there is a high tendency that the closeness to mast is a strong enabling factor for the identified problems in the area.

The pathology of the health problems identified is all traceable to the listed physical problems. For instance, headache, insomnia, ear problems respiratory diseases and cancer are all traceable to one or a combination of loud noise, continuous vibration, and fumes/smoke. It was observed that, the difference in the incidence of health problems measured across the zones is not statistically significant at 95% confidence level. This may be interpreted in two ways: the incidence of the listed health problems is not a function of residents' closeness to the mast or that the health effects of the masts transcends the distance considered. However, it may be safer to go with the second school of thought. This is because in theory, continuous loud noise, vibration, and fumes may have connections with one of headache, insomnia, ear problems, etc. In essence, the effect of telecommunication masts even in the short run; reach farer a distance beyond 20 meters. Policy makers need to take issue from this and ensure the adequate buffering for the comfort and safety of residents in the city. Other environmental problems perceived by the residents were observed to be associated with the location of masts. For instance, property value decline, poor patronage, reduced private development of buildings, destruction of vegetation and livestock, etc were observed to be more in the zone closest to the mast and decreases across to the farthest zone from the mast.

Relationship between Resident's Livability and Closeness to Mast

The interval data arrived at from the Likert scaling was subjected to bi-variate correlation analysis using the Pearson Moment Rule. The objective here is to explain the relationship between variables of mast location and variables of residents' livability. All the interval scaled variables were subjected to bi-variate correlation, however only relationships that were specifies by the software to have statistical significance were extracted for further discussion. These are presented on the table below.

Table 3

SN	Relationship between	R	P value	Remark
1	Distance to mast and headache	.762	.004	Significant
2	Distance to Mast and Insomnia	.730	.007	Significant
3	Distance to Mast and Ear Impairment	.602	.012	Significant
4	Distance to mast and Nausea	-.596	.041	Significant
5	Distance to Mast and Cancer	.598	.044	Significant
6	Distance to Mast and Respiratory Disease	.446	.102	Insignificant
7	Length of stay with Mast and property Value Decline	.783	.002	Significant
8	Length of Stay with Mast and Poor Patronage	.633	.051	Significant
9	Length of stay with Mast and Livestock destruction	.453	.112	Insignificant

Source: Author's Field Survey, 2013.

Probably, the relationship that commands the greatest attention is the length of stay with mast, the distance of house from mast and severity of diseases. There was observed a very high correlation between short distance of houses to mast and both severity of headache (Correlation coefficient = .762, P Value = .004) and insomnia (Correlation coefficient = .730, P Value = .007). as both sicknesses correlates .902 (P Value = .000). Ear impairment correlates (.602) with distance to mast. These relationships are statistically significant at 95% confidence level. Cancer and closeness to mast has a weak relationship. Respiratory disease has a relationship with closeness to the mast so weak that it is statistically insignificant.

Nausea seems not to have any relationship with closeness to mast or staying around it for a long period of time. The correlation although shows an inverse relationship between % of respondent living with mast between 11-15 yrs and severity of nausea (r = -.596), which is significant at 0.05 levels with P value 0.041. This may be interpreted to be that the

closer to mast the less the incidence of nausea. However, since there is no theoretical medical explanation between the two, the correlation is regarded as spurious.

A relatively high correlation was observed between staying long around the mast and property value decline on the one hand; and patronage for property on the other. This connotes that prospective tenants prefer to stay at other places more than houses very close to the mast. It is possible that some are afraid of the consequences of staying in such appurtenance.

Planning Implication

- Most masts are erected anywhere in the area to improve the operator's economy without considering planning sites.
- Masts are erected very close to sensitive areas like residential, schools, health centres without obeying planning standards.
- The health of the people is at risk if the mast does not obey minimum setbacks and this is due to noise from mast generator and vibration from mast
- clustering of mast reduces the environment aesthetics

Therefore, from the above planning implication, mast location and clustering poses a great challenge to planners and policy makers. It is therefore advocated that planner should be given preference in the course of proper planning development projects like base station project to improve the health, safety and beauty of the environment.

RECOMMENDATIONS

The following preventive measures should be followed in order to make the environment and community safe from the effect of the mast:

- Many residences do not know the risk involved in living near a mast. Therefore public awareness should be made to the public about the effect of residing near a mast.
- Enactment of laws to greedy landlord: - many landlords are very inconsiderate; they just allow these telecom operators to fix their mast anywhere, not minding the side effect this can have on their tenant. Therefore, law should be enacted to land owners who lease their lands for the telecom operators for installing mast without obeying minimum standards
- Planning authorities should be notified before any erection of mast is made by telecom operators. EIA report should be done by the operators to know the risk and the importance of the development to the environment. Any telecom operator that fails to submit the EIA report should not be permitted.
- National Environmental Standard and Regulations Enforcement agency (NESTRA) should continue to shut down the facilities of the operator that does not comply with the EIA requirement.
- Telecom operators can come together to have one base station (mast) and each operator can connect with this base station. This reduces clustering of masts in the society

- Planning authorities should respond positively to telecommunication development proposal while taking account of the advice on the protection of urban and rural areas.

CONCLUSIONS

The study has been able to establish that there is health and environmental effects in the sitting of base stations (Telecommunication mast) in residential areas, schools and health centre. The study has therefore recommended that the need for proper planning of development projects cannot be over emphasized. It is therefore believed that, if the recommendations are worked upon, there will be a better, healthy, safe and beautiful environment.

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