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TELEMAST LOCATION AND ITS SAFETY IMPLICATION IN AN URBAN AREA OF OGUN STATE, NIGERIA

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Abstract

The study examined the growing concentration of telemasts and its safety implications in Ijebu Igbo area of Ogun State, Nigeria. Scanned, edge merged and updated topographic maps and satellite imagery of an updated Google Earth Pro data were used to create the database of Ijebu-Igbo with attributes such as telemasts of Globalcom, Mtn, Etisalat, Airtel and Nitel, roads, buildings, health facilities, police stations, fire station and boundary of the study area using Arc GIS 10.1. Results from the analyses showed that average household size is seven (7) and average height of the telemasts is 50m. Also, 35 buildings fall within 10m gap distance of National Environmental Standards and Regulations Enforcement Agency (NESREA). The database permits generation of shortest distance between locations, alternative distance in case of barrier and nearest health facilities to telemasts in case of disasters. In case of disaster, the likely number of people that may be affected ranged from 7 to 8,141. Increased teledensity is needed but siting of telemasts in public areas should be discouraged and when there is the need, the 10m gap of telemasts to buildings can be reviewed or complied with. More so, the use of Information Handling Service (IHS) sometimes called 'co-location' should be encouraged because it enables multiple use of a telemast by several GSM operators. It is also important that Environmental Impact Assessment be properly conducted in siting telemasts. More so, area of radiation of emission needs to be explored in order to examine costs effectiveness of erecting telemasts in public area.

Keywords: Telemasts; Safety Implications; Urban Area; Ogun State; Nigeria

Introduction

Location is the foundation of geographical investigation and its analysis has always presented challenging themes for practitioners of the discipline. The apprehension about location causes geographers to interpret the subject in terms of space and spatial relation because public and private facilities are not always located in the same place as the users. Thus, the spatial separations of facilities from the users sometimes involve the use of transport to overcome the separating distance. Hence, the choice of suitable location seems to spell the difference between success and failure (Ayeni, 2016).

Location as one of the fundamental geographic concepts is very important decision in supply chain strategy of any company because it determines access to goods and services which in turn affects the well-being of individuals, communities and nations (Samuel, 2016). Almost every enterprise in the private and public domains faces the problem of strategically locating facilities to provide services to consumers in a manner that facilitates access or coverage while minimizing the cost of providing such facility or service (Lea & Simmons, 2000; Murray, 2003; Tong & Murray, 2009).

Locational matters are important to households, organizations and entrepreneurs who are in constant process of decision making. Households for instance, want to select a home or take a mortgage, choose a school for the children, or meet other daily chores. Entrepreneurs and organizations may want to site new industries and commercial activities, Governments at various levels are constantly taking decisions on where to place

economic activities and public facilities and services (Samuel, 2016).

In the literature, the distinction between public and private location decisions is highly significant as it clearly defines the goals that drive location decision making under different regimes which in turn determine patterns of location and access to services. Teitz (1968) in an attempt to draw a line between public and private location, he observed that public facility location is driven by welfare and equity considerations, given the available resources while profit maximization and competitive advantage are some of the drivers of private location decisions.

In Nigeria, the telecommunication facilities were first put in place by the colonial administration in 1886 when a cable connection was established between Lagos and colonial office in London (Raji, 1998; Onakoya, 2012). Until deregulation of the industry, the Nigeria telecommunication facilities were one of the poorest in the world (Ndukwe, 2006). The privatization of Nigerian telecommunication introduces competitiveness most especially in infrastructure and particularly the mobile telecommunication segment. The liberalization of the telecommunication industry has also led to rapid growth and expansion. The telephone subsector of the industry has been a major beneficiary. Several mobile telecommunication companies emerged and these include MTN, Globalcom known as GLO, Econet whose name changed from Vodacom to Zain and now Airtel, Etisalat, Visafone currently acquired by MTN, ZOOM, Multilinks and Starcomms amongst the lot. These companies have increased the citizens' access to telephone services. In addition, it provides a variety of telecommunication services such Ethernet, Short Messages Services (SMS) and Global System of Mobile Communication (GSM) and mobile banking.

Telecommunications services in Nigeria are mostly delivered through the global system of mobile telecommunication (GSM) privately via personal mobile phones or publicly via call centres. Call centres here are taken to comprise established 'Business Centers' which combines telephony with computer services and the make shift 'Call Centers' and foldable umbrella. They also include the government-sponsored telecommunication centres with computer, call and internet services (Community Communications Centres). All of these services are largely dependent on the availability and quality of mobile telecommunications signals in the area, itself a function of the distance that separates the prospective users from the nearest Base Transceiver Station (BTS). In many practical applications, service areas are not necessarily circular, as terrain, transportation, and service characteristics of the facility often result in irregular shape (Samuel, 2016).

Huge growth has also been recorded in telecommunication density from 0.71% in 2001 to 63.11% in 2010 and 96.08% in 2014 (Ajanaku, 2014). The average rate of growth the telecommunication sector over the last two decades specifically from 1986 to 2010 was 16.3% (Baez, 2010). The Nation (2015) observed that the teledensity of the country's telecommunications industry increased from 103.91% from April to 104.69% in May with 0.78% increase in teledensity. Despite the role of telecommunication industry particularly the Global System of Mobile Communication (GSM), the indiscriminate location of base stations in residential areas especially in urban areas can be described as chaotic.

In a country like Nigeria where mobile technology accounts for the largest proportion of all ICT services, Ndukwe (2006) observed that mobile telecommunications is the most important segment of Nigerian telecommunications industry, accounting for more than 85% of the total active lines. In spite of the growth and improved access to telecommunication services in Nigeria (Ndukwe, 2006; ITU, 2008) and government's avowed commitment to the goal of universal access (USPF, 2007), there exist enormous challenges in increasing erection of telemasts in and around Nigeria urban space.

There is actually 'a place for everything', but one cannot underscore the importance of finding the right place for the right thing and at the right time for a healthy and orderly world. The objective of locational analysis can be viewed from two perspectives. The first is that, given a location, what is the best use for the given location? The second perspective is that for a given particular activity, where is the best location for the said activity (Ayeni, 2016; Samuel, 2016)? The significance of mobile phone is immeasurable. However, there is the need to strike a balance to such development because while profit maximization is essential to private investors in telemasts location, compromising the safety of human lives should not be tolerated (Raji, 2014).

In the UK for instance, Bree (2001) discovered that people are now demanding that authorities should impose minimum safety distances for mobile

telephone masts from public buildings, schools, housing and work places. He stressed that there was growing public concern relating to the possible health risks associated with mobile phone telecommunications masts and people are vehemently oppose to its erection in residential areas. He observed that there was fear regarding the electromagnetic radiation given off by communication masts and as each month passed, with additional scientific information becoming available, there was very good reason to understand the need for caution in erecting telemasts in residential areas.

Brighton & Hove City Council (2003) observed that research into the potentially harmful effects of radiation emitted from telecommunications masts is ongoing and incomplete. The results of the researches to date have been at best, inconclusive. Local residents, therefore, hold legitimate concerns about the ease with which mobile phone companies are able to get permission to site masts in residential areas, often close to schools and hospitals. For instance, they noted that in 2003 in Hampshire in the UK, a Judge revoked the permission of Hutchinson 3G to erect a 40-foot mast 22 yards from the front door of a 27 year old pregnant woman. Brighton and Hove City Council (2003) further resolved that planning officers should be guided to take potential adverse health effects of residents into account when making recommendations on the siting of telecommunications masts.

In Nigeria, before the advent of Global System for Mobile Communications (GSM) in 2001, there were communication masts erected by internet service providers (ISPs), banks, and government agencies, for the purpose of transmitting and receiving communication signals. But the licensing of GSM to operators such as MTN and ECONET (now Airtel) in 2001, GlobalCom in 2003, and Etisalat in 2009, automatically increased the number of communication masts, when the operators embarked on erecting individual masts in large numbers. Okonji (2013) observed that Nigeria has over 25, 000 erected masts from GSM operators alone and they are all littered across the airspace, combined with that of the ISPs and banks.

Increasing number of communication masts in the Nigeria airspace, has no doubt, increased the dangers that are associated with telemasts. Collapse of communication masts across the country thus; pose threat to lives and property. Vanguard in Business (2009) noted that the Federal Ministry of Environment had observed the increase in the telemasts and stressed the need for adequate inventory of existing telecommunications masts and base stations in the country. The ministry also called for proper Environmental Impact Assessment (EIA) on new installations in accordance with the law and 10m gap distances. It was argued that though the telecommunications industry had impacted positively on the economy and lives of the country in the last fifteen years. However, this achievement should not be allowed to hamper people's health and the environment which is more in line with sustainability concept of balancing the social, economic and environmental aspects of development.

Although, there are studies in the area of telecommunication in Nigeria, but most of these studies focused more on telecommunication and travel (Oyesiku, 1990; Adeniji-Soji, 1995; Solanke, 2005; Osoba, 2011) to mention but a few. Oladiti (2007) and Ishola (2012) however, use geographic information system (GIS) to examine mobile phone location as new and appropriate methodology to analyze urban mobility; assessment of base station of service providers; and the coverage area of the service providers respectively. But many of these studies failed to look at the locational implication of telemasts of the service providers on the safety of residents' properties. Thus, analysis of locational pattern of telemasts in Ijebu-Igbo community (an emerging urban centre) with rural surroundings where little attention is drawn to safety of the residence by observing the 10m distance to buildings in Ijebu-North Local Government Area of Ogun State Nigeria is an attempt to contribute to telecommunication masts safety literature using GIS.

Materials and Methods

The Study Area

The study area is situated in Ijebu North Local Government Area which is part of the 20 Local Government Areas of Ogun State, Nigeria with a landmass of 13,394 hectares was created in 1976 (Figure 1). Federal Government of Nigeria Official Gazette (2007) places the estimated population of the local government area to be 284,336. The local government area is majorly inhabited by the Ijebu subgroup of the Yoruba. There are many petty traders in the local government area and these traders trade in farming products (kolanut, cocoa and oil palm produce), processed leather for consumption,

transportation business, quarrying and lumbering in commercial quantities. The local government area comprises of notable communities such as Ijebu-Igbo, Ago-Iwoye, Oru, Ilaporu, Awa, Mamu and their rural communities.

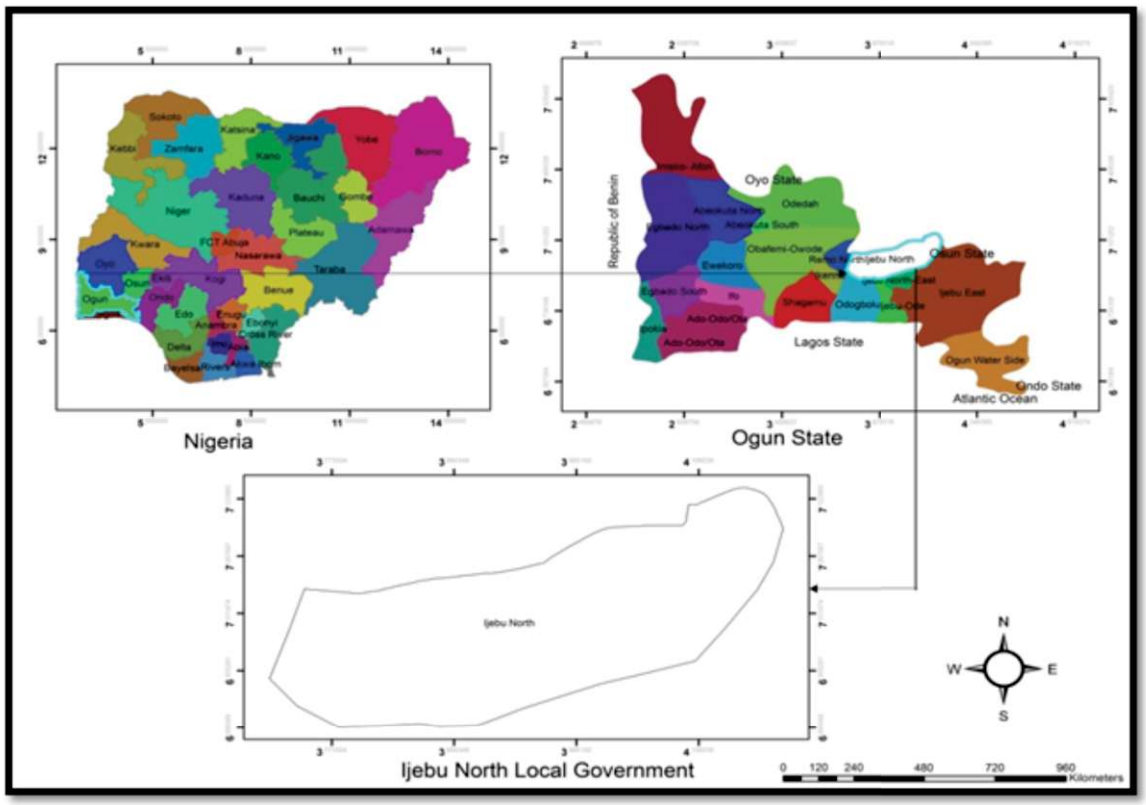

Figure 1: Maps of Nigeria, Ogun State and Ijebu North Local Government Area

The study area (Ijebu-Igbo) is the Local Government Area headquarter (Figure 2). It is located between latitude 6º.5 and 7ºN and between longitude 3º.451 and 4º.051 (Odumosu, 1992). The choice of Ijebu-Igbo is based on its development as urban centre with growth rate of 2.6 % and over 120,000 inhabitants with rural surroundings (Asiyanbola, Raji & Shaibu, 2012). The modest growth rate of the town can be attributed to its locational advantages. It is located 5km away from Ijebu-Ode – Ibadan highway and 30 kilometres away from Sagamu – Benin expressway while the nearest railway station is about 50 kilometres away from Ibadan.

The town is majorly residential with the central business district at the centre. It is well served with other minor roads and one major trunk B interstate road (Oba Adeboye road) which spans the whole length of it (Figure 2). Houses in Ijebu-Igbo are dominated by traditional compound types which are now broken into small, detached houses. Owing to the abundant laterite in the locality, mud is the main material for building walls; storey buildings adorn the landscape here and there giving the city an amorphous shape of red roof houses of varying heights and sizes. At the periphery of the city, modern buildings of cement block walls with asbestos roofs are springing up. They give some form of modern outlook to the city.

The town can boast of modern amenities such as electricity, pipe-borne water, automatic telephone exchange and the largest abattoir in Ijebu land (Asiyanbola et al., 2012) Most houses in Ijebu-Igbo were 'owner-occupied' with average household of seven (7) but the nomenclature changed when an annex of Olabisi Onabanjo University (formerly Ogun State University) was located at the community (Raji, 2014). The influx of university students has raised the social life of the city. Increasing facilities such as Technical College, Polytechnic, banks and several petrol stations, the telecommunication service providers (GLO, MTN, ETISALAT, AIRTEL) also seized the opportunity by erecting their telemasts at various locations in the community.

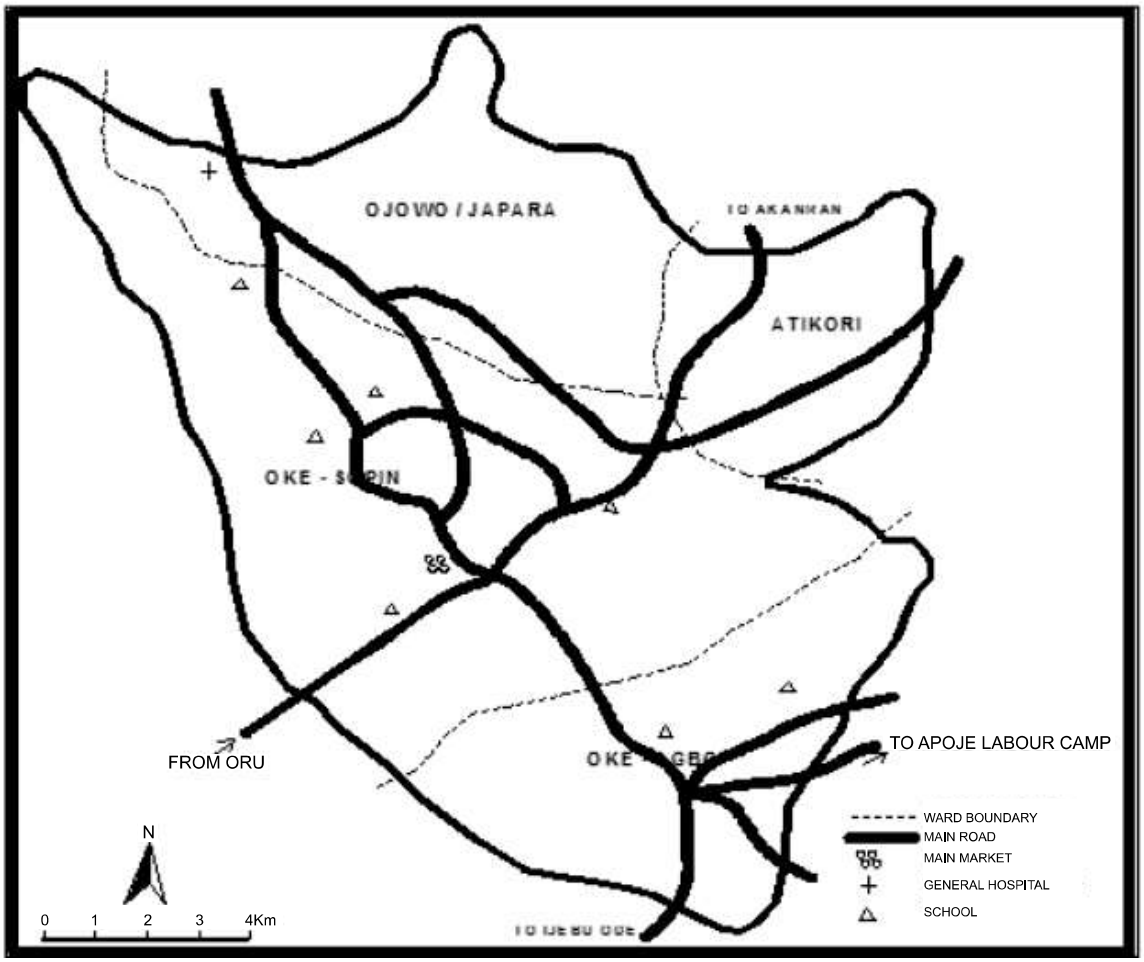

Figure 2: Map of Ijebu Igbo

Methods

The study was carried out with the help of fifteen research assistants. All the telecommunication service providers' telemasts in Ijebu-Igbo were surveyed. At the time of survey, there are five service providers and twenty two (22) telemasts (Table 1). The service providers are Air Telecommunication, Etisalat, Global Communication, Mobile Telecommunication of Nigeria and Nigeria Telecommunication with abbreviation AIRTEL, ETI, GLO, MTN and NITEL respectively The official colour of AIRTEL is red, ETI (deep green), GLO (light green), MTN (yellow) and NITEL adapted blue. NITEL owned by the Federal Government of Nigeria, has been moribund. This explains its non-functionality but had to be captured in the survey because their infrastructure especially mast is still in place and its risk potential not diminish (Table 1).

Leica Differential Global Positioning System (DGPS) was used to obtain the coordinates of telemasts, hospitals, clinics, police stations and fire stations in the community. The heights of the telemasts were measured with the aid of Leical Disto 3 dimensional laser distance touch measurement. Name, address and GPS coordinates of the telemasts are presented in Table 2.

Satellite image of the study area was captured through updated Google Earth Pro at 25m resolution and 200m scale. Topographic Maps of Ijebu-Ode NE (Sheet 280 NE; Scale 1:50,000) of year 1964 and Ijebu-Ife NW (Sheet 281 NW; Scale 1:50,000) of year 1966 from the Office of Surveyor General of Federation contained Ijebu-Igbo community. The topographical sheets were edge merged and scanned in order to provide base map for the study. Google Earth Pro images captured were mosaic and georeferenced. Roads and buildings were digitised. Thus, the shape files of roads, buildings, telemasts, health clinics and Ijebu-Igbo area boundary were generated using ArcGIS 10.1 (Figure 3).

Table 1: Telecom Service Providers and their functionality in Ijebu-Igbo

Name of Service Provider	Total Number of Telemast	Abbreviation	Official Colour	Functionality
AIR TELECOMMUNICATION	1	AIRTEL	Red	Functional
ETISALAT	3	ETI	Deep Green	All functional
GLOBAL COMMUNICATION	10	GLO	Light Green	All functional
MOBILE TELECOMUNICATION OF NIGERIA	7	MTN	Yellow	All functional
NIGERIA TELECOMMUNICATION (NITEL)	1	NITEL	Adapted Blue	Not Functional

Source: Field Survey

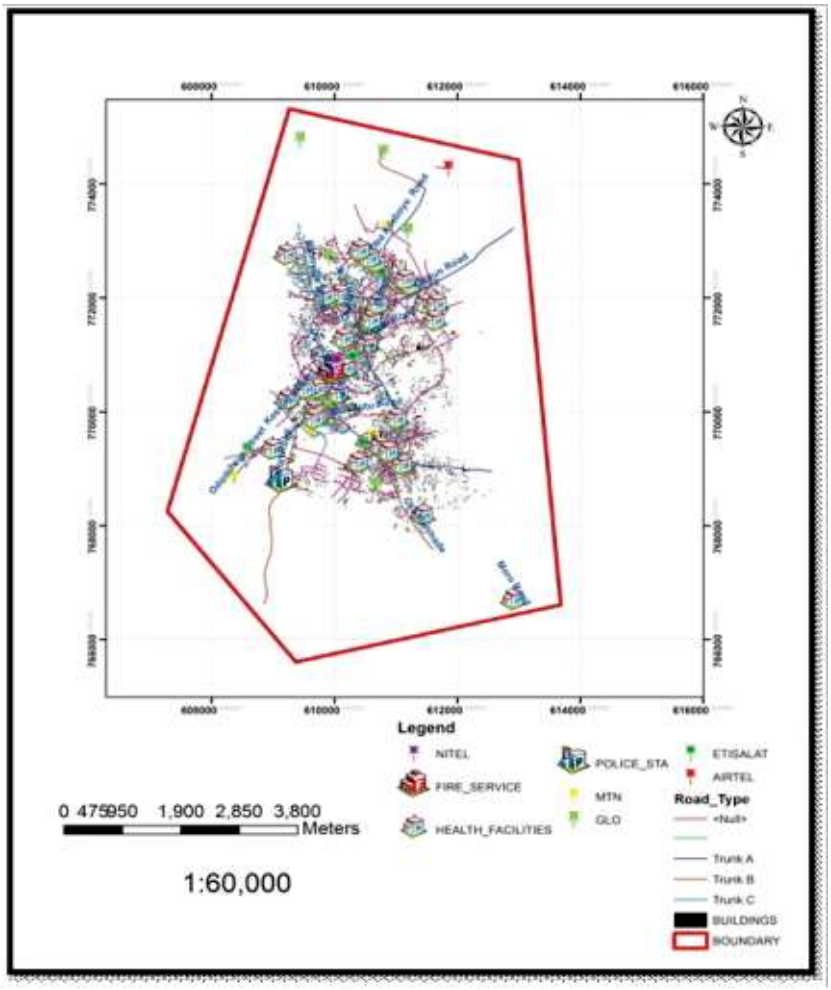

Figure 3: Composite map of Ijebu Igbo

Table 2: Name, address and GPS coordinates of telemasts of the Service providers in Ijebu-Igbo

NAME	ADDRESS	GPS COORDINATES	
		X	Y
GLOBALCOM			
GLO - 1	Abraham Adesanya Polytechnic	774754	609443
GLO - 2	Erigboro Village Oke Sopen	780913	621137
GLO - 3	Molete Street	773088	611218
GLO - 4	Dopelu Titun Road	772595	609995
GLO - 5	Oba Adeboye Road	771524	610676
GLO - 6	Olad Hospital Street	770240	609268
GLO - 7	Chief Obafemi Awolowo Avenue East	770037	6100145
GLO - 8	Molusi College Road	769657	611148
GLO - 9	Laide Fowosere Street	769253	608663
GLO - 10	Oke Moro Street	768706	610687
MTN			
MTN - 1	Orita Atikori	773222	610853
MTN - 2	Off Oba Adeboye Road	771826	610628
MTN - 3	Ogungbo Street	770649	610282
MTN - 4	Ansarudeen Central Mosque Street	769586	609712
MTN - 5	Oseni Street	769644	609857
MTN - 6	Abraham Adesanya Street	769436	610726
MTN - 7	Ododoroye Street	770126	608587
ETISALAT			
ETI - 1	Oba Adeboye Road Oke Ife Atikori	772206	610890
ETI - 2	Oba Adeboye Road Church Olokuta	770795	610385
ETI - 3	Oyebola Street Opposite St. John's Primary School	769276	610528
AIRTEL			
AIRTEL	Ijebu – Igbo Oba Akran Road	777034	612411
NITEL			
NITEL	Obafemi Awolowo Avenue Central	770733	610172

Source: Field Survey

Geographical analyses employed on data obtained include buffering and network operations. The operations were captured in Arc MAP environment in order to examine the number of telemasts that violated the 10m distance set by NESREA and the likely safety implications in case of accidental fall on the buildings and roads of Ijebu Igbo community.

Results and Discussion

Buffering Analysis and Violation of Distance Standard

Buffering analysis is mostly used in vector-based GIS to determine the extent of influence of a facility from the target area. The buffer distance can vary according to the values of a given field and a feature may have more than one buffer zone and the distance units can be in meter, feet, kilometer, etc.

In this study, a buffer of radius 10m to 60m was generated in Arc Map environment from each of the telemasts in order to determine the number of buildings that falls within specified radius. The choice of 10m to 60m radius range is based on (i) NESREA specified 10m distance of telemasts from buildings, (ii) the average height of telemasts in the study area is 50m and in case of accidental fall, we assume the multiplier effects of the likely distance of damage will be more than 50m.

Figures 4 and 5 show buffering analysis involving GLOBALCOM telemast tagged GLO-5 (see Table 1). Figure 4 however, shows analysis process of10m buffering from GLO-5.

The result of the operation in Figure 4 generates the result in Figure 5. In Figure 5, the result shows that two (2) buildings fall within the 10m radius and this implies that GLO-5 of GLOBALCOM violates the 10m distance gap regulation of NESREA to buildings.

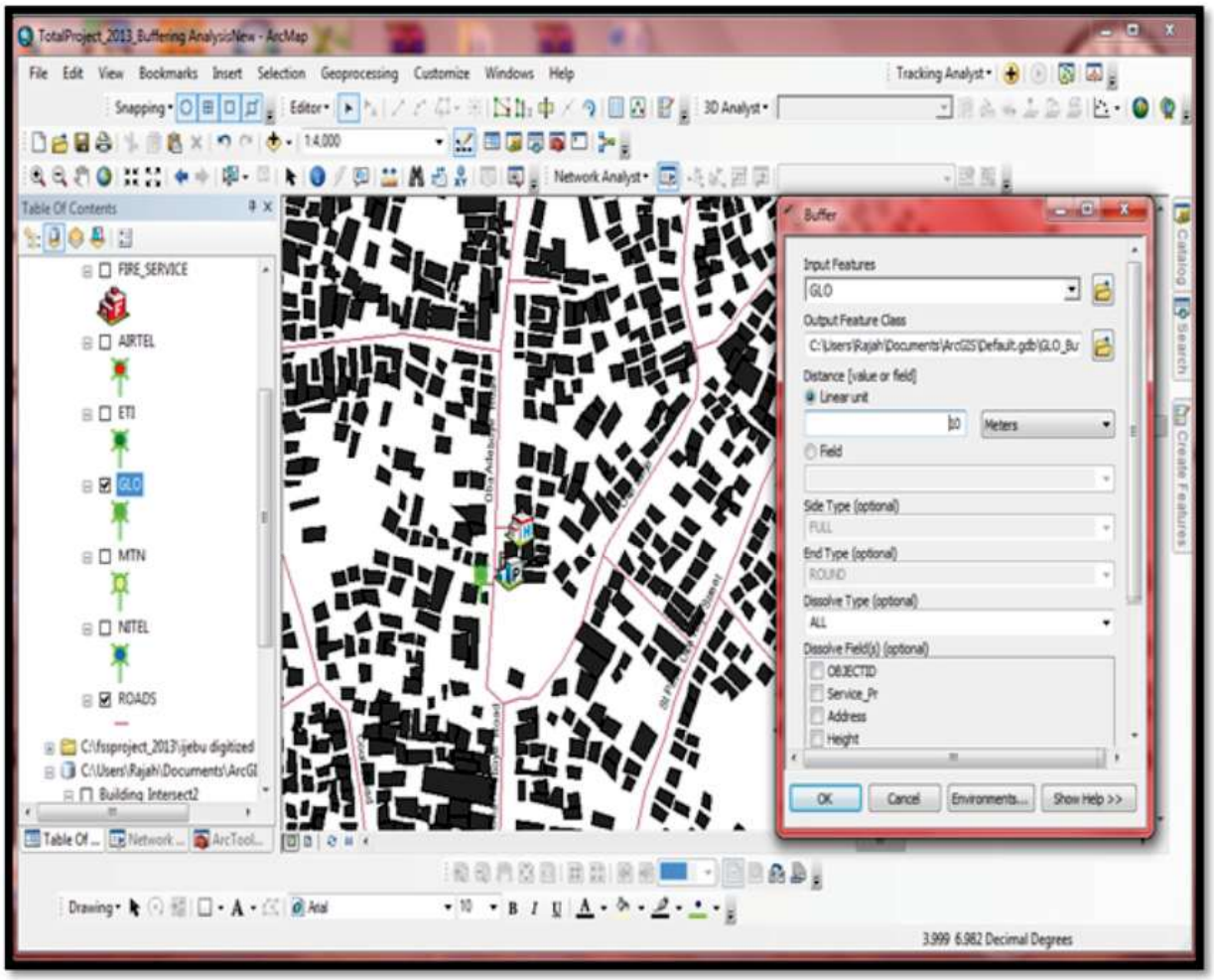

Figure 4: Operation of 10m Buffer from GLO-5

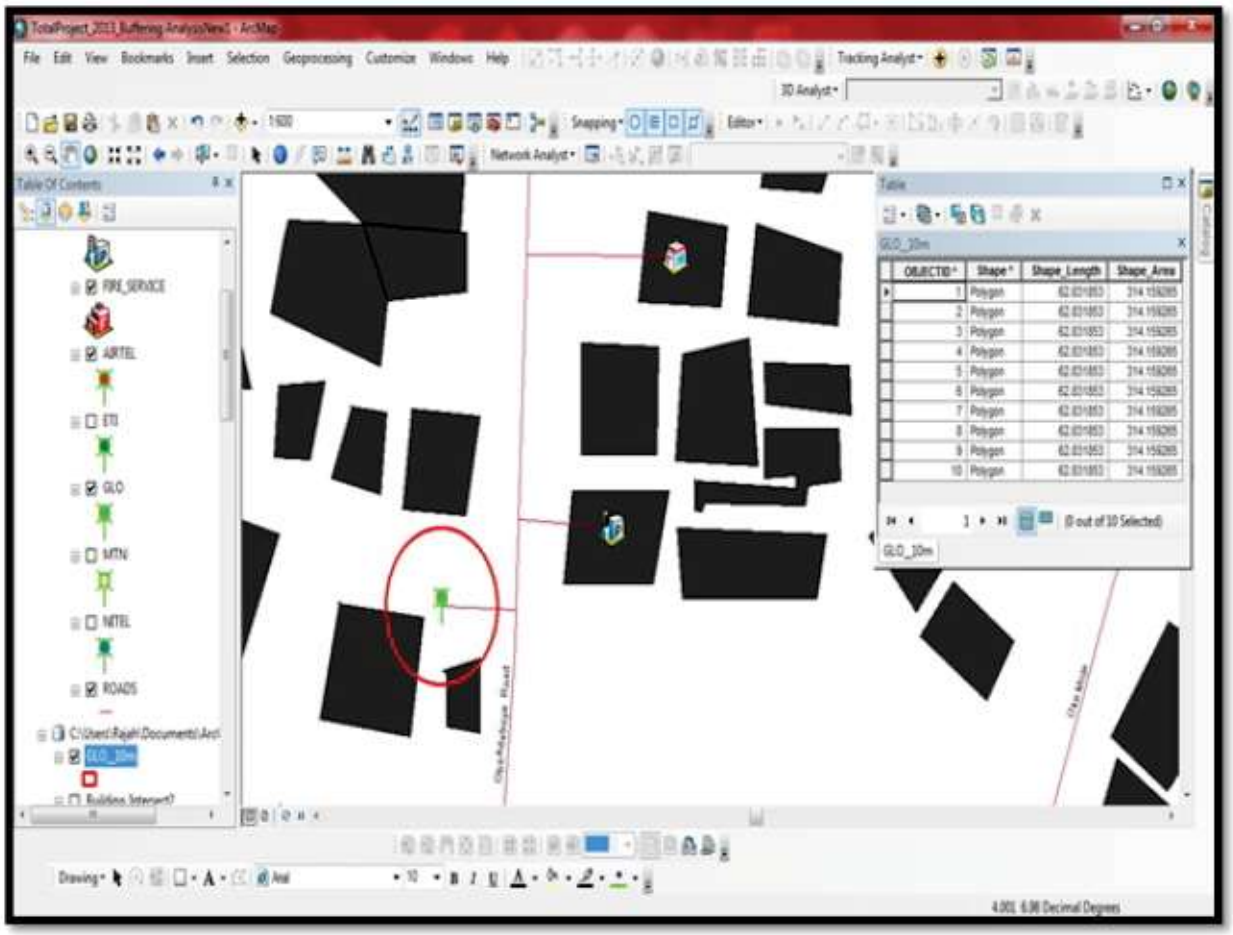

Figure 5: Result of operation of 10m Buffer from GLO-5

Tables 3 thus summarized the number of buildings and roads that fall within the 10m to 60m range of each telemast of GLOBALCOM after performing buffering analyses on each of the telemast based on NESREA distance of 10m gap of telemast from buildings and public areas. Table 3 shows that eight (8) of the ten (10) (80%) GLOBALCOM telemasts violates the 10m requirement. The telemasts involve include GLO -3, GLO-4, GLO-5, GLO-6, GLO-7, GLO-8, GLO-9 and GLO-10. Thus, GLOBALCOM operates its masts in Ijebu-Igbo with 80% default level.

In the case of MTN, Table 4 shows that 14 buildings were affected in the study area and six of the seven MTN telemasts violated the 10m gap. MTN therefore operates its telemasts at 86% default level. Regarding ETISALAT, all the telemasts (100%) violate the 10m gap with a total number of 5 buildings involved (Table 5). In the case of AIRTEL, no building is involved and for NITEL, 2 buildings are involved (100%) and it violated the 10m gap (Table 6).

Table 3: Number of Buildings and Roads within 10m to 60m radius of GLO Telemasts

S/No	Service Provider	10m	20m	30m	40m	50m	60m
1	GLO-1	-	-	-	-	-	-
2	GLO-2	-	-	-	R	R	R
3	GLO-3	B	3B+R	3B+R	4B+R	6B+R	6B+R
4	GLO-4	3B	6B+R	5B+R	8B+R	8B+R	16B+R
5	GLO-5	2B	6B+R	8B+R	11B+R	17B+R	23B+R
6	GLO-6	B	2B	3B+R	4B+R	6B+R	7B+R
7	GLO-7	3B	5B+R	8B+R	14B+R	23B+R	33B+R
8	GLO-8	3B	6B+R	9B+R	16B+R	21B+R	29B+R
9	GLO-9	B+R	10B+R	12B+R	21B+R	28B+R	33B+R
10	GLO-10	-	2B	3B	7B	9B	5B+R
Total		**14B+R**	**40B+6R**	**57B+7R**	**100B+8R**	**150B+8R**	**152B+9R**

Source: Authors' Field Survey

Where: B = Building and R = Road

Table 4: Number of Buildings and Roads within10m to 60m radius of MTN Telemasts

S/No	Service Provider	10m	20m	30m	40m	50m	60m
1	MTN-1	-	B	2B	3B+R	5B+R	5B+R
2	MTN-2	3B	5B	11B	13B	21B+R	26B+R
3	MTN-3	2B	6B+R	10B+R	21B+R	28B+R	33B+R
4	MTN-4	2B+R	4B+R	7B+R	9B+R	16B+R	18B+R
5	MTN-5	2B+R	2B+R	4B+R	7B+R	18B+R	20B+R
6	MTN-6	3B	6B	8B+R	12B+R	18B+R	22B+R
7	MTN-7	2B	2B+R	5B+R	5B+R	10B+R	10B+R
Total		**14B+2R**	**26B+4R**	**47B+5R**	**72+6R**	**116B+7R**	**134+7R**

Source: Authors' Field Survey

Table 5: Number of Buildings and Roads within10m to 60m buffer of ETISALAT Telemasts

S/No	Service Provider	10m	20m	30m	40m	50m	60m
1	ETI-1	B	2B+R	4B+R	5B+R	13B+R	23B+R
2	ETI-2	B	4B	7B+R	15B	17B+R	23B+R
3	ETI-3	3B	8B	10B+R	18B+R	20B+R	32B+R
Total		**5B**	**14B+R**	**21B+3R**	**37B+2R**	**44B+R**	**78B+3R**

Source: Authors' Field Survey

Table 6: Number of Buildings and Road within10m to 60m buffer of AIRTEL and NITEL Telemasts

S/No	Service Provider	10m	20m	30m	40m	50m	60m
1	AIRTEL	R	R	R	R	R	R
2	NITEL	2B	2B	4B+R	4B+R	11B+R	13B+R

Source: Authors' Field Survey

From these analyses, it is obvious that the telecom providers operate their masts between 80% to 100% default level. This is indeed instructive and risky. However, by extension the potential threat is higher at further radius.Table 7 thus provides a summary of buildings that are within 10m to 60m radius of the telemasts providers. A total of one thousand one hundred and sixty-three (1,163) buildings fall within 10m to 60m radius of the telemasts of the service providers (Table 7).

Table 7: Summary of the Total Number of Buildings that falls within 10m to 60m radii

BUFFERING VALUE	MTN	GLO	ETI	NITEL	AIRTEL	TOTAL
10m	14	14	5	2	-	35
20m	26	40	14	2	-	82
30m	47	57	21	4	-	129
40m	72	100	37	4	-	213
50m	116	150	50	11	-	327
60m	134	152	78	13	-	377
TOTAL	**409**	**513**	**205**	**36**	**-**	**1,163**

Source: Authors' Field Survey

In case of accidental fall of the telemast and possible victims, there may be the need to move victims to the nearest health facilities. Therefore, the next section discusses network analysis with respect to the likely closest health facilities that can be accessed and the likely safety implication.

Network Analysis and Safety Implications of the Telemasts

Network analysis in GIS is applicable in the area of pipeline, electricity, road and so on. Regarding road network, the analysis helps in generating details about road network of which include the length, shortest and alternative routes to different facilities and nearest facilities to a particular incidence. In this study, the length and names of streets in the study area were created and shortest distance between two locations can be generated. Also, nearest facilities to a given location can be determined.

In case of accidental fall of any of the telemasts, there is the need to evacuate injured people to the nearest medical facility. Applying network analysis to the safety implication of the telemasts, the database created for the study is such that the nearest medical facilities can be located from each of the telemasts. For instance, Figure 6 is GLOBALCOM telemast tagged GLO-4 and four health facilities such as Japara Health Centre, Ijebu Igbo General Hospital, Oluwatunmise Trado-Medical Clinic and Tolulope Clinic and Maternity Home were the four (4) health facilities picked (Figure 6). A query of two (2) closest health facilities to GLO-4 telemasts was inputted in the layer property (Figure 7) and the result of the analysis was displayed in Fgure 8. Figure 9 then shows the direction, total length of the two closest health facilities in order of shortest distance and they are:

(I) Ijebu-Igbo General Hospital 657.7m

(ii) Oluwatunmise Trado-Medical Clinic 749.8m

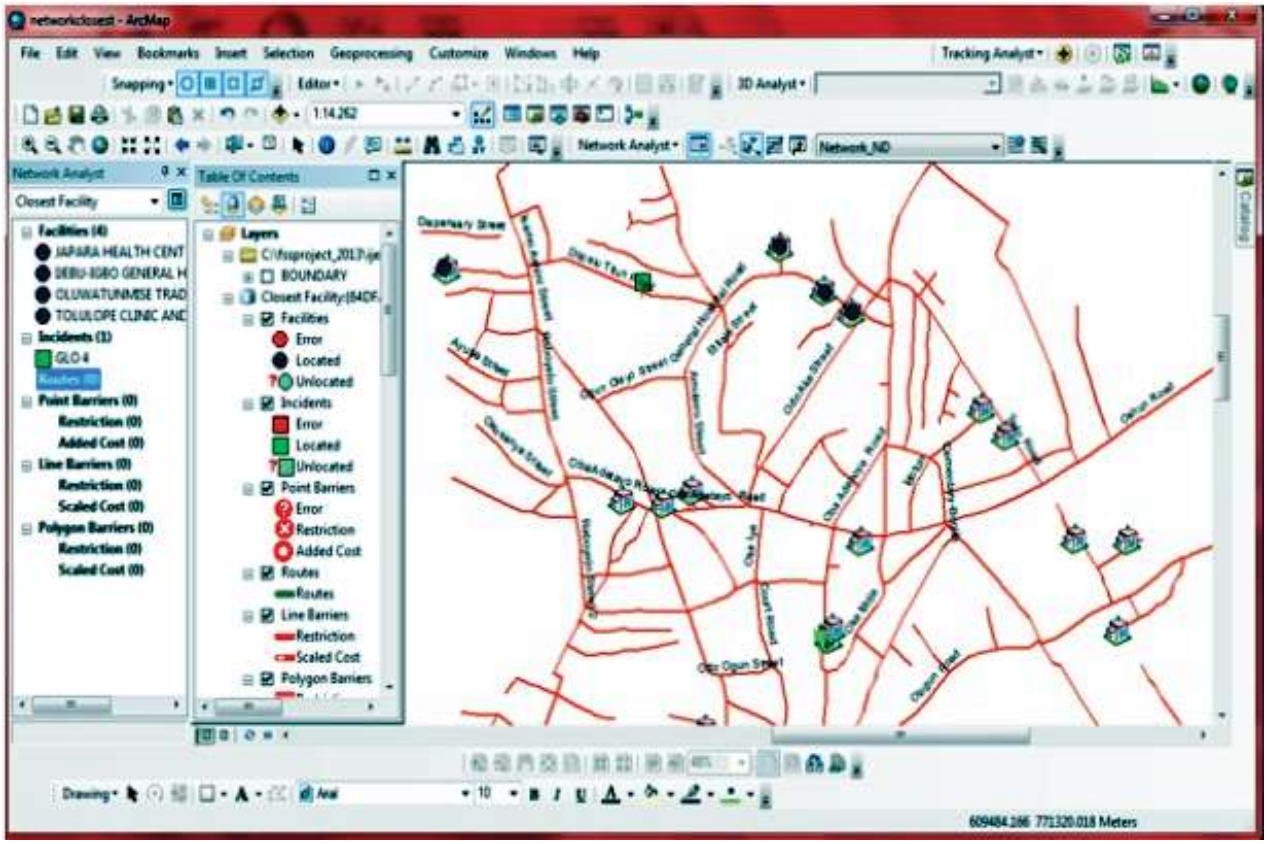

Figure 6: GLO-4 Incident Telemast for four Health Facilities

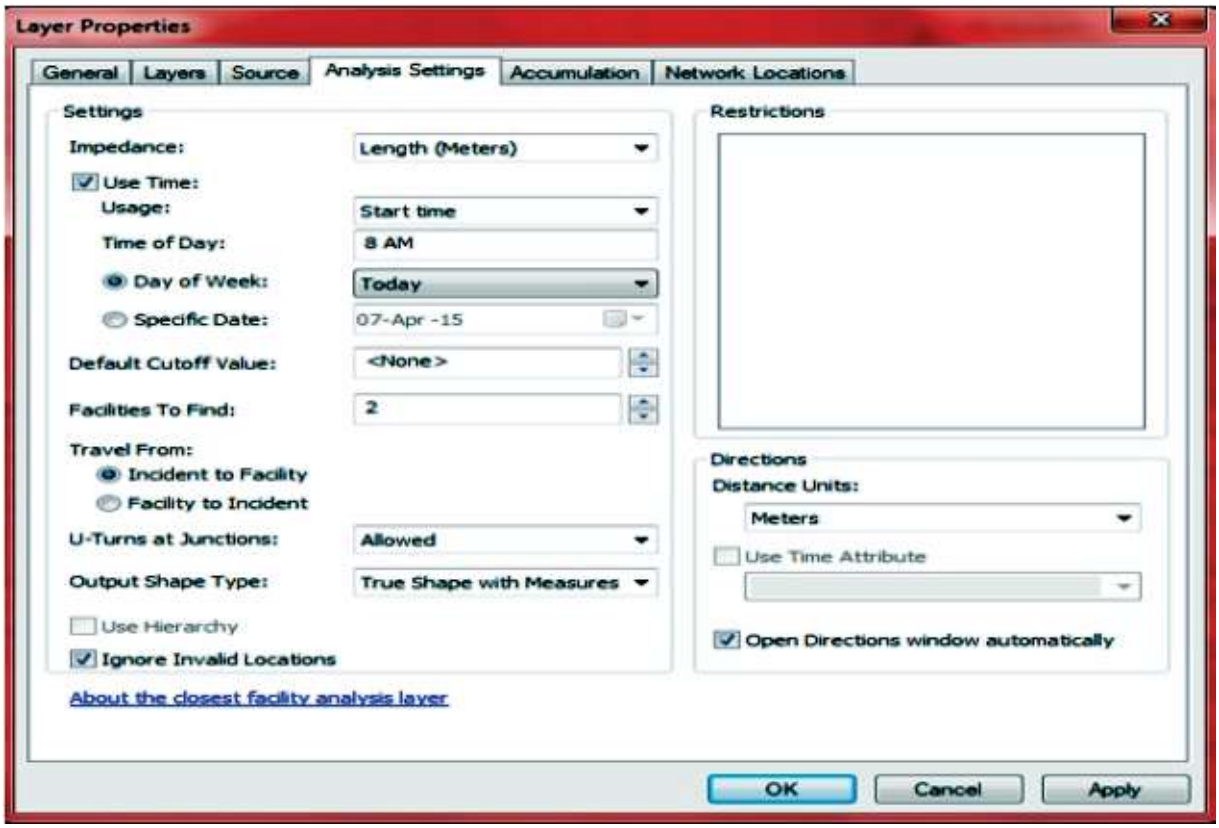

Figure 7: Incident Analysis inputted for two (2) Closest Health Facilities

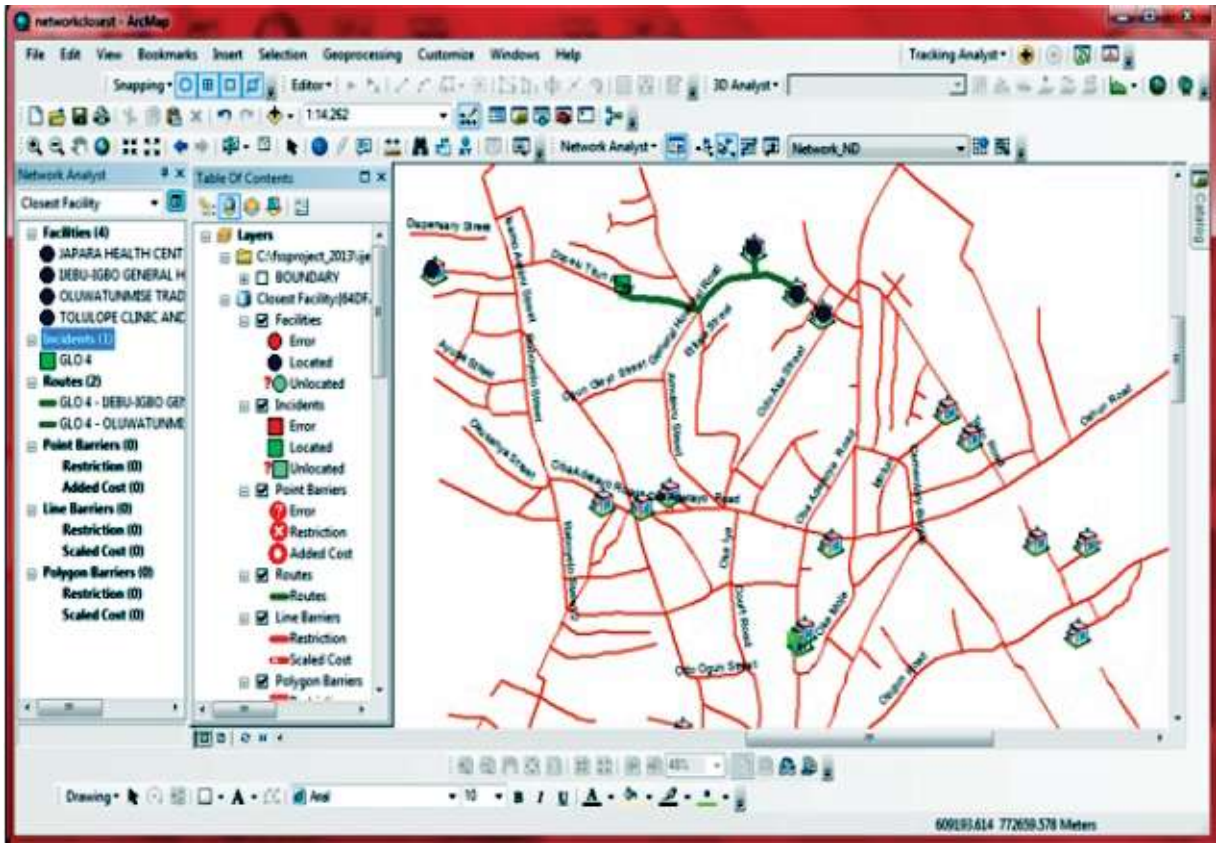

Figure 8: Two closest facilities to GLO-4 Incident Telemast

Figure 9: Direction and Distance to cover to the closest Health Facilities

In terms of area coverage or spatial extent, GLOBALCOM has the highest number of telemasts in the study area and as expected it also has the largest coverage area (Figure 10). MTN is GSM provider that has the second largest number of telemasts and has larger coverage than ETISALAT, NITEL AND AIRTEL in that order. Although, NITEL is not functioning, it coverage area from the analysis showed that it covers the central part of the study area while AIRTEL is skewed to the outskirt of the study area.

Based on buffering analysis, accidental fall of any of the telemasts may probably affect one or more buildings. In the study a residential building was observed to have an average of seven (7) household and with reference to Table 7, a 10m distance in case of an accidental fall of GLOBALCOM telemasts, may likely affect seven (7) to ninety eight (98) members of the household. Similarly, the same numbers of household are likely to be affected by accidental fall of MTN telemast. Regarding ETISALAT, numbers of household that are likely to be affected ranged from seven (7) to thirty five (35). No casualty is likely to be recorded by AIRTEL telecommunication fall. But NITEL telemast may likely affect seven (7) to fourteen (14) members of household.

The total number of buildings captured from digitized imagery of the study area was 11,346 and the total number of buildings that falls within 10m to 60m radius of the GSM providers is 1,163 (Table 7). The number that falls within 10m to 60m radius (1,163) representing 10.3% of the 11,346 buildings captured in the study area and this places the probable number of vulnerable residence to eight thousand one hundred and forty-one (8,141).

GLOBALCOM has wider coverage as shown in Figure 10 and this can be attributed to the number of telemasts of the service provider which is more than other service providers' telemasts in the study area. It can be assumed that in terms of accidental fall, GLOBALCOM telemasts may have higher probability of causing damages to lives and properties in the range of 10m to 60m distance discussed in the study.

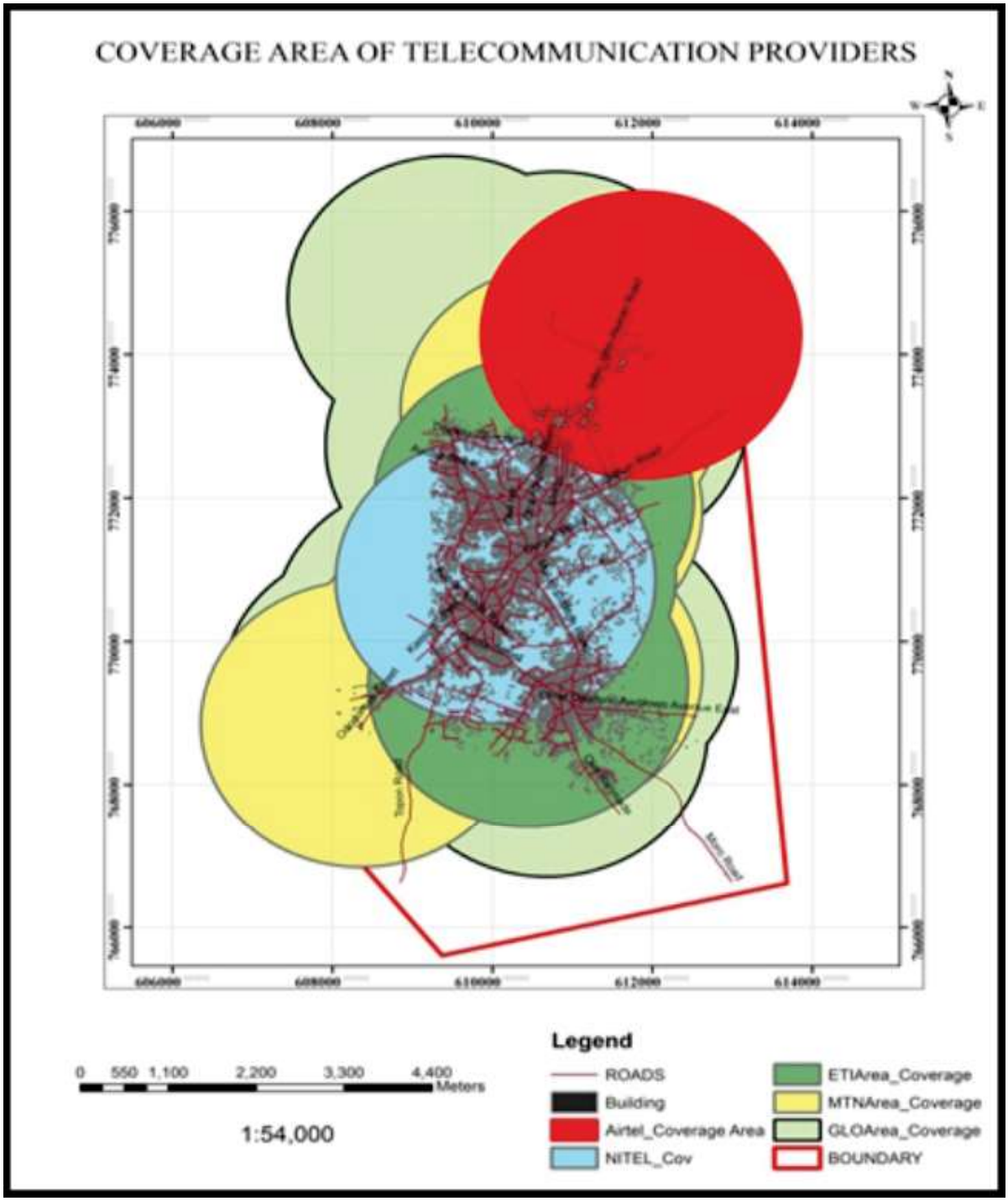

Figure 10: Coverage Area of GSM Providers

Conclusion and Recommendations

The liberalisation of telecommunication sector of Nigerian economy in 1992 and the subsequent take-off Global System of Mobile Communication (GSM) in 2001 has revolutionised Information and Communication Technology industry in the country. However, there is the need to strike a balance on the need and safety of the people and indiscriminate location of telemasts of GSM providers in Ijebu-Igbo community in Ogun State.

From the study, a spatial database of features such as telemasts, health facilities, police stations roads in the study area were created and spatial analyses such as overlay, buffering, network and measurement were made. The study shows that most of the telemasts violated 10m radius of the masts

from buildings. In case of accidental fall of a telemasts, there is likely destructions to lives and property in the study area. Thus, it is recommended that siting of telemasts in public areas should be discouraged, and when there is the need, the 10m gap to buildings should be reviewed. This is because 10m radius is too small when considering the height of the telemasts and knowing the extent of damage it can cause on people's life and properties in case of accidental fall.

More so, the use of Information Handling Services (HIS) sometimes called 'co-location' or masts sharing should be encouraged. IHS enables multiple use of telemasts by several GSM operators and someway in remote locations which help to protect indiscriminate siting of telemasts and as well improves aesthetics of our rural and urban spaces.

It is also important for the government officials to conduct critical appraisal of Environmental Impact Assessment (EIA) of telemasts and site visitation by government agencies in charge of safety must be carried out to ensure compliance. Regulatory agencies should also increase their monitoring systems in semi-urban area and rural areas where there may likely be deviant to rules of siting telecommunication masts. More so, fifteen years stipulated by law to validate the good state of telemasts is year 2016.Thus, it is the responsibility of National Environmental Standards and Regulations Enforcement Agency (NESREA) to ensure that the telemasts undergo maintenance or defective test. In addition, aspect of radiation of emission that is assumed to have health risks to residence through ionising requires exploration so as to examine the costs effectiveness of erecting telecommunication masts in residential area.

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