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Mapping of Telecommunication Mast Utilities in Auchi, Nigeria

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ABSTRACT

The socio-economic growth of cities around the world is significantly influenced by telecommunication. In order to take advantage of telecommunications, numerous cities in developing nations across the globe are now extending their telecommunications infrastructures, particularly in the field of the global system of mobile telephony (GSM). In light of the foregoing, this study assesses the significance and positioning of telecommunication towers near Auchi town in the Etsako west L.G.A. of Edo State. This study mapped the locations of telecommunications masts, produced a utility map, and collected attribute data for these facilities using GIS and remote sensing techniques. For data collection and analysis, the ArcGIS 10.7 program, Terra Incognita, and handheld GPS receiver were all employed. The Terra Incognita was used to download the satellite image, the portable GPS was used to get ground coordinates, and ArcGIS 10.7 was used to analyze the data. For the study, the coordinates of 40 telecommunication mast locations in Edo States Auchi Etsako west L.G.A. were gathered. The utilization of these masts, which are dispersed throughout the research region, will improve communication and simplify internet access. With the information gathered, a map of Auchi was created that showed the locations of every mast.

Key words: Telecommunication, Utility, Mapping, Remote sensing, GIS, Auchi

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1. INTRODUCTION

A scaled representation of all facility in the study region, both above and below the surface, is known as infrastructure mapping. The term "infrastructure" refers to the organization of large-scale public services such sewage systems, water, oil, and gas supply, telecommunications towers, and electricity (Atilo, 2009). Governments own and maintain a large portion of the nation's physical infrastructure. Prioritizing and budgeting for the future require efficient utility management. The benefits of cutting-edge technology in resource mapping and land use for the nations that take them seriously are well documented. Most traditional surveying and mapping techniques are now being transformed to digital format as the field of surveying and mapping enters a new phase. Before the development of GIS as a cutting-edge technology in surveying and mapping, maps were produced using analog methods to place features (Bello, 2010). Prior to the Global System for Mobile Communication (GSM), Nigeria Telecommunication Limited established a number of transmitting and receiving stations in various regions and areas of the nation (NITEL). The functionality of these forms of telecommunication, particularly the telephone system, is ensured by the close proximity of any of these stations to our area (Davin, 2016).

The emergence of a trend in the telecommunications sector in light of the expanding economies of developing nations like Nigeria, which emphasizes information as a competitive advantage, has given rise to the usage of GSM (phones) as a medium of communication. In 2001, two service providers MTN and Airtel introduced the GSM as a way of communication to Nigerian society (formerly called V-Mobile, Celtel, Zain, and now Airtel). Glo, the third service provider, joined the team one year later. Five years later, Etisalat (9mobile), the fourth service provider, debuted (Hart *et al.,* 2015). Multilink followed seven years later. This is in addition to other fixed wireless phone system service providers including Starcoms, Boudex, Intercellular, Mtel, Visa Phone, and many others. In order to improve the level of service they provided to their target clients, these service providers built reception and transmission masts across the nation and densely packed these mast structures in the cities of their choosing.

Cities and urban areas with high concentrations of these masts include Benin, Abuja, Kano, Port Harcourt, Lagos, Kaduna, and Calabar, among others (Lan, 2011). As a result, it is crucial to establish an information system on these different service providers, including spatial data about the locations of their facilities and the method of service

delivery. The relationship between facility locations and their pattern and trend within the vicinity of Auchi Town, the administrative center of Etsako West Local Government Area, will also be made clear.

2. RESEARCH METHODOLOGY

The study flow chart is presented in Figure 1. The instrument used consists of both soft and hardware components. The collection of software and hardware is as follows:
GARMIN 60, handheld Global Positioning System (GPS);
Computer system (Toshiba laptop);
HP DeskJet 9100 Printer;
ArcGIS 10.7 Version;
Terra Incognita, and
Microsoft Word Office 2007.
The process involves the collection of relevant information relating to the study area, such as old maps and some secondary data about telecommunication masts and the study area, which were extracted using remote sensing (RS) and geographic information systems (GIS) as presented in the flowchart below:.

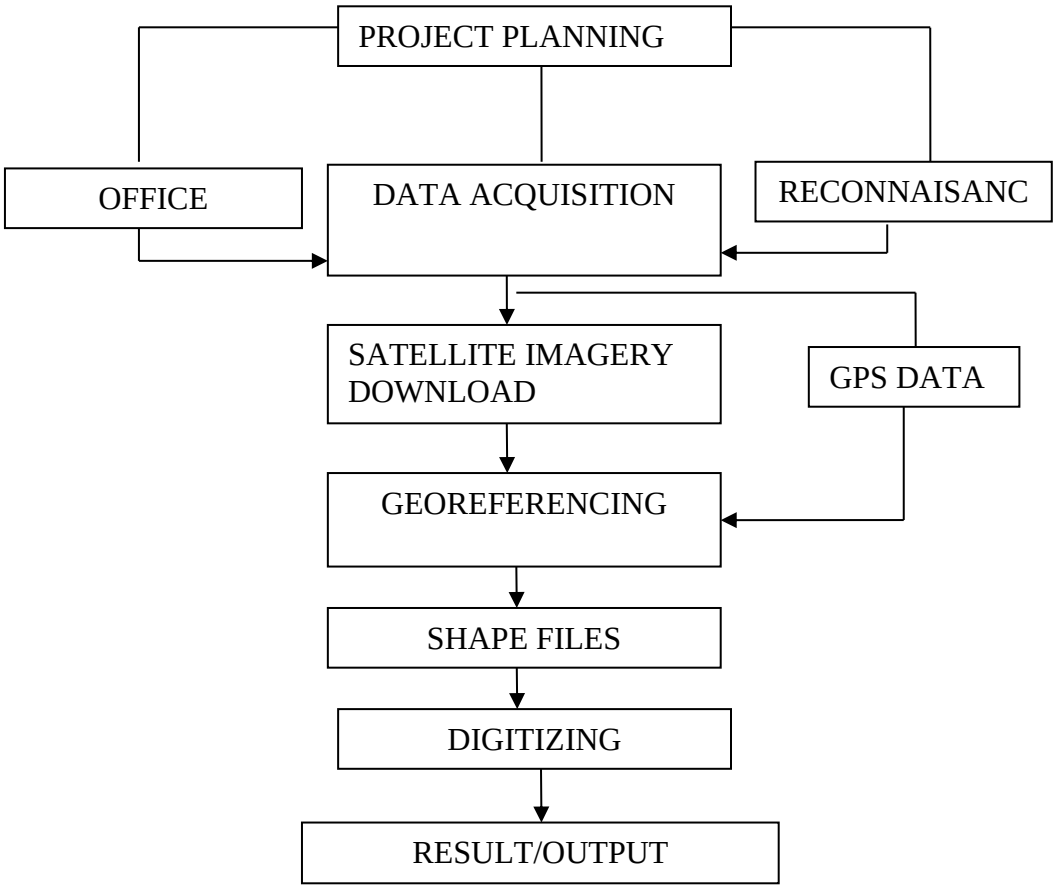

Fig. 1 The study flow chart
Source: Author's field work, 2022

2.1 Data Source, Acquisition and Processing

The sources of datasets were used. These sources are both primary and secondary. The major source is the site's own direct data collection. Using a handheld GPS, a ground survey method was used to get the mast data. On the other hand, specific information about the attribute data that was acquired from the service providers' offices served as a secondary source of data gathering. Terra Incognita was used to retrieve the remote sensing data for this study. With high resolution photos available for download for all sorts of maps, including Bing, Google Maps, Open Street Maps, etc., the Terra Incognita search engine is a straightforward, uncomplicated, and yet incredibly helpful and practical program. Satellite photos can be downloaded from Terra Incognita, a GPS mapping and management search engine.
Images from Terra Incognita are fixed because they do not need to be georeferenced. In other words, they are georeferenced prior to digitization and downloaded in their specific locations, much like on Google Earth. A projection is a methodical way to depict points on an ellipsoid. On the plane, the grid of meridian and parallel lines is shown as

grid coordinates. The map projection system, on the other hand, establishes a connection between a point's location on the surface of the earth and its location on the map.

The method of "ground truthing" entails comparing the locations of features on the map that were visible in the satellite images to their actual locations. Moving throughout the research area while using a handheld GPS to track the locations of such features is required. The phrase "ground truth" refers to location data that the researcher collected while on location. For remote sensing to connect picture data to ground-based features and features in the real world, ground truthing is necessary. In order to comprehend and analyze what is being perceived, ground truth data must be gathered. The digitization stage of the study is shown in Figure 2.

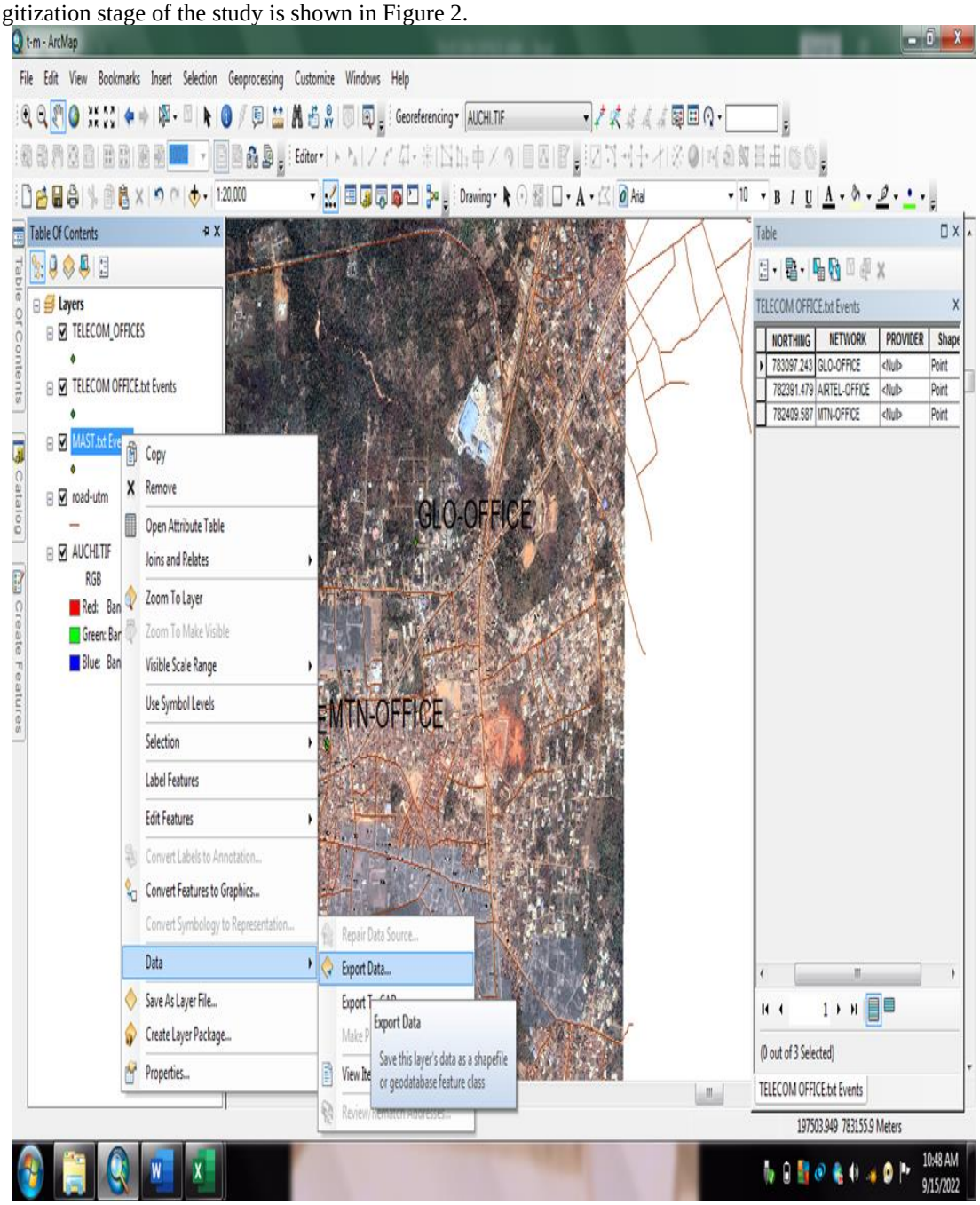

Fig. 2 Digitizing stage of the study
Source: Author's field work, 2022

3. RESULTS AND DISCUSSION

3.1 Database creation

According to Idiris, Anyabine and Alasa (2022) database is defined as a collection of structured related records stored in a electronic cabinet which can be easily accessed, query, manage and update for effective utilization. After all the

necessary shape files have been created, it becomes a necessity to create a database with attributes that describes the shape files by adding new fields to the dataset, thereby enhancing easy decision making. This was done as follows:

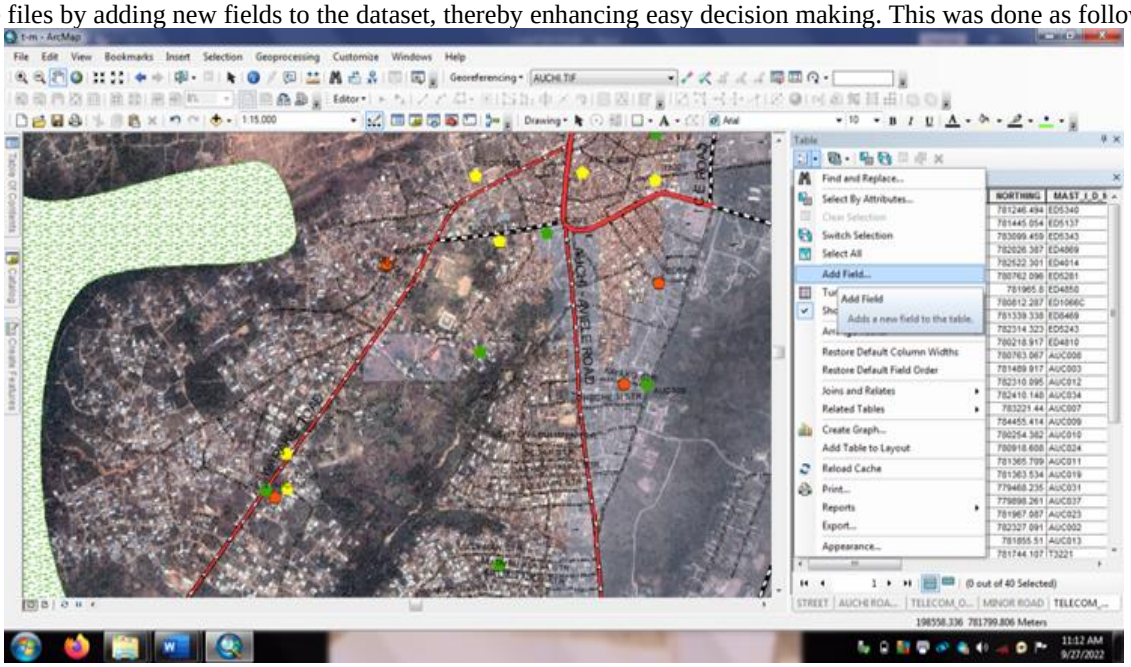

Fig. 3 Opening attribute
Source: Author's field work, 2022

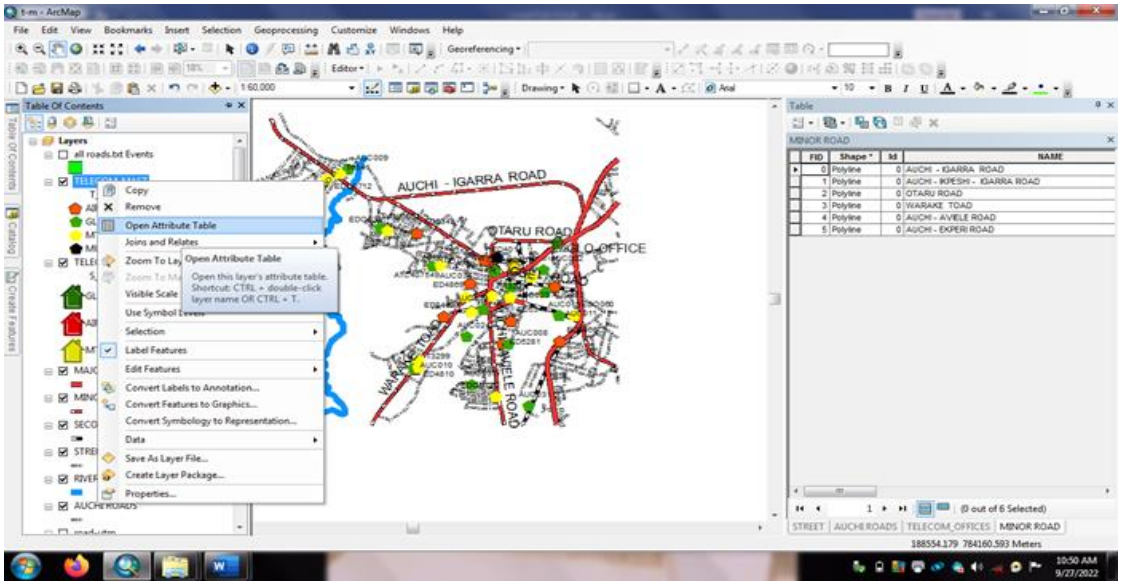

Fig. 4 Addition of new field to the dataset
Source: Author's field work, 2022

The GPS coordinates of all the telecommunication masts were determined and later used to map the location of the masts. A database was created for the various masts. The spatial and attribute data obtained from the offices of the service providers were analyzed using ArcGIS 10.7. Based on the data analysis, it is critical that the National Communication Commission (NCC) guide and control the placement of these masts. It is also critical to establish a system for developing an integrated approach to the siting of these facilities and the associated societal and economic impacts. The list of masts in Auchi is shown in Table 1.

3.2 Query

Query expressions were used in ArcGIS to select a subset of features and table records. Query expressions adhere to Standard Query Language (SQL) expressions. SQL is a standard computer language that contains a set of defined syntax and expressions used for accessing and managing data in databases and other processing technologies. When using ArcGIS dialogue boxes to construct a SQL expression, auto-complete was used to help apply the correct syntax

for the data source you're querying. As you type, a prompt appears showing the field names, values, and keywords supported by the data source. The power of geographic analysis is the ability to ask and answer questions about geographic features, their attributes, and the relationship between them. This is what is known as a *"query*." A query chooses a subset of records from the database, as shown in Figure 5.

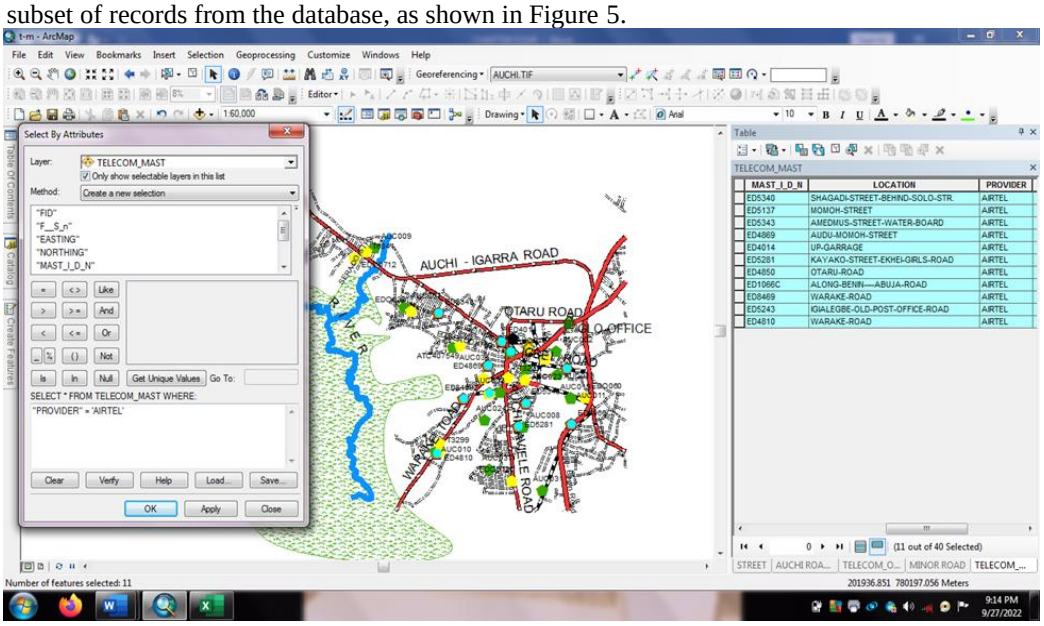

Fig. 5 Query showing Airtel masts in Auchi
Source: Author's field work, 2022

Proximity analysis was used in GIS to select features by location, considering their distances from another feature. Figure 6 indicated 200 m proximity criteria, and it is revealed that 11 masts were sited within a 200 m radius of another mast. According to Figure 7, of the 40 masts in Auchi, eleven are Airtel, fifteen are Glo, which is the most masts in Auchi, followed by MTN with thirteen masts, and the multipurpose mast is only one and not yet operational.

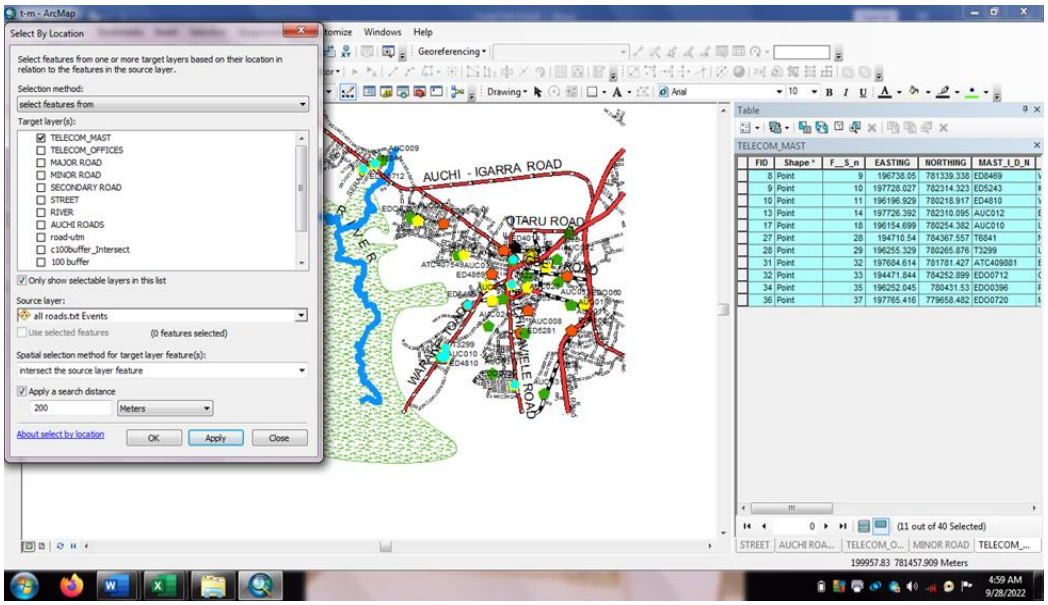

Fig. 6 Mast within 200 m proximity to other masts
Source: Author's field work, 2022

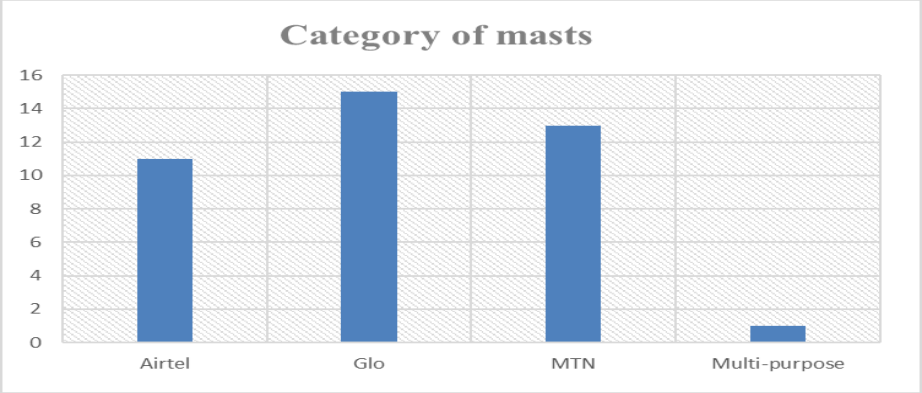

Fig. 7 Categories of masts in Auchi
Source: Author's field work, 2022

Table -1 List of mast in Auchi

S/n	EASTING	NORTHING	MAST_ID	LOCATION	PROVIDER	T_Index	STATUS
1	198053.902	781246.494	ED5340	GADI STREET BEHIND SOLC	AIRTEL	1	Active
2	197283.044	781445.054	ED5137	MOMOH STREET	AIRTEL	1	Active
3	196224.275	783099.459	ED5343	EDMUS STREET WATER BO	AIRTEL	1	Active
4	197256.064	782026.387	ED4869	AUDU MOMOH STREET	AIRTEL	1	Active
5	197533.4	782522.301	ED4014	UP GARRAGE	AIRTEL	1	Active
6	197886.35	780762.096	ED5281	AKO STREET EKHEI GIRLS F	AIRTEL	1	Active
7	198900.304	781965.8	ED4850	OTARU ROAD	AIRTEL	1	Active
8	198992.215	780812.287	ED1066C	ALONG BENIN -ABUJA ROA	AIRTEL	1	Active
9	196738.05	781339.338	ED8469	WARAKE ROAD	AIRTEL	1	Active
10	197728.027	782314.323	ED5243	LEGBE OLD POST OFFICE R	AIRTEL	1	Active
11	196196.929	780218.917	ED4810	WARAKE ROAD	AIRTEL	1	Active
12	197997.367	780763.067	AUC008	AKO STREET, EKHEI GIRLS I	GLO	2	Active
13	197515.029	781489.917	AUC003	MOMOH STREET	GLO	2	Active
14	197726.392	782310.095	AUC012	BEHIND FIRST BAK PLC	GLO	2	Active
15	196531.094	782410.148	AUC034	DOKHA STREET, WATER B	GLO	2	Active
16	195508.208	783221.44	AUC007	. ABDULWAHAB SALIU ST	GLO	2	Active
17	194889.927	784455.414	AUC009	SAH STREET, UTEKE CAMI	GLO	2	Active
18	196154.699	780254.382	AUC010	UGUALO STREET	GLO	2	Active
19	197193.53	780918.608	AUC024	UGUALE STREET, EGELESOF	GLO	2	Active
20	198979.55	781365.709	AUC011	BOREME MARKET CAMPUS	GLO	2	Active
21	198997.539	781363.534	AUC019	BOREME MARKET CAMPUS	GLO	2	Active
22	198402.935	779468.235	AUC031	CEDAP VILLAGE CAMPUS 2	GLO	2	Active
23	197283.457	779898.261	AUC037	MAN STREET EKHEI GIRLS I	GLO	2	Active
24	198042.846	781967.087	AUC023	MISSION ROAD	GLO	2	Active
25	198683.678	782327.091	AUC002	ABOTSE PRIMARY SCHOOL	GLO	2	Active
26	198717.138	781855.51	AUC013	CEMETERY ROAD	GLO	2	Active
27	198039.178	781744.107	T3221	UCHI MARKET	MTN	3	Active
28	194710.54	784367.557	T6841	NASEME BARRACKS	MTN	3	Active
29	196255.329	780265.876	T3299	UGUALE STREET EGELESOF	MTN	3	Active
30	196675.017	782430.487	ATC407549	DOKHAI STREET WATER E	MTN	3	Active
31	195655.042	783154.623	EDO0381	OBUGIE STREET WATER BC	MTN	3	Active
32	197684.614	781781.427	ATC409881	EHIND FORMER ZENITH BA	MTN	3	Active
33	194471.844	784252.899	EDO0712	FONIA STREET IGBIRA CAM	MTN	3	Active
34	197285.935	781451.687	EDO0738	WARAKE ROAD	MTN	3	Active
35	196252.045	780431.53	EDO0396	AL INT'L SCHL WARAKE R	MTN	3	Active
36	199282.753	781369.784	EDO060	LUMNI BUILDING CAMPUS	MTN	3	Active
37	197765.416	779658.482	EDO0720	MAL. ZUBERU ABIRI STREE	MTN	3	Active
38	198458.028	782169.186	EDO0023	BACK OF PUBLIC FIELD	MTN	3	Active
39	197170.4	781764.403	EDO0458	SHI PRIMARY SCHL WARA	MTN	3	Active
40	197782.609	782600.358		GAIUS STREET, OFF OTARU RC	Multi purpose	4	Inactive

Source: Author's field work, 2022

3.3 Environmental Impact Assessment

The Environmental Impact Assessment (EIA) evaluates residents' perceptions of the effects of telecommunication mast location on health and urban livability in Auchi, which appraises the inventory of masts in the study area, mast location analysis, and the benefits and effects of masts and their location on the lives of people living nearby. Research shows that the antennae, transmitters, and receivers are mounted on the body of the telecommunications mast structures. These antennas receive very high-frequency radio waves from cell phones, which, when absorbed by the body in large amounts, produce heat that can lead to burns and body tissue damage. Radiation exposure has long been a concern for the public, policymakers, and health researchers. In 2011, the International Agency for Research on Cancer (IARC) reviewed the published literature and classified radio frequency radiation, which mimics lifetime human exposures and has shown significantly increased rates of Schwannomas and malignant gliomas, as well as chromosomal DNA damage.

4. CONCLUSION

This research work emphasizes the use of GIS to portray the spatial attributes of the GSM telecommunication mast location in Auchi. It provides an outlook for land use planners and policymakers to appreciate the emerging challenges of land encumbrances by these facilities. It becomes essential for land managers to have an institutional framework that will aid in providing a geographical basis for sitting masts. Atilola (2009) asserts that the most basic prerequisite for any land administration is the spatial content of the environment of any nation for sustainable economic development; its physical and economic resources, as well as the natural, cultural, and infrastructural features, must first be identified, taken stock of, and surveyed. This suggests very strongly, the neglect of the professionals that are technically and technologically equipped to provide this geographic information, namely the surveyors and other related professional stakeholder groups. The result of this research work can be applied to utility planning for sustainable development in Auchi town. Also, it could be useful to town planners for proper planning and siting of a telecommunications mast in Auchi town. The multiplicity of mast sites in the study area by the various service providers without a particular trend or degree of densification is an indication that there is no comprehensive database and graphical representation (thematic map of telecommunication mast facilities) of existing mast sites in terms of their spatial and attribute characteristics.

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