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Locational Analysis of Telecommunications Infrastructure in Residential Neigbourhoods of Lagos Metropolis

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1 ABSTRACT

Telecommunications play a major role in the socio-economic develoment of cities all over the world. Indeed, many cities in developing countries of the world are currently expanding their telecommunication infrastructure especially in the area of global system of mobile telecommunication (GSM) to take advantage of the many benefits that telecoms offer. However, the provision and location of telecoms infrastructure lacks conscious physical planning efforts. Thus, this study focuses on the spatial distribution and location of telecommunications base stations in selected residential areas of Lagos Metropolis. It specifically examines the general attributes of base station locations and the factors that influence the location of the base station locations. Three local government areas (Lagos Island, Eti-Osa and Ikeja) within Lagos metropolis were purposively selected for purpose of data collection. The residential areas in the selected local government areas were stratified into three (3) homogenous residential densities namely, low, medium and high. Geographical data from all identified base station locations were collected using a GPS instrument and analysed with the aid of spatial statistics inquiry specifically, the Nearest Neighbor Analysis using the ArcMap 9.2 (extension) tool. This study identified fifty-eight (58) base stations randomly distributed within nine different residential areas. In the high density residential areas, the observed mean distance between base stations located in the same area is less than 1km while the mean distance for medium and low residential density areas is above 1km. The most important factors considered by the operators in location of base stations include population, intensity of commercial activities, customer satisfaction and profit maximization. Most base stations within residential areas do not have town planning approval. The study recommendations that telecommunication operators should prepare and submit their program on network expansion for integration into the land use plan of the study area and for city in general. Also, the Nigerian Communications Commission (NCC) in partnership planning authorities need to enforce guidelines for the erection of telecommunication infrastructure. The study concludes that future location of telecom infrastructure in the study area should be based on conscious planning decisions.

2 INTRODUCTION

Urbanization is neither a crisis nor a tragedy; it is a challenge for the present and the future. The process of urbanization has created a host of new opportunities enmeshed with new and ill-understood problems. Urbanization is not a new phenomenon on the continent of Africa as shown by cities like Lagos, Ibadan, Addis-Ababa, Cairo, Kano, and Timbuktu. What is noteworthy about contemporary urbanization in Africa is its fast pace (UN, 2004). The dispersion of conurbations, the rate of urbanization and the change in lifestyles cast more or less doubt on the urban model looked on as "the European city". Every society is linked by three different types of infrastructures: transportation, energy, and communications. Contemporary urbanisation is often distinguished by the level of infrastructures present in a place while the level and availability of telecommunications infrastructures in particular determines the status of cites today. It suffices to say that while cities are the end-result of the urbanization process, infrastructure is definitely the bloodstream of cities. Hence, telecommunication services are backed by certain peculiar infrastructures.

However, Bell (1979) noted that revolution in communications now makes it likely that there will be a major shift in the relative importance of one of the infrastructure hence; communications will be the central infrastructure tying together a society. The new technologies are expected to play certain roles within the scope of a sustainable urban development. The information superhighway is a revolutionary trend occasioned by the widespread effect of globalization the world over.

The dawn of globalization effects on information dissemination as well as seamless communication in Nigeria became a reality in 2001 with the introduction of global system of mobile telecommunication (GSM) services by two telecommunication giants namely MTN Communications and Econet Wireless

Communications. However, the land tenure system as well as the fragmentation of land in Nigeria has hindered the ease of procuring land for the purpose of installing masts and base stations, especially in built-up areas where the concentration of subscribers is very high. Various methods are adopted for the purpose of having suitable sites and avenue for the erection of the masts and base stations towards serving the conceived purpose. The choice of the chosen sites for the said purpose depend among others on the elevation of the identified places 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 others factor (Omole, 2006).

It is against this background that this study seeks to examine the locational pattern of telecommunication base stations in different residential density areas of Lagos Metropolis

3 LITERATURE REVIEW

The importance of telecommunication in the socio-economic development of cities cannot be over emphasized. According to Moss (1999) advanced communication technologies are transforming the form and function of large metropolitan regions. For centuries, the growth of cities depended on transportation linkages to facilitate the movement of people and goods. As advanced, industrialized nations rely more heavily upon information-based services, the viability of a metropolitan region will depend on its communications infrastructure to facilitate the movement of ideas and information.

As the industrial age experienced a shift in the predominance of crude agricultural implements to mechanization of tools so has the information age transformed the type of infrastructure required for effective flow of ideas and information in today's world. While these developments portend benefits for our societies, there are also concerns on the preparedness of our contemporary cities to evolve and adapt to a seamless transition. Moss (1999) envisaged that just as the number of ships that arrived at a port was once regarded as the measure of a city's economic activity, the information that flows in and out of a city will be the appropriate indicators of a community's well-being in the twenty-first century. He went further to suggest that the emerging telecommunications infrastructure presents both a challenge and an opportunity. The challenge is to develop theoretical concepts and empirical techniques for analyzing the relationship between new telecommunication systems and existing communication processes. The opportunity is to improve our understanding of how communications technology influences the organization of work, time, and space in an advanced urban society.

With the acceptance of the new technologies with particular reference to the global systems of mobile telecommunication (GSM), investors in the sector are in the race for increasing their service reach while optimizing returns. This is a traditional business phenomenon. However, this often comes with certain implications for the socio-economic environment of cities. George (1999) observed that the behaviour of individuals and groups in urban areas is clearly competitive. The groups or individual attempts to maximize satisfaction. This urge have led to new and innovative methods of operation, which often alter structure, and use of land resources. These alterations more than often result in problems.

Yen and Mahmassani (1997) noted that the development of telecommunication technologies might affect land use patterns and play a role in the growth of economic activities and the spatial distribution of industry. They suggested two specific aspects of office-location decisions by organizations in assessing the impact from the new technology; the need for certain organizations to locate where they can access telecommunication networks; and an increased opportunity for the organizations to locate their offices in the areas where infrastructure costs are generally lower than traditional office locations such as downtown areas are factors that could influence location decision.

Gaspar and Glaeser (1998) tried to uncover the relationship between IT and face-to-face interactions and the cities that facilitate these interactions. In an empirical analysis using telephone call data, the authors concluded that these are complements rather than substitutes. As a result, the centralizing forces in cities did not seem to vanish. However, as the authors noted, it is very hard to separate the exclusive effect of IT in their regression models.

Gordon and Richardson (1997) conjectured that IT technology may lead to a dispersion of economic activities and population, possibly up to the stage where geography is irrelevant. They noted that high-rise or concentrated settlement has been dominant when transport or communication costs were high but that such

costs are likely to continue to fall in the future. It might be possible to summarize that office work, rather than office workers, will do the traveling (Drucker, 1989).

The critical issue here is whether transportation and communication are complementary or competitive. If the former is the case, geography still might matter even with the advent of the new communications technology. Arguing against the optimistic view of technology, Salomon (1996) mentioned that there have been excessive expectations of the information age, for instance, that telecommunications can eliminate the effects of distance and as a result can have profound effects on the spatial organization of society. Even though the study claimed that a complete change of urban form could not be expected in the information age, the author agreed that there are some changes that may result from these technological changes. One example of the telecommunications dispersal effect is an emergence of the back office activities located remotely from the core organization.

Furthermore, there exists a gap between the introduction of new IT and the changes in the spatial pattern of firms (Capello, 1994). This is ascribed to an overestimation of technological potential and to an optimistic and superficial analysis on the relationship between the new technology and spatial restructuring. The study noted that in the long run, those technologies lead to a new production strategy such as the "just-in-time" (JIT) system and it will require a physical proximity (either in an inter-urban or intra-urban context) between firms and eventually a spatial clustering of economic activities are expected.

However, as Fujita and Hamaguchi (2001) noted, firms (specifically the buyers of intermediate goods in the research) can be more dispersed if they have a better-developed transportation/ communication infrastructure as in the examples of many developed countries.

Conceptually, the geography and distribution of economic activities can be redefined on the basis of information flows. Echeverri-Carroll (1996) noted that an effect of the geographical relationships between organizations cannot be conceptualized without understanding the intra-organizational and inter-organizational computer networks that bind particular locations together. Even though spatial decentralization continues to be relevant, the process is characterized by a much higher functional integration using the information network. It is implied that network connectivity can be a more important factor in deciding the geographical relationships than physical distance especially in the information age.

However, this writer did not agree that such technology leads to the demise of the concept of distance. The conclusion was that since these technologies also impose higher investments on inter-firm linkages and more stringent restrictions on labor's skills and flexibility, both ... restrain the location of industry in space.

Mokhtarian (1998) focused more on the spatial residential pattern of commuting. She noted that "the effect of the new technology is not to reduce travel but to increase the flexibility of travel and, as a result, the total number of trips may be higher with a substantial portion of travel shifted to off-peak periods. The ability to commute because of telecommuting often leads to a relocation of residences further away from work enough for total VMT (vehicle miles traveled) on a smaller number of commuting days to exceed the previous levels". On a system-wide level, this trend may result in a decentralizing effect on urban form.

George (1999) while explaining the modifications to the Alonso's model of land use pattern in Lagos metropolitan area hinged on the principle of accessibility to alternative locations. Quoting the exact words; "urban location decisions are interdependent". This interdependence very often shows itself in agglomeration of similar establishments. This creates external economies – the ease of face-to-face contacts in the office zone or the fact that locating shops together minimizes commuting costs and attracts customer".

In a comparative analysis of this trend in the Chicago and Seoul regions, it was concluded by some analysts that information technology has a very influential and positive effect on the agglomeration of firms. Despite the dispersion-inducing factors of the limited availability of information technology and accessibility to a well-equipped information network in many areas restrict the locational choices of firms, and as a result the distribution pattern is more concentrated. While this might change in the future as IT facilities disperse, for now the uneven distribution of IT infrastructure is a centripetal force. This tendency also occurs in an interurban context (Jungyul, Tschangho, and Geoffrey, 2003).

Audirac and Fitzgerald (2003) reviewed literature on information technology and urban form and concluded that ''current urban planning discussion regarding the New Economy centers are based on planning, managing, and redesigning form of cities and regions in order to attract and nurture knowledge economies.

Enhancing the quality of life, by restraining urban sprawl, is seen as essential to urban competitiveness in the information age. However, the literature that examines the synergies between information technologies and urban form does not only point re-concentration of certain economic activities but also to the furtherance of exurban development, socio-spatial segregation, and traffic gridlock. Having established that the information technology phenomenon in general has had impact on the development of contemporary urban forms and cities by extension, below are some literatures on location of telecommunication infrastructure and access to efficient telecommunication service in residential areas.

Schuler (1992) observed that the availability, quality and use of telecommunications and transportation systems are keys to social development throughout the world over the next century, but the extent and diversity of use of these systems hinge crucially on the ease and quality of access to local networks by a diversity of users. Telecommunication networks require public attention both to sustain an optimal level of services. While for economic efficiency and technological development purposes, it may be important to have private providers of individual components, the efficient planning, co-ordination and method recovery of common network costs for the entire system require public oversight. Furthermore, the transportation and telecommunications systems interact, sometimes as substitutes, sometimes as complements, in ramifications for the spatial configuration of economic activity and the long-term use of this infrastructure.

Similarly, Moss (1999) examined the components and implications of the changing urban telecommunications infrastructure and its impact on research and policymaking. The study confirmed that contrary to popular belief, communication technologies have not replaced face-to-face contact. Rather, new communication systems have enhanced those cities that serve as the information centers of the world. Rather than lead to the obsolescence of cities, new communication technologies have contributed to the emergence of a handful of "world cities". Because a new and sophisticated telecommunications infrastructure is being built within large metropolitan regions to accommodate sophisticated data and voice services, those communities that are already equipped to handle such technologies are at an advantage. Moss (1999) suggested that ‘‘we need to improve our knowledge and understanding of the relationship between new telecommunication technologies and the rich web of interpersonal communications that occurs in cities’’. The evidence to date indicates that communication technologies are vital elements in maintaining and stimulating both internal and external patterns of urban communications. It is essential to recognize the distinctive roles of government and business. The private sector should be the engine of telecommunications development at the urban level. The public sector, however, should monitor private sector initiatives and use private telecommunication networks for serving public purposes.

Wakely and Phe (2000) observed that the existing models of residential location are facing difficulties in explaining new trends in urban development such as gentrification and abandonment. Hence, the components of a new theory of residential location were proposed. In essence, the mainstream approach which stresses the access/space trade-off seems to be at variance with the current reality of dispersal of both housing in modern cities. The study proposed that the focus on the city centre(s) and distance (or both) should be shifted to two other categories of parameter: housing status and dwelling quality. Outcomes of interaction between these parameters can be used not only to describe but also to predict various types of residential development in different urban contexts.

Frenkel (2001) observed that various studies have provided evidence of the advantages of the ability of metropolitan areas to attract industries, which employ advanced technology and are strongly involved in the process of innovation. The statement emanated from the results of an empirical study of the location choice of Israeli hi-tech metropolitan area, carried out in the Northern region of Israel (which encompasses the Haifa metropolitan and its surrounding localities) and based on field-survey data obtained from hi-tech plants. The study investigated the effect of different factors on location choice and also identifies the direct contribution factor to the probability of choosing the metropolitan area as a preferred location with implications for industrial policy.

Moriset (2003) focused on the tendency of e-business towards urban concentration in Europe using France as a case study. The study assumed that the complexity of the urban sector results in an increasing variety of business location. The survey of 92 firms in the multimedia sector of Lyon shows that enterprises do not have the same location needs, neither at regional nor Multimedia and software designers are more 'footloose' than Web agencies and Internet service outsourcers, which are linked to their clients and to broadband

networks. The former may locate in picturesque renovated areas, or even in rural areas. The latter tend to share high-tech-suited locations with Internet and telecom carriers in state-of-the-art, wired premises. Finally, this study considers the question of the status of a medium city and its different districts in the context of a growing information economy.

In the opinion of Rutherford (2005), there appears to be substantial convergence in the type and extent of telecommunications networks being deployed between and in major European cities to serve increasing numbers of corporate clients, thus one of the principal material elements in the development of a world city network. Through discussion and an empirical exploration of the interurban and intra-urban network development of one major telecommunications providers in Europe, however, it is shown how the planning, construction and expansion of these infrastructures remain crucially shaped by a variety of historical, regulatory, economic, physical and organizational constraints and compulsions which are specific to individuals. The mutually constitutive nature of economic and technological connectivities suggest, therefore, development of a world city network continues to have an important dimension of territorial fixity, reflecting multi-scalar entanglement of territory and globalization that forms the world cities of today.

However, Graham (2002) posits that the societal diffusion of information and communications technologies (ICTs) remains starkly uneven at all scales. The contemporary city displays this unevenness most visibly. In cities, clusters and enclaves of 'super-connected' people, firms and institutions often mix with large numbers of people with non-access to communications technologies. In such a context, the study sought to demonstrate that dominant trends in ICT development are currently helping new extremes of social and geographical unevenness within and between human settlements and cities, in both North and the South. It went further to explore the prospect that such stark 'urban digital divides' be ameliorated through progressive and innovative policy initiatives which treat cities and electronic technologies parallel.

Mills and Whitacre (2007) observed that as residential Internet access in the United States shifts toward high-speed connections, a gap has emerged in high-speed access relative to urban high-speed access. Potential causes of this high-speed ``digital divide" include rural—urban differences in people, place, and infrastructure. Combining current population survey data from 2001, and 2003 with novel infrastructure data, the study determined the relative roles of these factors in the urban divide. Bootstrapped decompositions of logit model results demonstrate that rural—urban and in network externalities, but not in infrastructure, are the dominant causes of the high-speed residential internet access.

4 THE CONTEXT OF LAGOS

Lagos, Nigeria's lagoon city and the fastest growing mega city in the world is a product of the country's rapid urbanization. It attained mega city status in 1995 when its population reached the 10 million mark (UN-Habitat). From its global city ranking of 31st in 1985, Lagos population exploded to 13.4 million in Year 2000 to become the world's 6th mega city and Africa's foremost urban centre and hub of national, regional and global socio-economic and political activities. Spatially, the Lagos Mega city region, covering 154,540 hectares (2000), approximates to 17 of the State's 20 Local government Areas and impinges imperceptibly on 4 Local Government Areas of the adjoining Ogun State. Lagos State population is estimated to be growing at between 6% and 8% annually (LASEED 2004) which is 10 times that of New York and Los Angeles. The population which is estimated at 18 million in 2007 (UN-Habitat 2007) is equal to that of 32 African countries joined together. Indeed the Lekki sub-region in the south-Eastern part of growing at about 16.99% annually as against the National average of 2.9%. The mega city, with an average population density of 20,000/sq.km compared to the National average of 1,308 sq. Km., serves as the springboard for innovation and development throughout Nigeria and West Africa.

Even though geographically disjoined, located on poor soil and overwhelmed by its growth, Lagos is the dominant economy in Nigeria as reflected by the following: Gross National Product (GNP) of Lagos is three times that of any West African Country, (World Bank, 2011). It accounts for over 65% of Nigeria's Gross Domestic Product (GDP) and over 70% of National industrial investments. It also accounts for over 70% of Nigeria's commercial activities. Lagos is host to the premier Nigerian Capital Money Market and has a large informal sector workforce of 70%. It is the hub of aviation activities (82.61% international; 47.30% domestic). Lagos is also the Telecommunication and Media hub of Nigeria (50% of 20 million PTO/GSM subscribers). There is high property value appreciation (145% in 2000; 446% in 2005) in Lagos with 29 Industrial estates and 4 Central Business Districts. Lagos Ports handle over 70% of total National cargo

freight and generates 50% of National Port Revenue. The city houses the Western terminus of the Nigeria Railway system in Iddo. It is the lead contributor in non-oil sector to Nigeria's GDP in 2005 (19%-equals that of 13 states) Lagos utilizes 45% of National electricity supply and consumes 50% of National petroleum products. Lagos is also designated as Africa's Financial Centre (FSS 2020). It is the node of West African gas Pipeline Project and Sub-Saharan Africa's largest ICT market. These facts prompted the NEPAD Cities Forum (2004) to observe that "sustainable development in Africa will be won or lost in Lagos".

Year	Population	Global ranking
1985	5.8 million	31st
1990	7.1 million	21st
1995	10.28 million	-
2000	13.42 million	6th Megacity
2005	16.85 million	
2010	**20.19 million**	3rd Megacity
2015	24.6 million	-
2020	**35 million**	

Table 1: Lagos Megacity Population Trend

5 STUDY APPROACH

For the purpose of data collection, three (Lagos Island, Eti-Osa and Ikeja) of the sixteen local government areas within Lagos metropolis were purposively selected because they have high concentration of GSM base stations. Nine (31.0%) of the 29 residential areas in the three local government areas were randomly selected for this study. These include two low, three medium and four high density residential areas. A total of 58 base stations were identified in the nine residential areas. Two categories of primary data were collected to achieve the goal of the study. The first include information on location and characteristics of the base stations. A data form was designed to collect information observed by field officers on land use characteristics of base stations in the residential areas. Also, geographical data from all identified base station locations were collected using a GPS instrument. The second category of data was obtained from telecommunication operator with the aid of structured questionnaire. This includes information of factors that influence the location of their base stations in the study area. Both descriptive and inferential statistical techniques were used for data analysis. The main hypothesis in this study is that the spatial pattern of base station locations in residential areas of Lagos is not random. Consequently, the hypothesis was tested with the Nearest Neighbour Analysis tool using the ArcMap 9.2 (extension).

6 FINDINGS AND DISCUSSIONS

6.1 Characteristics of Base Station Locations

The distribution of base stations across the three residential density areas reveals that 33.0% of the base stations are located in low density residential areas, 26.0% in medium density residential areas and 41.0% in high density residential areas. The mean number of base stations in each of the residential density areas is 6 in high, 5 in medium and 10 in low density residential areas respectively. The availability of land in low density residential areas rather than population may be responsible for the high concentration of base stations in low density areas. Analysis of the nature of location of the base stations reveals five possible locations which are further classified as dedicated and non-dedicated. Majority (47.0%) are located on shared or subdivided plots, 10.0% on dedicated plots of land, 31.0% on roof tops, 5.0% on organised open spaces and 7.0% on incidental open spaces. Hence, 90.0% of the base stations are located on non-dedicated locations/plots of land. This suggests lack of conscious planning in the distribution and location of base stations in the study area.Consequently future expansion of base stations in residential areas may continue to invade and succeed the residential uses rather than co-locate with other base stations.

A further study of the nature of adjacent land uses to the base stations shows that 28.0% have residential uses as their adjacent land use, 40.0% have commercial and 33.0% have other types of land uses(public, recreation and industrial) as their adjacent land uses. This again reveals that location of base stations in the study area lacks coordination in term of land uses planning. A consideration of the type of roads adjacent to

the base stations shows that majority 41.0% are located adjacent to access roads within the residential areas, 22.0% are located adjacent to arterial or expressways, 16.0% along distributor roads and 21.0% along collector roads. This suggests that telecom operators prefer to locate most of their base stations adjacent to higher hierarchy of roads in and around residential areas. Accessibility is considered as the major factor for this pattern since the base stations need to be serviced on regular basis especially for the supply of fuel for the electricity generating sets that power the base stations.

6.2 Spatial Pattern of Base Station Locations

The main hypothesis in this study is that location of base stations in Lagos is not random. This suggets that location of base statiions in Lagos follow a conscious planning efforts. However, descriptive analysis so far suggests that there were no conscious planning in the location of base stations by telecom operators. The results of the Nearest Neighbour analysis using ArcMap 9.2 (extension) tool shows that for five contigous residential areas in both Eti-Osa and Lagos Island local governemnets, the observed mean distance of all the 27 base stations is 0.98km and the recorded standard deviation (Z-score) is 0.16. Thus the spatial pattern observed is neither clustered nor dispersed but random in nature. The mean distance of the base stations in medium density residential areas of Ikeja was found to be 1.4km with a Z-score of 2.15. This also confirms random pattern of base station locations. Also,what is obvious from this study is that the mean distance of base stations in high density residential areas of Lagos is less than 1Km while they are higher than 1Km in both medium and high density residential areas. These results further confirm the earlier low ranking of proximity of base station as a factor of location of base stations by operators. The randon pattern observed further confirms the absence of a definite spatial planning and technical treshold standard to guide base station locations.

6.3 Factors Influencing Location of Base Stations

The factors influencing the location of base stations in the study area were obtained from the telecom operators. The result shows that there are 10 key factors and these include: accessibility, land value, size of land area, population, availability of power/electricity, security, proximity to other base stations, topography, regulatory standards and technical specifications. These factors were ranked based on their importance. Population was ranked first, followed by topography, technical specifications, land value, security level of the location, accessibility to the location, availability of power, size of the land, regulatory standard (Planning/NCC) and lastly proximity to other base stations. While there is an agreement among telecom operators about the most important factor being population of the community, there is no common template used as guide in the choice of location. Hence availability of land becomes a dominant factor of location and the implication of this is that most of the locations are unplanned and thus the spatial distribution is likely to be haphazard.

A major challenge faced by telecom operators in locating their base stations is in securing town planning approvals/ permit. The absence of a city-wide plan for the provision and location of telecommunication infrastucture makes it difficult to get secure adequate locations. Futher, scarcity of land in a highly populted city like Lagos is a big challenge for infrastructure development. Consequently, locations that could be adapted for base stations such as roof tops, incidental open spaces and shared plots of land in residential areas as previously observed become the alternative sites. However, due to the pressure on infrastructure, the telecom operators need to expand their network to meet up with service demand. Consequently, most of the operators prefer to approach residential land owners to lease part of their properties to them for the purpose of locationg thier base stations. This explains why majority of base stations are on shared plots of land. However, these shared properties hardly conform with the town planning and NCC regulations. This leads to non approval of many locations of base stations by the regulatory agencies and thus limits infrastructure expansion which ultimately affects capacity of operator for service delivery.

7 CONCLUSION

The significance of telecommunication in the socio-ecomic development of cities in both developed and developing nations have been recognized by scholars, hence this study has investigated the spatial distribution and location characteristics of telecommunication base stations in Lagos. The study concludes that the spatial distribution of base station locations is random and this is due to the absence of definite spatial planning efforts to guide the telecom operators in the location of their infrastructure. This situation

will surely have environmental, safety, and health implications which are not yet determined. It concludes further that future expansion will be difficult in the face scarcity of ideal property and stringent physical planning regulations. In the future, more residential uses will have to give way to base stations especially in high density residential areas either through lease or outright purchase of such properties by telecom operators. The study also concludes that economic factors rather than standards and government regulations influence location of base stations in Lagos. The study recommends that the government agency (LASMIRA) in charge of safety, environmental and health concerns of telecom infrastructure should be alive to its responsibilities given the unplanned nature of base station locations.It recommends futher that the telecom operators should put in place their infrastructural expansion plan which should be integrated with the existing land use plan of the residential areas.

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