Spatial Distribution of Public Secondary Schools in Ikeduru Local Government Area, Imo State, Nigeria

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Abstract

This study analysed the spatial distribution of public secondary schools in Ikeduru Local Government Area (LGA) of Owerri Senatorial Zone, Imo State and also examined the level of accessibility of students to public secondary schools in their domiciles. Two research questions were raised to guide this study. A descriptive survey research design was adopted. The target population comprised all the 13 public secondary schools in Ikeduru LGA. The sample for the study comprised the 13 public secondary schools purposively selected. The schools were stratified using the stratified sampling technique. 10% of 4,969 students gave 497students as the sample size using the simple random sampling techniques. The instruments designed to collect the primary and secondary data comprised two checklists, namely, School Location Checklist (SLC) and Accessibility of School Network Checklist (ASNC). The data collected were analysed using descriptive statistics. The Geo-statistical analysis was conducted using the ArcGIS for the production of the maps of the study area. The findings revealed, among others that the pattern of distribution of the public secondary schools showed clustered, lopsided and uneven spatial distributions of schools. It was, therefore, recommended among others that, school mapping strategies should be adopted to create database in order to ensure that schools were located in close proximity to students' homes with respect to population density and catchment area of the students.

Keywords: Spatial distribution, GPS, GIS, Accessibility.

Introduction

Secondary education which occupies the middle level in the education pyramid of a nation's education system is the education students receive after primary education and it provides entrants to the tertiary level of education and prepares students for the skills needed for economic and socio-cultural

empowerment. The equitable spatial distribution of schools at this level of education is very crucial to the attainment of optimum academic performance of students in both urban and rural settlements in order to achieve even development of human resources for nation building. However, the effectiveness of any secondary education varies due to the quality, equitability and adequacy of the spatial distribution of and accessibility to the location of secondary schools, and its attendant effects on the academic performance of students in secondary schools.

The spatial distribution of secondary schools is very important in the lives of students in consideration of the accessibility of school networks in terms of distance covered by students to school, mode of travel and time of arrival to school in relation to the domiciles of the students. High academic performance may not be achieved by students in a situation where they have to travel a very long distance to school as this will affect the time of arrival to school. Consequently, quite a majority of the students will arrive late to school and therefore, miss most periods of lessons in the morning which will in the long run, have adverse effects on the quality of education received by the students, thereby hampering their academic performance.

In recent years, the spatial inequality in the distribution of schools and its facilities such as teachers, students, equipment and other instructional materials, have become an important feature in the majority of developing countries including Nigeria. The uneven distribution of schools does not only affect education access, but it also lowers the quality of education. Therefore, an appropriate spatial distribution of schools is a major index of the achievement of a higher academic performance in schools which is necessary for an even development of the students in different communities for optimum human capital development.

However, accessibility to the secondary level of education has remained a daunting task. There has been growing concern about the quality of education received by children at this level owing to problems arising from unprecedented student population as a result of acute shortage of school places. Evidence from various researchers confirmed that the quality of education in Nigeria, especially at the secondary level of education has eroded markedly. As a result, most outputs from this level of education are said to lack critical skills needed for their survival in society, and intellectual abilities and capabilities which are essential prerequisites for entry into tertiary institutions. One of the purposes of secondary education in Nigeria, among others things as spelt out in the National Policy on Education, is to inspire students with the desire for self-improvement and achievement of excellence (Federal Republic of Nigeria, 2013). Educational

planners and managers, often are faced with the greatest challenges of equalizing educational opportunities for all children. They are also confronted with some spatial problems relating to education, including deciding the most appropriate sites to locate or open new schools, finding out the communities that are starved of learning establishments and where facilities are needed or duplicated, as well as identifying where teachers are mostly needed, which areas of specialization are mostly affected and which categories of teachers require in-service training. An equitable distribution of schools is of paramount importance to ensure even development across zones or states. This is achievable through a well-planned educational system which can be better guaranteed through proper school mapping of the area in order to ensure equity.

School mapping is the most ideal planning tool which employs appropriate planning techniques such as global positioning system (GPS) and geographic information system (GIS) to ensure that schools are spatially distributed and located in the appropriate communities and sites to ensure equity and fairness. Spatial distribution of schools should be based on population density, catchment areas and proximity to students' domiciles for sustainable uniform development of the students in all ramifications. This could be achieved by applying school mapping tenets, guidelines, principles, equity and rationality in school location. However, Mustapha, Ogunyemi, Alaga & Samuel (2016) observed that the distribution of educational facilities in most parts of Nigeria was politically biased to the extent that a facility was over utilized while others were underutilized in some areas. They also opined that location of schools should be based on factors such as population, proximity and economy efficiency for sustainable development. Similarly, Ewendu (2015) stated that over politicization of education in terms of school location and school facilities provision had caused a lot of damage to the educational system, thereby lowering the productivity in educational outcomes, especially in secondary education.

A range of studies have been conducted on the spatial distribution of schools using appropriate planning tools such as: school mapping techniques involving GPS and GIS. Many authors found that an improper distribution of schools have resulted to lopsided, uneven and clustered location of learning establishments (Abraha, 2019; Ewendu, 2018; Olubor, 2017; Mustapha et al, 2016; Abbas 2012; Aliyu, Sule & Youngu, 2012; and Mustapha, 2006) thereby introducing a serious disparity in access to education.

Spatial distribution of schools is very crucial as it is considered as one of the potent factors that influence the distribution of educational resources both in quantity and quality. Equitable distribution of schools across zones and local government areas of any state, will ensure even distribution of facilities in the

schools such as teachers, equipment, school buildings and other facilities needed for proper functioning of schools as well as for even development of the learners anywhere they reside, be it urban or rural areas in the state.

Olamiju & Olujimi (2011) acknowledged that equitable distribution of schools and its facilities was desired to ensure even development of people and their environment. This is absolutely necessary especially in this era when there is a sharp increase in the number of primary school completers which places intense pressure on the growing demand for secondary education coupled with the fact that there are not enough places to accommodate the teeming populace demanding for secondary education due to acute shortages of secondary schools. To ensure that schools are rationally distributed, school mapping techniques are applied using some school mapping tools such as Global Positioning System (GPS) and Geographic Information System (GIS). These tools can clearly identify the areas where schools and educational facilities are lacking. GPS and GIS are the most ideal techniques employed for equitable and even distribution of schools among localities. Fabiyi & Ogunyemi (2015) discovered that geographical location and spatial distribution of primary school in developing countries were characterized by an uneven distribution that commonly limited the level of accessibility, which, in turn, affected the quality of education. As indicated by Caillods (1983), school mapping is used to investigate and ensure an efficient and equitable distribution of schools and resource within and between school systems, especially when a large scale reform or significant expansion of educational system takes place.

Researchers in education such as Aliyu, et al (2012), Olubadewo, Abdulkarim & Ahmed (2013) and Ewendu (2018) found the application of Global Positioning System (GPS) and Geographic Information System (GIS) very useful in mapping learning establishments in order to ensure equitability in the location of schools, distribution of learning facilities, enrolment of students, assessment of distances covered by students to school and the distribution of teachers.

Study Area

Imo State is one of the 36 States in Nigeria, with Owerri as its capital. It is located in the South-Eastern part of the country and it is subdivided into three senatorial zones, among which is Owerri Senatorial Zone which is further subdivided into Owerri Senatorial Zones 1 and 2. It covers an area of around 5,288 square km and lies between latitude 5.476310 and longitude 7.025853. It is the most populous zone in the State with an estimated population of 1,401,873 as at 2016. The population density varies from 230 persons per square km to 1,400

persons per square km. Owerri Senatorial Zone comprises 9 Local Government Areas among which is Ikeduru Local Government Area.

Average Distance Travelled by Students to School using the Geospatial Approach

The proximity of learning places to the homes of the learners is an important factor that enhances attendance in school because, long distances from the students' residence to school are attributed to be among the major reasons discovered to influence the students' academic performances in schools. According to Nyandwi (2014), distance is a factor that influences students' academic performances in secondary schools. Studies have shown that one of the effects of a long distance to school is that it reduces learners' study time utilization, hence, influences academic performance of students. This is why some schools provide official transport for students in order to enhance time utilization for both students and teachers (Simiju, 2015). It is important that schools should be built in areas where students can easily go to school from their homes without much stress. Duze (2010) stipulated that in the establishment of schools, consideration should be given to closeness to students' homes.

Some researchers such as Abbas (2012), Mustapha *et al* (2016) and Ewendu (2018) who adopted this approach found it useful and stipulated that it was the best approach because it enables a nearest neighbor analysis or buffer analysis to check if schools were evenly dispersed within the area of interest. By so doing, it enables a geo-database to be created upon which queries were conducted. This provides a framework for fixing priorities and determining objectives upon which best decisions can be taken whether schools should be located inside urban residential or commercial districts.

A centrally located school reinforces community life and spirit because it is easily accessible to many children in that community. When schools are sited in low density housing areas, most children are likely to live far away from school and there is the likelihood that the students will trek long distances to get to school. If schools are located in close proximity to higher density areas, children will live nearby and will more likely walk to school without any difficulty. Schools should be close enough to the neighborhoods they serve for students to go to school. To this end, UNESCO (1991) reported that in India, the maximum walking distance to school from students houses was set to be less than 1km for lower primary school level of education and 3km for upper primary and secondary levels. Nyandiwi (2014) and Jiya *et al* (2014) therefore, concluded that the long walking distance from home to school contributed to a poor academic performance of students.

Statement of the Problem

There has been growing concern about the rapid expansion of students' population without commensurate expansion of educational resources owing to the dearth in school places as well as acute shortage of physical and material resources required for institutions to function effectively. This is perceived to have given rise to recurring poor academic performances of students in secondary schools despite government, parents, community and resources to secondary education to make the system efficient. This calls for investigation and proper planning. Therefore, it is very important to find out: What is the pattern of distribution of public secondary schools in Owerri Senatorial Zone of Imo State? Which residential Zones is the location of schools deprived more than others? What is the level of accessibility of public secondary schools to students in this locality?

Research Question

To guide this study, the following research questions were raised:
1. What is the pattern of the distribution of public secondary schools in the different locations in Ikeduru LGA of Imo State?
2. Are the public secondary schools accessible to students in Ikeduru LGA?

Purpose of the Study

The purpose of this study was to determine the pattern of spatial distribution of public secondary schools in the different locations in Ikeduru LGA and to ascertain the level of accessibility of students from their homes to their various schools.

Significance of the Study

The geo-database (longitude and latitude) created in this study of the existing public secondary schools will provide valid documents to the educational planners, government, managers, Ministry of Education and researchers, and this will help in the equitable spatial distribution and location of schools in order to correct the imbalance in the distribution of schools.

Methodology

A descriptive survey research design was adopted in this study. The target population of this study comprised all the 13 public secondary schools in Ikeduru LGA which were selected and used in the study. The sample for the study comprised all the 13 public secondary schools in Ikeduru LGA which were purposively selected. The schools were stratified using stratified sampling

techniques and10% of 4,969 to give 497 students as the sample size which was selected using simple random sampling techniques to select the sample size of SS3 students. The instruments designed to collect the primary and secondary data comprised two checklists namely: School Location Checklist (SLC) and Accessibility of School Network Checklist (ASNC). The SLC was used to collect primary data known as spatial data using the Global Positioning System (GPS) handheld receiver which was used to collect the coordinate values such as the longitude and latitude of each public secondary school in the study area. It was also used to find out the actual location of the various schools in the locality of Ikeduru LGA in the Zone, while the secondary data known as the attribute data gave the background information of the schools such as the names of the schools, name of the community where the school is located and local government area, the students' enrolment figures and their present class. The data collected were analyzed using descriptive statistics which included percentages, frequencies count, mean and the Geo-statistical analysis which was conducted using the ArcGIS for the production of the maps of the study area.

Presentation of Results

Research Question One: What is the pattern of the distribution of public secondary schools in the different locations in Ikeduru LGA in Owerri Senatorial Zone of Imo State?

The research question was answered using the handheld GPS receiver which collected the coordinates (longitude and latitude) of all the 13 public secondary schools in Ikeduru Local Government Area in Owerri Senatorial Zone and the results were displayed in Table 1.

Pattern of Distribution of Public Secondary Schools in Ikeduru LGA in Owerri Senatorial Zone

Table 1: Distribution of Public Secondary Schools in Ikeduru LGA by Population Density

LGA	No of schools	Percentage distribution (%)	Population (based on 2006 census result)	Mean Enrolment for 5Years (%)
Ikeduru	13	11.50	74,712	90.80

Source: (1) National Population Commission (2006)

Table 1 displayed the pattern of distribution of the public secondary schools in all the localities in Ikeduru Local Government Area and it revealed the number of schools in the LGA, the percentage of schools distributed in the LGA of Owerri Senatorial Zone, the population of the LGA based on the 2006 census data results as well as the mean enrolment of students from 2010/2011 to 2014/2015 academic sessions. Table 1 revealed that Ikeduru LGA with a population of 74,712 as at 2006 census report had 13 public secondary schools representing 11.50% of the distributed public secondary schools in Owerri Senatorial Zone.

Also, Table 2 comprised the names of the schools, zone, locality name where schools were located and the coordinates (longitude/Easting and latitude/Northing) indicating their attribute and spatial data. In Ikeduru LGA, the names of the schools, serial numbers of each school, names of Local Government Area, LGA Headquarters, locality name which were the attribute data as well as the coordinates (Easting and Northing) of each school which were the spatial data were presented in Table 2. These were accompanied by their corresponding maps in Figures 1 and 2.

Table 2: Pattern of Distribution of Public Secondary Schools in Ikeduru LGA, Owerri Senatorial Zone showing the Attribute and Spatial Data

SN	State	LGA Name	LGA HQ	Locality Name	Name_of_ School	Sena- torial Zone	Longi- tude	Latitude	Easting	Northing	NEAR _FID	NEAR_DIST
1	Imo	Ikeduru	Iho	Obodo Amaimo	Amaimo Comm Secondary School	Owerri Zone 1	7.18701	5.57956	299176	617037.6	0	4676.138
2	Imo	Ikeduru	Iho	Amatta	Amatta Comm Secondary School	Owerri Zone 1	7.09135	5.54154	289188.4	612798.2	0	7344.191
3	Imo	Ikeduru	Iho	Ntu Atta West	Atta Secondary School	Owerri Zone 1	7.12124	5.60568	292343.8	619395.2	0	2731.026
4	Imo	Ikeduru	Iho	Umu- ezem Ugirike	Comm Secondary School Ugirike	Owerri Zone 1	7.21675	5.56759	302467.3	615703.7	0	8178.465
5	Imo	Ikeduru	Iho	Umuoti Inyishi	Comm Secondary School Inyishi	Owerri Zone 1	7.1726	5.60396	297587.6	619741	0	3592.108
6	Imo	Ikeduru	Iho	Amato Avuvu	Commpr Secondary School Avuvu	Owerri Zone 1	7.17085	5.60869	297395.4	620264.8	0	3752.466
7	Imo	Ikeduru	Iho	Amaeke Ihuo Dinueze Alim	Iho-Dimeze Compr Secondary School Ngugo	Owerri Zone 1 Owerri	7.09166	5.60869	291509.3	616625.3	0	3272.994

8	Imo	Ikeduru	Iho	Ngugo	Compr Secondary School Ikeduru	Zone 1	7.13808	5.57604	293752.9	616665.2	0	1397.015
9	Imo	Ikeduru	Iho	Amanwegbu Umuonunaka Owu-binubi	Owu-Amakohia Secondary School	Owerri Zone 1	7.19468	5.51983	300005.7	610429.1	0	9165.303
10	Imo	Ikeduru	Iho	Amamba Eziama	Secondary Commercial School Eziama Umudim	Owerri Zone 1	7.15013	5.5635	295083.8	615274.1	0	2582.366
11	Imo	Ikeduru	Iho	Ndiokwu Umudim	Secondary School Umuoziri	Owerri Zone 1	7.15615	5.62872	295109.7	620987.2	0	3230.431
12	Imo	Ikeduru	Iho	Umu-oziri Inyishi	Secondary Tech School	Owerri Zone 1	7.15531	5.57892	295663.2	616977.7	0	1375.568
13	Imo	Ikeduru	Iho	Umu-kpechi Uzoagba	Uzoagba Secondary School	Owerri Zone 1	7.12064	5.54895	291810.9	613675.2	0	4961.456

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Figures 1 and 2 showed the name of each school as labelled by its serial number on the maps. The schools were labeled using their serial numbers as entered in the Microsoft excel file which was used to plot the schools on the map. The LGA Headquarters were labelled using the name. They were described by their legends. The map of Ikeduru Local Government Area showing the location of each school within LGA was displayed in Figure 1, indicating the pattern of the distribution of public secondary schools and the local government headquarters in Ikeduru LGA in Owerri Senatorial Zone. Furthermore, Figure 1 revealed that the distribution of the public secondary schools as indicated on the maps concentrated around the LGA Headquarters and a vast majority of the communities were not served with secondary schools. It showed illogical, clustered and uneven distribution of schools across the LGA indicating lopsided school locations.
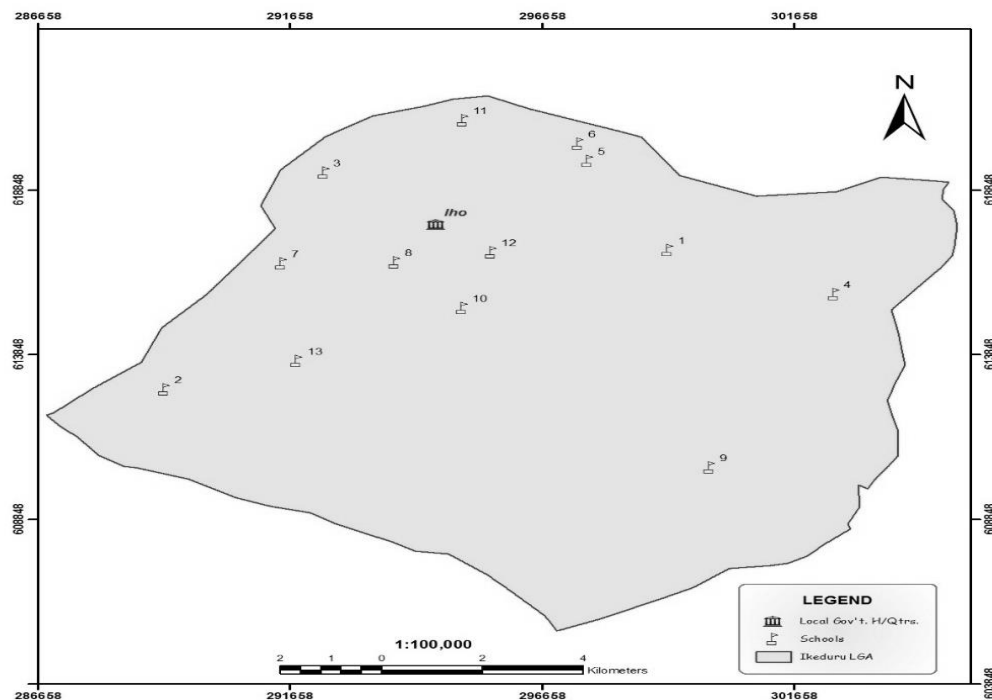
Figure 1: Map showing the Spatial Distribution of Public
Secondary Schools in Ikeduru LGA

The map displayed in Figure 1 showed that Ikeduru LGA had 13 public secondary schools. It represented 11.50% of the public secondary schools distributed in the area. The population of Ikeduru as recorded in 2006 census was

74,712. The displayed map showed that the public secondary schools in Ikeduru LGA were not evenly distributed as revealed in Figure 1. Also, Figure1 revealed that there were no schools around the communities bounded by the area between 291658N to 301658N and between 603848E to 613848E. Furthermore, Figure 1 also revealed that school numbers 5 and 6 as well as school 8, 10 and 12 clustered while schools 1, 4 and 9 were sparsely distributed.

Research question two: Are the public secondary schools accessible to students in Ikeduru LGA in Owerri Senatorial Zone?

To measure the accessibility of the existing school network in physical terms in different locations of schools in Ikeduru LGA in Owerri Senatorial Zone of Imo State, a variable such as distance travelled from the domiciles of students to school was analysed and the result was presented in Tables 3 and further displayed in Figure 2.

To answer the question, the data on the average distance travelled by students from their homes (domiciles) to school in the different locations of public secondary schools in Ikeduru LGA in Owerri Senatorial Zone were collected and analysed using frequency and percentage. The result was presented in the range of: less than 1km, 1 to 3km; 4 to 5km and 6km and above as shown in the Table 3.

Table 3: Average Distance Travelled by Students from Home to School

Local Government Area	Distance Travelled from Home to School by Students			
	Less than 1km (%)	**1-3km (%)**	**4-5km (%)**	**6km and Above (%)**
Ikeduru	27.0	36.5	29.8	6.7

Source: Data from field work

Table 3 indicated that the percentage of students who covered the average distance of less than 1km from home to school was students from various public secondary schools in the LGA, representing 27.0%. The percentage of students who covered average distance of 1km to 3km accounted for 36.5%. Also, students who covered an average distance of 4 to 5km to school represented 29.8%, while 6.7% accounted for students who covered 6km and above. The analysis from Table 3 also showed that the percentage of students who covered average distance of less than 1km to 3km in Ikeduru LGA was 63.5%. Meanwhile, the percentage of students who covered the average distance of 4km to 6km and above, in this LGA were 29.8%.

Buffers were created around each school cited in this study, within the Ikeduru Local Government Area in Owerri Senatorial Zone. The centre of each circle was the location of the school around which the buffer was created.
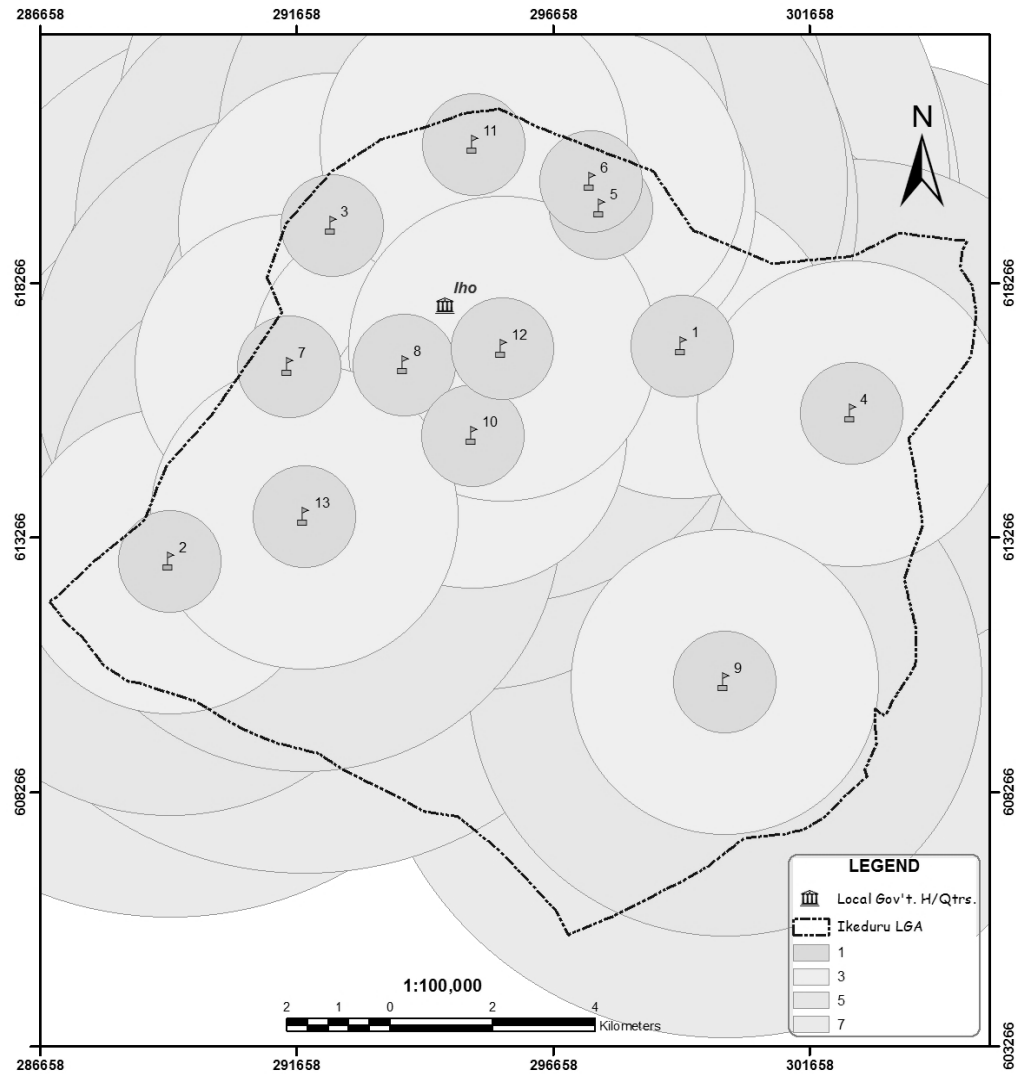
Figure 2: Buffer Map for Ikeduru LGA showing the Service Area of each School

Figure 2 showed a buffer map of Ikeduru LGA. The schools were represented by green flags, labelled using their serial numbers while the

administrative boundary of the LGA was seen as a red/blue broken line as the case may be. The LGA headquarters were seen represented by a blue building and labelled with the LGA headquarters name. Each buffer around the schools was seen as a coloured ring or band. The first was the 1km buffer radii around the school and the next band (pink) was the 3km buffer measured from the school to the circumference of the pink ring/band. The 5km buffer was the yellow band while the 7km buffer was the light blue band. The buffer analysis in Figure 2 further buttressed the data in Table 2

Discussion of Findings

Research question one sought to find out the pattern of the distribution of public secondary schools in the different locations in Ikeduru LGA of Imo State. The findings from the analysis produced by the ArcGIS showed clustered, lopsided and uneven spatial distribution of the public secondary schools as shown in Figures 1 and 2 of the digital map. The analysis further showed that the existing public secondary schools were sited mostly around the Local Government Headquarters indicating clustered locations, unbalanced and uneven distributions of schools across the LGA. This implies that students who attended school from a far distance are at a great disadvantage because when schools are lopsidedly distributed very far from students' homes, it will affect their regular attendance to school and will invariably, influence the student's academic performance in schools.

This study agreed with Olamiju & Olujimi's (2011) work which saw a lopsidedness in the distribution of educational facilities in Akure Region which had resulted in the decline in the quality of education. Consistent with these findings, Mugu (2015) found an inequality in the distribution of educational facilities in primary schools in Kaura LGA, Kaduna State, Nigeria. The findings were also consistent with Abbas' (2012) work which found a great spatial unevenness in the distribution of secondary schools in Sabon-Gari and Zaria Local Government Areas of Kaduna State.

Accessibility of public secondary schools in Ikeduru LGA was the concern of research question two. The findings revealed in Table 3 and Figure 2 showed 27.0% of students who lived less than 1km buffer service radii from their homes to schools in the different locations of the public secondary schools in Ikeduru LGA. they lived very near to school and therefore, had very high accessibility to school. Similarly, 36.5% students living within 1km to 3km buffer service radii lived near the school and, as such, had high accessibility to school. Meanwhile, 29.8% students living within 4km to 5km buffer radii lived far from school and consequently, they had low accessibility to school whereas, 6.7% of students

living within 6km to 7km and above lived very far from school. It implied that they had low to very low accessibility to school. Majority of 36.5% of students covered more than 3km to 7km and above to reach their schools. The average distance of more than 3km to 7km and above covered by students from their homes to school was outrageously very far and indeed, far greater than the distance norm stipulated by UNESCO (1991) that the maximum distance covered by students in secondary schools from home to school should not be more than 3km. This is attributed to the fact that schools are unevenly distributed across all the localities in Ikeduru LGA. When schools are located close to students' homes, it encourages them to go to school and this increases enrolment of students in such areas. But when schools are located very far from students' places of residence, majority of those who travelled far to receive education might, in the long run, be discouraged from going to school, lose interest in schooling and eventually drop out of school due to the hectic and strenuous journey to school. Distant journeys of more than 3km from students' homes would be very hectic and strenuous as they would likely arrive to school late and tired. Consequently, they may not concentrate in their lessons and this will adversely impact on the quality of instructions received by the students. The culminating effect will lead to poor academic performance and a high rate of dropout of students from school. The findings were consistent with those of Mustapha et al (2016) which revealed that limiting the level of accessibility to facilities made users in rural areas to travel longer distances than expected to access the schools of choice. Abraha (2019) agreed that an uneven distribution of educational institutions not only denied accessibility but also, greatly affected education quality. In line with this, Mustapha et al (2016) agreed that a standard be raised in order to avoid travelling longer distances to access quality education at the expense of schools which are closer to them.

Conclusion

The geospatial analysis in this study revealed some localities that were not equitably served with schools. Students from those communities tended to travel very long distances to school. The existing public secondary schools clustered mostly around the local government headquarters. That showed an uneven spatial distribution of schools as a result of illogical and lopsided location of public secondary schools across Ikeduru Local Government Area in Owerri Senatorial Zone of Imo State. This study concluded that a journey greater than 3km to 7km and above taken by students to reach their schools was outrageously very far greater than the distance stipulated by UNESCO (1991) that the maximum

distance covered by students to school should not exceed 3km from the domiciles of the students.

Recommendations

Based on the findings, the following recommendations were made:

- Educational planners and managers should adopt school mapping techniques such as GPS and GIS in order to create a database of the schools so that, subsequently, new schools will be better located.
- More schools should be established in areas where the buffer radii revealed no school or sparsely distributed schools to ensure equity.
- No schools should be located more than 3km away from the domiciles of the students.
- Accessibility of students to school should be increased by establishing schools in close proximity to the students' homes in order to increase the rate of enrolment.

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