MAPPING SCHOOLS FOR INCLUSIVITY IN IFE CENTRAL LOCAL GOVERNMENT AREA OF OSUN STATE, NIGERIA

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Abstract:

The investigation created data sets using administrative boundaries and road networks in Ife Central Local Government area of Osun State, Nigeria. The study also mapped spatial distribution of primary schools in the study area and determined its primary school enrolments. The geo-database was also linked while a spatial decision support system for educational planning purposes in Ife Central LGA. These were with a view to ascertain the importance of GIS technologies in school mapping. The study gathered through field work using the Global Positional System (GPS) tool to collect the coordinate positions of the primary schools while oral interviews were held with 10 head teachers (N=31) or their proxies. The data so gathered were incorporated into the Geographic Information System (GIS) environment for analysis of water body in the study area while direct estimation of schools' enrolments, number of classrooms, number of teachers and their qualifications using survey approach. Results indicated the existence of 276 classrooms, 4677 pupils and 416 teachers in the 31 public primary schools located in little 'water body' areas; and major roads concentrated towards the southern part of the LGA. Most of the primary schools are located in the south (4.25 to 7.235 degrees) while the northern part of the study area had only four primary schools (7.237-7.350 degrees). The enrolment range of primary schools in the south was 259 to 600 pupils much more than enrolment range in the northern part (30 to 144). Results also showed the existence of a range of two classrooms (L.A. Middle School in Iremo Ward 1) to 22 classrooms at Baptist Elementary School in Ilare Ward 4 in the study area. The teachers possessed both Nigeria Certificate in Education (NCE) which is described as 'highly qualified middle level manpower in the National Policy of Education' (Federal Republic of Nigeria, 2013) and Bachelor degrees. The study recommended, among many other steps, a better spread of

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the schools towards the northern part in order to reduce the distance of schools thus complying with United Nations Children Fund two kilometres distance from homes in the study area; the need to build more classrooms in the northern part and thus divert some resources from the south to the northern part of the study area particularly in the urban slums; and thus, disaggregating crowded settlement in the south. The study concluded that the GIS technology was capable of engendering inclusivity and efficiency in the management of schools' establishment.

Keywords: global positioning system, school mapping, accessibility

1. Introduction

The location of primary schools in an environment usually hinges on certain conditions, which often include politics and localisation of residences. The alarming rates of out-of-school children in Nigeria which was eight million in January 2019; 13.2 million in April 2019; and 14 million in January 2020 (Federal Government of Nigeria) draws attention to factors which may be responsible for high out--of-school rates and low school attendance rate. The Millennium Development Goals (2000) and the Sustainable Development Goals (2015) emphasise the need to achieve 100% enrolment in primary schools by 2015 and 2030, respectively. In this regard, the various states in Nigeria, through the existing local governments have started establishing more primary schools. In spite of efforts of the State to facilitate the reduction in out-of-school population in Nigeria, much success appears not to have been recorded in this direction. The continued persistence of increasing out-of-school population may be attributed to weak administrative planning. This investigation focussed on the use of GIS tools for the mapping of primary schools to boost enrolment and reduce the incidence of out of school cases.

Administrative planning has reference in the delineation of the likely consequences of options among various alternatives in order to ensure efficiency and effectiveness. In school administration, administrative planning relates to the blueprint for the management of schools. It defines the boundaries for the implementation of educational plans.

Many authors have expounded views on school mapping and its relevance to educational development (Gould, 1994; National Institute for Educational Planning and Administration (NIEPA), 1997; Rangaraju, 2012; Sabir, 2013; Adelokun & Adewole, 2017). The emphasis in all these works is on the location of schools in appropriate parts of a community in such a way that social exclusion is avoided. School mapping involves the identification of locations where schools are in terms of geographical and demographic elements within a defined area. Mapping schools is necessary for the purpose of planning either for the establishment of new schools or estimating cost elements of human and material resources in the school system.

Akpakwu (2012) in Ekpoh (2018) stresses the objectives of school mapping to include increased access to educational opportunities; ensuring equity in the distribution

of educational facilities; ensuring safety and convenience to and from school; achieving 'cost efficiency and effectiveness' in the use of facilities; and preventing lopsidedness in the location of schools. Similarly, while Psacharopoulos and Woodhall (2001) emphasise the need to avoid underutilisation, Sabir (2013) calls for the need to ensure effective distribution of facilities through the appropriate mapping of schools. Mendelsohn's (2005) application of school mapping in Palestine recommends, among others, the rationalisation of the network of school curriculum, planning new schools in densely populated areas to combat overcrowding in schools and planning the 'deployment of teachers' appropriately. Hence, appropriate location of schools is captured in school mapping when planning the establishment of schools. In this age of technological advancement, one of the tools that can be used to achieve appropriate mapping is the Global Positioning System (GRPS or GPS), through Geographic Information System (GIS). GIS has become a relevant tool for the planning of the provision of educational infrastructures particularly in developing countries where the response rate to the social demand for education has become so topical.

The United Nations Development Programme (UNDP) in Human Development Reports (2016) emphasises the need to 'enlarge the freedom' of citizens. Though its focus was on "agencies and health", one of such freedoms could be extended to freedom to receive education with minimal hindrances. This emphasises universalism of schooling. Every citizen is supposed to have unfettered access to schooling; and, in the context of this study, basic education. This may not be achieved if the distance of schools to homes is unfavourable to the beneficiaries. In such situation, the distance increases either the direct costs of schooling (through transportation costs) or indirect costs (such as causing fatigues arising from travelling to and from schools). Thus, the location of schools becomes a strong factor in ensuring human development at that level and by implication, the Sustainable Development Goal 4.

Osun State is one of the 36 states in Nigeria. It has 30 local government areas (LGAs) and an Area Office. Figure 1 shows the distribution pattern of the settlements and the existing schools. As far back as 1981, Nwankwo had alerted Nigerians of the challenges to educational planning. He identified these challenges as weak data base, inadequate resources, depressing economy and a host of others. The 'weak data base' observation might be a real issue as many plans are implemented without accurate data. In addressing the challenge of weak data base in other climes of the world, many researchers (Fatemah, Yuji & Todd, 2009; Okan 2012; Anurag, Surabhi, Anju & Shashi, 2014;) and a host of others have applied GIS in their investigations on educational planning. Fatemah *et al.* (2009), focussing on Northern Iran, have suggested the introduction of free bus service for pupils who travelled more than 1.7 kilometres in Northern Iran. Okan (2012), concentrated on Tbilishi, Georgia. Okan showed the need for each education unit to have access to a common database. Anurag *et al.* (2014) assessed the education system of a municipality in India by generating spatial and non-spatial data of school location, road network, population of teachers and their qualifications as well as number of buildings in each school.

2. Statement of the problem

One of the pressing social challenges facing most developing nations, including Nigeria, is the rapidly increasing social demand for education in the face of steadily decreasing resources for it. The education system in Nigeria has witnessed various challenges because of inadequate planning particularly for the distribution of facilities in schools. Some schools may be located where they are not needed; some may be overstaffed while others are understaffed. Some need more infrastructure than others; unfortunately, the available resources are allocated where they are not needed thereby making things to be difficult for educational planners and administrators.

The State government of Osun faces a myriad of problems in relation to service provisions to the local education board. There is, therefore, lack of coordination in investment especially infrastructure, public utilities and human resources resulting in inequitable and imbalance in education facilities due to poor access to these essential educational services.

GIS is one of the most promising means for enhancing equality in distribution of educational facilities among the public schools, who largely depend on government or donor support for survival, and provision of utilities and services. The focus of this Geographic Information System (GIS) is to emphasise the use or applicability of GIS in Education by determining education district, teachers' qualities, infrastructural facilities, create school mapping, where school can be established and help decision makers to solve problems which are related to location geographical in education easily and quickly. This calls for geospatial and personnel assessment of public primary schools in Ife Central Area of Osun State to correct perceived imbalances in distribution of human and material resources for educational planning and administration.

3. Research objectives

The aim of the investigation is to apply GIS in building a proper spatial decision support system that can be used to plan the siting of schools in the study area. The specific objectives are to:
   1) create spatial data sets with administrative boundaries and major road networks within the communities in the study area;
   2) map spatial distribution of primary schools in the study area;
   3) determine primary school enrolments in the study area;
   4) link the geo-database in education decision support system to the spatial data.

3.1 Research questions
The investigation was guided by the following questions:
   1) Where are the boundaries of Ife Central Local Government Area in Osun State, Nigeria?
   2) Where are the existing primary schools in the study area?

3) What are the primary school pupils' enrolments in the study area?
4) What are the links of the geo-data base of the primary schools in the study area with particular reference to location, distribution and nearest neighbour analysis?

4. The study area

Ife Central Local Government Area is bounded in the south by Ife East Local Government Area, in the west by Ife North Local Government, in the east by Ondo State and in the north by Ilesha. The headquarters of Ife Central Local Government Area is along Ibadan express Road. Geographically, it is located between latitudes 7 ̊28' 43.5"N and 7 ̊34' 51.41"N; longitudes 4 ̊27' 22.5"E and 4 ̊35' 40.61"E; and an altitude of 256m above sea level (Figure 1). The climate is tropical. Like every other Southwest area, the rainy season starts April to October while the dry season lasts October to March with mean annual rainfall of about 1400mm, relative humidity is about 75.8% and 86% while the dry season runs from November to March with temperature ranging between 280C to 340C. The population of the area is about 167,254 persons consisting of 88,403 males and 78,801 females based on the National Population Commission census result of 2006. A graphic description is presented in Figure 1.

Figure 1: The Study Area: Ife Central Local Government Area, Osun State, Nigeria
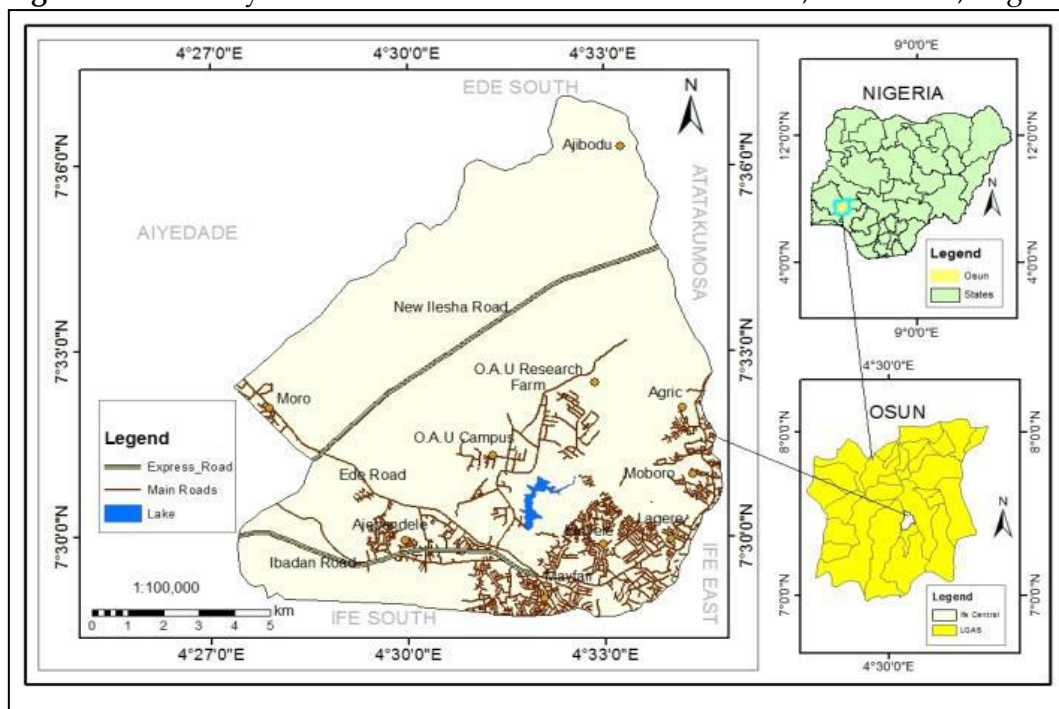
(**Source:** Fieldwork)

5. Method

Primary and secondary data were gathered mainly from two sources: head-teachers of primary schools in Ife Central local government area of Osun State, Nigeria and the

global positioning system (GPS) of primary schools prepared through the field work. The primary data comprised the information gathered through the use of Garmin Global Positioning System while secondary data were obtained through field work. All the 31 primary schools were visited and oral interviews were conducted with the 31 head teachers to gather information on school teachers, pupil's information and data on school facilities. The global positioning system was used to collect coordinate points of the schools. The GPS was used to determine the precise location of Schools. The attribute information was merged into a set of data on school locations (x, y co-ordinates). All the spatial data and non-spatial data were captured in Geographic Information System Platform for geospatial assessments of the school and personnel.

6. Results and discussion

In order to explore the research questions, the findings were subjected to map interpretation.

Research Question 1: Where are the boundaries of Ife Central Local Area in Osun State, Nigeria?

First question required the description of major towns, roads and water body in the study area. This is captured in Figure 2:

Figure 2: Showing the Major Towns, Road and Water Body in the IFCLGA
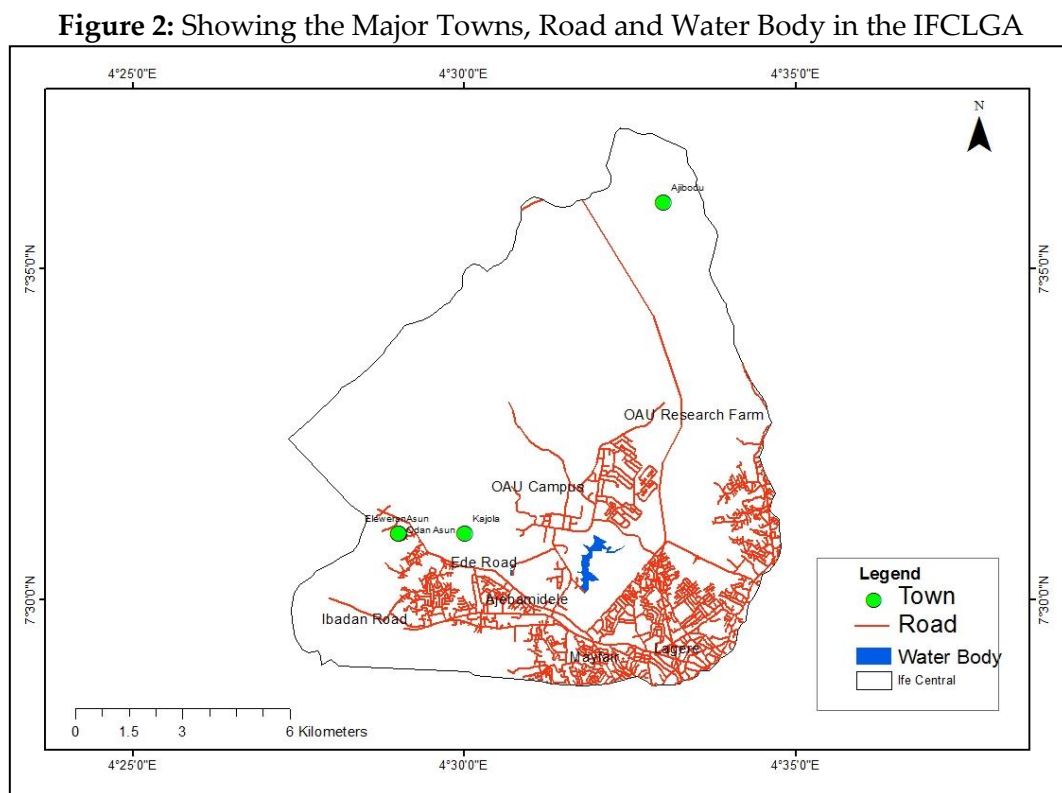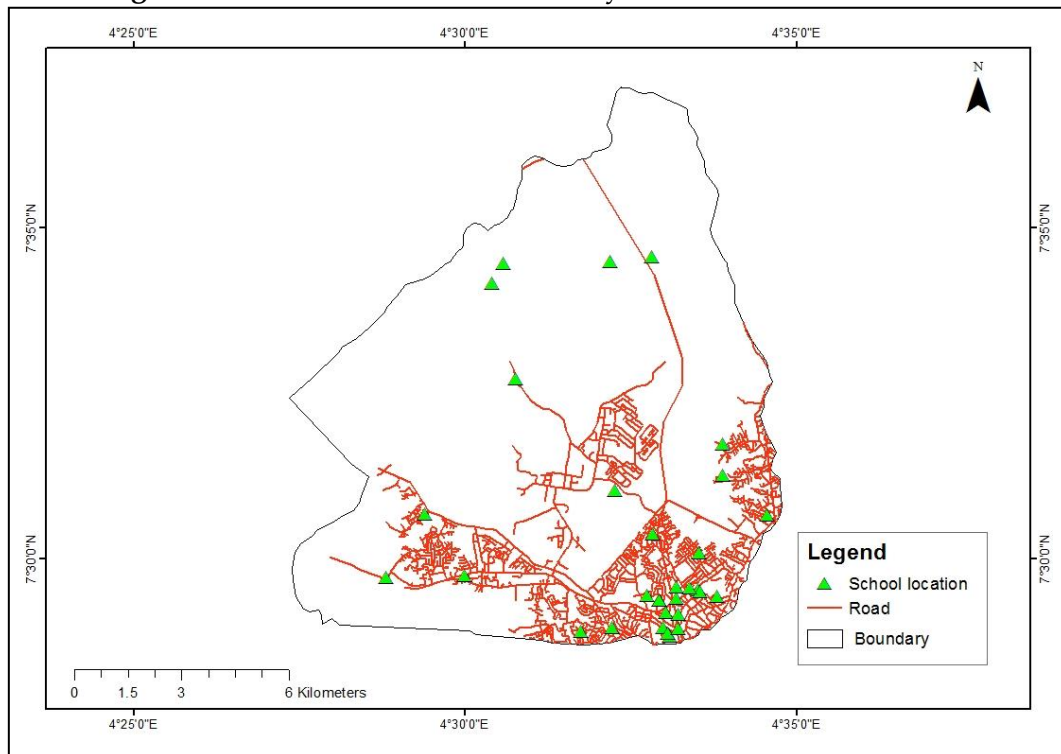

(**Source:** Fieldwork)

Figure 2 shows that in most of major towns, roads and waterbody are more towards the southeastern part of the LGA than the north and southwestern part. This has

implications for the school system. The western part of the LGA has sparse population and therefore very few schools. With very few major roads, the western part may not support adequate learning. This is because not only are schools very few, access roads are scanty. There is the possibility of numerous private primary schools in the north and southwestern parts. Municipal facilities may be inadequate too in the northwestern part of the LGA thus leading to increased costs of managing existing private schools.

Research Question 2: Where are the existing public primary schools in the study area?

Figure 3 shows the location of existing public primary schools. The Figure shows the existence of five public primary schools in the northwestern part of the LGA; three in the southwest and 23 in the southeastern part. This is captured in Figure 3.

**Figure 3:** Distribution of Public Primary Schools in Ife Central LGA

(**Source:** Fieldwork)

The preponderance of the existing public primary schools in the southwestern part might be as a result of the scanty settlement pattern in the northwestern part. From interviews with the headteachers, the war between Ife and Modakeke cost many residents their buildings and schools were not also spared. This, in essence, implied that the few public schools might be running below capacity since the population is scanty too.

Research Question 3: What are the primary school pupils' enrolments in the study area?

Data gathered from the school registers were extrapolated and compressed in a graphic form in Figure 4.

Figure 4: Enrolments of Public Primary Pupils in Ife Central LGA
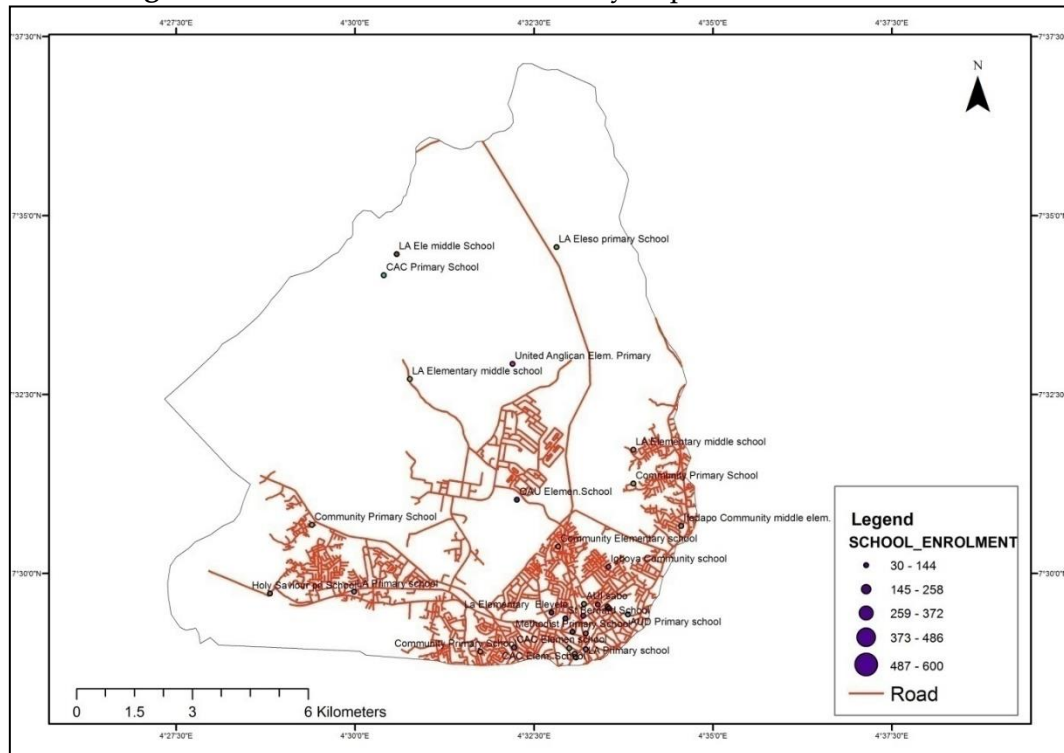
(**Source:** Fieldwork)

The legends of school enrolment in Figure 4 show the incidence of large enrolments in the southestern part of the LGA. The range in 2016 was between 259 and 600 while northwestern part recorded as low as 30 to 144. This did not come as a surprise. The scanty human population could not account for any large enrolment in the northwest. The terrible effect of communal crisis of late 90s is still being felt by the two communities located within Ife Central LGA. This further confirms the harmful effects of communal crises on educational development of affected areas. These include overpopulation in some areas leading to large enrolments and pressure on municipal facilities such as roads and basic amenities. With the current state of the Nigerian economy (the local government councils not exempt from the dwindling resources) and the consequent toll on educational infrastructure, primary education goals may be at the lowest level of implementation.

Research Question 4: What are the links of the geo-data base of the primary schools in the study area with particular reference to location, distribution and nearest neighbour analysis?

This question required data on specific characteristics of each of the 31 primary schools in the study area which were collected from the Independent National Electoral Commission (INEC) office in the LGA for Ward location. The data are presented in Appendix 1. Variables such as location of school, ward name, school enrolment, number of classrooms, number of teachers, teachers' qualifications, number of buildings (all as at

2018) longitude and latitude. The data in Appendix 1 were then compressed and analysed to give the chloropleth map in Figure 5.

Figure 5: Distribution of Primary Schools in various Wards in IFCLGA (Chloropleth Map)
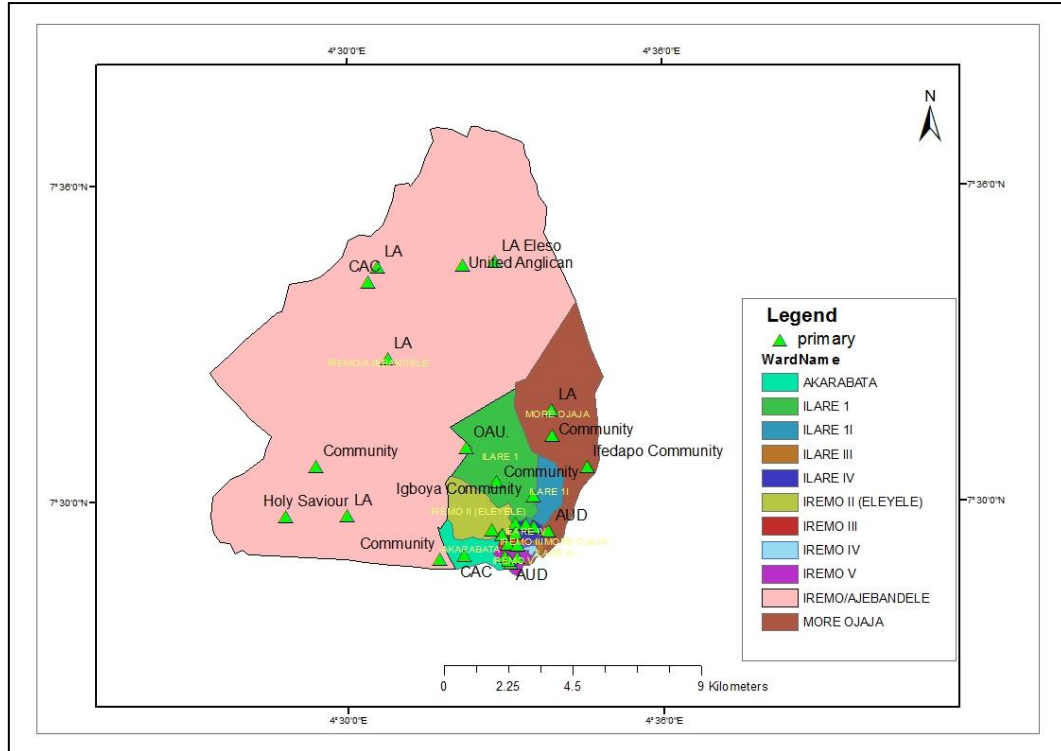
(**Source:** Ife Central Local Education Authority and Fieldwork)

Figure 5 captures, in a Chloropleth map, the characteristics of the 31 public primary schools under investigation. A ward by ward analysis was further done to show the political and educational implications of the location of the primary schools. This is in view of the need to maintain the maximum of two kilometres distance of each school to the home of a beneficiary as recommended by United Nations Children's Fund (UNICEF). Politically, it may be unfair to have the location of schools tilted more towards a part of ward than other wards. Some observations noteworthy include: of the 11 wards in IFCLGA, Iremo 1/Ajebandele ward has the highest number of public primary schools (9) followed by Ilare 4 (4); Iremo 3 (4); Ilare 1(3); Ilare 2 (1); Akarabata (1); Iremo 5 (4); More/Ojaja (4); while Ilare 3 and Iremo 4 both have no public primary schools. The study also captured the Average Nearest Neighbour (ANN) summary through pattern analysis of the data on location of schools in wards. This is presented in Figure 6.
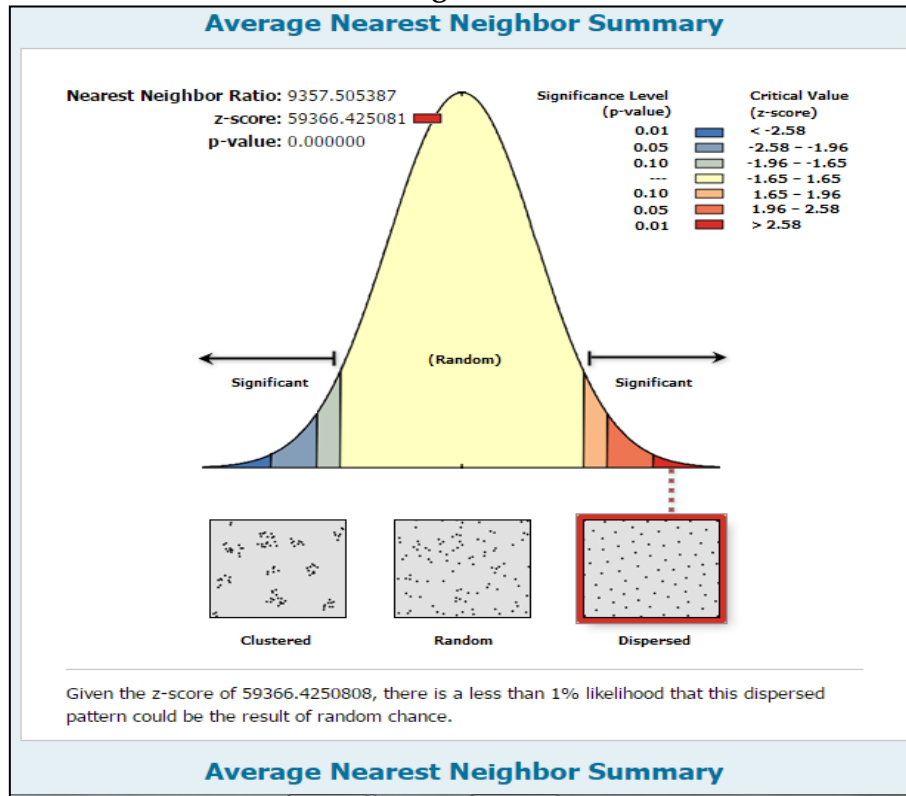
Figure 6:

Average Nearest Neighbor Summary

Nearest Neighbor Ratio: 9357.505387
z-score: 59366.425081
p-value: 0.000000

Significance Level (p-value) | Critical Value (z-score)
0.01 | < -2.58
0.05 | -2.58 – -1.96
0.10 | -1.96 – -1.65
--- | -1.65 – 1.65
0.10 | 1.65 – 1.96
0.05 | 1.96 – 2.58
0.01 | > 2.58

Given the z-score of 59366.4250808, there is a less than 1% likelihood that this dispersed pattern could be the result of random chance.
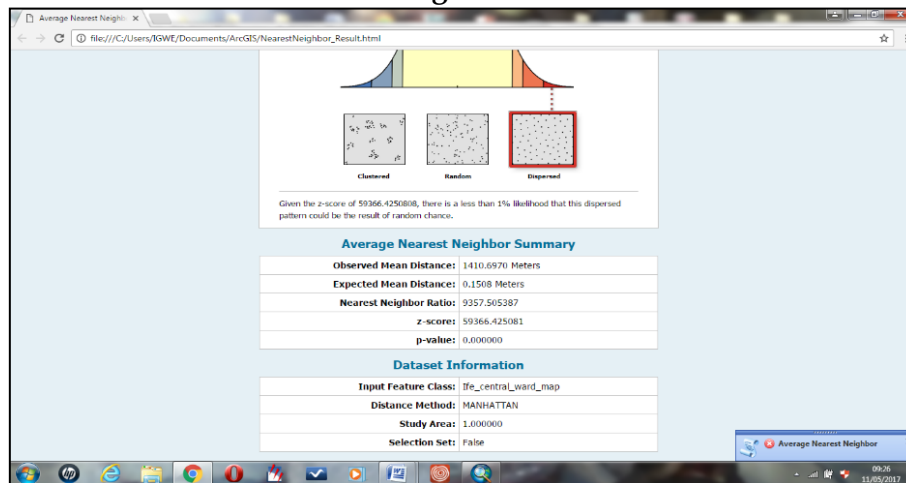
Average Nearest Neighbor Summary

Figure 7:

7. Discussion

Figure 2 shows the major towns, roads, water body, and facilities available in Ife Central LGA. The major towns include Kajola, Ajibodu, Eleweran Asun, Odun Asun. The facilities available are Obafemi Awolowo University and Opa dam. The spatial distribution of public primary schools in the area showed that more schools were concentrated in urban areas than in rural areas. This may be as a result of population density in the towns where various activities were ongoing and rural urban migration. There were a total number of 31 primary schools visited in Ife Central LGA. The

population of pupils in the primary schools (Figure 4) showed also that there were more pupils than other places especially in urban areas. The results showed that pupils were more concentrated in urban areas because of population growth and the business activities in the area. It also shows that this area has limited space for the establishment of schools because of the presence of markets. This is in line with the studies of Fatemah, Yuji, & Todd, (2009); Okan (2012); Olubadewo, Abdulkarim and Ahmed (2013); Fabiyi & Ogunyemi, (2015). The population was divided into five groups. The first schools ranged from 30-144. The second ranged from 145-258, the third from 259-372, the fourth from 373-486 and the last ranged from 487-600. The enrolment pattern showed that those schools in rural areas were mostly affected by decrease in enrolment because of sparse population. Those schools with high enrolments were located inside the urban areas with dense population.

Appendix 1 shows the geo-database of the primary schools in the study area with their names, location, ward name, school enrolment, number of classrooms, number of teachers, teachers' qualifications, number of buildings and coordinates (longitudes/latitudes). There was a total number of 31 Primary schools, 276 classrooms, 4,677 pupils and 416 teachers with qualifications ranging from NCE to Master's degree.

Teacher pupil ratio: This is one of the most useful and commonly used planning indicators in education. It is used for making projections about teaching manpower requirements of schools and enrolment forecast. It measures the number of pupils taught by a teacher at a particular time. It is expressed as total enrolment divided by the number of teachers. In this study, the ratio of pupil per teacher is 1:11 meaning that in every 11 pupil there is 1 teacher. The study area is within the United Nations Educational, Scientific and Cultural Organisation (UNESCO) standard ratio for primary school which stipulated 1:30. This finding shows that primary schools in Ife Central have many teachers with fewer number of pupils. (Appendix 1) This indicates that the teachers are very sufficient for the pupils in the classroom.

The average class size: This is measured by the average enrolment in a class at any level of the school system. A class size can be small, moderate or large depending on the general size of the overall enrolment. It is calculated by dividing the total enrolment by total number of the functional classroom available in the school system. In this study the average class size is 1:17 (Appendix 1). This is also within the UNESCO standard of 1:30 though the ratio led to underutilisation of various buildings in many of the schools visited.

Average school size: This relates to the size of students carrying capacity of a school on the average. It is an average measure of the number of pupils a school should accommodate. It is calculated by dividing the total enrolment in a level of education at a particular time by the total number of functional schools at that time. In this study, the average class size was 150. The data showed that many of the schools did not meet the class size standard. It is only those schools within the urban areas that met the criteria for the school size. The schools are St Mulumba, L. A Ajebandele, Baptist Primary School, St Peter's Primary School, Iremo, Methodist Primary School, Ifedapo, OAU Primary School,

St. Peters, Sabo and AUD, Ogbon-agbara which had school enrolment from 150 and above.

7.1 Pattern analysis

The extension of ArcGIS 10.4 was used for the analysis of the nearest neighbour using the spatial statistics from the toolbox by selecting the Average Near Neighbour. The results also show that the distribution of primary schools in the area (Figure 7) shows a dispersed rate with a significant level of 0.01 and a critical value of 2.58, while the SD was 59366.425081 standard deviation. The randomness showed 1% likelihood that the dispersed pattern could be as the result of random chance. The summary of average nearest neighbour shows that 1410.6970M was observed mean while expected mean is 0.1508M and the nearest neighbour ratio is 9359.505387 (Figure 6). The implications of this dispersed pattern shows that some pupils will travel more distance before getting to the schools especially those schools in rural areas (Fabiyi & Ogunyemi, 2015).

8. Recommendations

Public policies on education in developing economies are usually defective due to inability of policy agents to apply exactitude in their choices of policies. The implementers of policies thus have a window for manipulating policy designs particularly for political and/or pecuniary gains. There is a need for local government administrations to be made to provide land area for the siting of primary schools based on prepared plans by their state governments. These plans must be strictly followed in order to avoid the lopsidedness observed in this investigation.

While the indicators of teacher and students appear favourable in the investigation, the distance covered by some teachers who are resident in the west and north-western part of the LGA would only increase costs. Equitable distribution of primary schools would help ensure avoidable costs are not incurred.

Not only these, the use of accurate measurement in the location of schools would reduce resistance from the parents to the barest minimum. This is because of the scientific basis for siting such schools.

Conflict of interest statement

As authors, we declare that we have not authorised any other publisher to publish this work.

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Appendix 1: Geo-database of Public Primary Schools in IFCLGA

S/N	Name of School	Location	Ward Name	Sch. enrolment	Number of Classroom	Number of Teachers	Teachers Qualification Degree. NCE	Number of Building	Longitude X	Latitude Y
1	SS Peters and Paul Primary School	Ajigbayin	Iremo 3	200	17	20	4 16	7	4.55063	7.48641
2	CAC elem. school	Ojoyin	Iremo 5	94	7	9	3 6	3	4.5499	7.48261
3	St Micheal primary	Ogboagbara	Iremo 5	142	11	10	1 9	5	4.55147	7.48045
4	AUD Primary school	Ogboagbara	Iremo 5	275	15	17	1 16	6	4.55112	7.48128
5	LA Ele middle School	Olukotun	Iremo 1	46	2	4	0 4	1	4.5097	7.57433
6	CAC Primary School	Ita_Elewa	Iremo 5	68	11	6	3 3	5	4.50671	7.56945
7	LA Elementary middle school	AgbogboroIlefun	Iremo 1	80	6	5	0 5	2	4.51275	7.54524
8	United Anglican Elem. Primary	Ojo_olosa	Iremo 1	65	6	7	1 6	1	4.53661	7.57488
9	OAU Elemen.School	OAU campus	Ilare 1	200	13	16	7 9	6	4.5377	7.51716
10	LA Eleso Primary School	Ogbagile	Iremo 1	52	3	6	2 4	1	4.5469	7.57599
11	LA Elementary middle school	Aba Iya Gari	More Ojaja	75	6	8	1 7	2	4.5648	7.52878
12	Community Primary School	Opa	More Ojaja	80	6	10	2 8	1	4.5648	7.52091
13	Ifedapo Community middle elem.	Opa	More Ojaja	186	14	22	2 20	4	4.57596	7.51104
14	Baptist Elementary School	Ilare	Ilare 4	600	22	50	5 45	7	4.5588	7.49224
15	AUI Sabo	Ola_olu street	Ilare 4	200	7	19	4 15	3	4.5533	7.4929
16	Special Needs Children School	Ilare	Ilare 4	78	4	8	1 7	1	4.55918	7.49181
17	AUD Primary School	Ogbondo	More Ojaja	106	12	17	4 13	4	4.56354	7.49047

18	St Peter Primary School	Sabo	Ilare 2	258	16	20	2 18	7	4.5565	7.49273
19	Methodist Primary School	Opposite Oja	Ilare 4	205	6	19	3 16	2	4.55315	7.49015
20	St Peters Elementary school	Iremo	Iremo 3	388	15	26	1 25	5	4.55372	7.48602
21	LA Primary school	Akarabile	Akarabata	158	7	10	2 8	3	4.55372	7.48235
22	CAC Elemen school	Oke_Aanu	Akarabata	140	8	9	1 8	4	4.53707	7.48277
23	Community Primary School	AkileKajola	Iremo 1	56	6	9	0 9	2	4.48997	7.51131
24	Holy Saviour pri School	Fasina	Iremo 1	30	5	5	0 5	2	4.48018	7.49531
25	LA Primary school	Ajabandele	Iremo 1	180	7	18	3 15	4	4.4998	7.49572
26	Community Primary School	Oba Winnin	Iremo1	67	5	6	0 6	3	4.52919	7.48178
27	St Munumba Elementary school	Lagere	Iremo 3	200	7	16	0 16	2	4.549	7.4895
28	St Bernard School	Lagere	Iremo 3	120	7	8	3 5	2	4.549	7.4895
29	La Elementary Eleyele	Eleyele	Iremo 2	110	6	10	0 10	6	4.54576	7.49087
30	Igboya Community school	Agbola street	Ilare 1	98	6	13	1 12	3	4.55899	7.50156
31	Community Elementary school	Oluorogbo	Ilare1	120	8	13	1 12	4	4.5473	7.50624
Total				4677	276	416	68 328			

Sources: Ife Central Local Education Authority and Field work (2017).