

Creation of Geospatial Database for Educational Facilities in Oredo Local Government Area of Edo State, Nigeria

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Abstract: *This study aimed at creating a robust geospatial database for educational facilities in Oredo LGA of Edo State. This aim was achieved by: acquiring primary and secondary dataset of the study area, creating a geospatial database of educational facilities in Oredo LGA of Edo State, Nigeria, developing spatial and attribute queries that will aid in the management of educational facilities in the study area. The map of the study area was acquired and used to derive the base map through the process of digitizing using ArcGIS10.4.1. The coordinates of each school was obtained using a hand-held global positioning system (GPS) receiver and plotted on the base map. A very robust geospatial database was created after which spatial and attribute queries were carried out. The results show that the Oredo LGA has a very low teacher – student ratio of 1:43 as against 1:25 advocated by the National policy on Education 2011. Results further reveals that about five settlements in the study area do not have post primary school and majority of the schools are over populated. Spatial and attribute queries generated shows that only two (2) schools have toilet facilities with water while the remaining eleven (11) schools have no toilet facilities. Five (5) out of the thirteen (13) schools are built within about 500m to the moat which are seriously threatened by gully erosion from the moat. About three (3) schools have dilapidated buildings.*

Keywords: *Database, Education, Facilities, Geographic Information System, Management*

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I. Introduction

Education is a basic human right and is indispensable for the realization of other human rights as a means for accessing broader social, economic, political and cultural benefits. This is because it is transformative and empowering. Education contributes to building more just societies through reducing poverty and inequalities, enhancing acceptance of diversity, and promoting respect for the rule of law (Aliyu et al., 2012). The challenge of making adequate provision of facilities in the educational system lies in the management of facilities and the use of Geographic Information System tool is necessary. In a general sense the term GIS describes any information system that integrates, stores, edits analyzes, shares and display geographic information for informed decision making. GIS applications are tools that allow users to create interactive queries, analyze spatial information, edit data in maps and present the results of all these operations (Clarke, 1986).

Geographic information system (GIS) and education share common characteristics that cross the boundaries of disciplines and application areas. Similarly, education has been a subject of interest to every areas of our life and as such, the potential for GIS application in education is significant (Ayeni et al., 2012).

GIS is now recognized widely as a valuable tool for managing, analyzing, displaying large volumes of diverse data pertinent to many local, regional and national activities. Its use in environmental planning is rapidly increasing. Education management is an activity highly dependent on environmental resources since the process most time involves structures and is a phenomenon which in event of lack of planning is likely to erode its base; hence its strength can be enhanced by GIS application (Ayeni et al., 2012).

Yoko and Seisuke (2004) stated that schools in Bangkok have their databases scattered all over different agencies and are not integrated into digital format thereby preventing location analysis using GIS. Ojiako and Igbokwe (2009) identify the same at Nnewi Urban area of Anambra State. They stated “The learning conditions in schools are alarming with lack of teaching materials, overcrowded classrooms and generally run-down condition of many of the schools buildings. The significance of these cited reviews is that the introduction of GIS as a tool helps data presentation easier to access, provide more flexible assistance in prospective planning at multiple unit of analysis and carrying out queries at any time.

GIS is a computerized tool that consist of (computerized) map, a database of descriptive information (attributes) and a set of software that performs complex spatial operations. It is one of the new technologies available for management of resources. Using GIS management and allocation of resources through the effective use of shared data can provide better service through efficient decision making. The current roles of both NPEC and UBE demand quick and accurate decision making. None of these agencies uses GIS, therefore

most of their responsibilities are discharged using other tools that may be deemed fit. These other tools are however not adequate to justify quick and accurate discharge of these responsibilities.

The unevenness in the distribution of educational facilities and the inadequate management of the educational facilities is a common feature in most Secondary School System.

The educational authorities of the school system try to even the distribution of these facilities but the population keeps increasing, enrolment figures of student keep changing from year to year, the number of teachers is not constant and the physical facilities keep depreciating over a period of time. There is need to replace and redistribute these educational facilities in order to determine areas with poor utilization. The task requires several sources of data including facilities location, population statistics of teachers and students, road map, information about the school itself, recreational facilities etc.

Disparity in the distribution of schools is noticeable in Oredo LGA of Edo State; this may hinder the national objectives of establishing them. In terms of accessibility some students have to walk a long distance to get to school and the available classrooms, tables and chairs are not sufficient as a result of increased population and enrolment. The qualified teachers to manage the huge number of students in terms of teaching are not available.

According to Onyidoh (2007) there is nothing wrong with the formulation of the educational curriculum and policy but, the implementation is the main problem. The implementation of laudable policies has often been hampered by incessant change of government, unstable academic calendars, poor and inadequate facilities, lack of motivation for staff, insecurity of life and property and the unwillingness of the products to make positive contribution to society. As a result of Faculty implementation of the National Policy on Education, these have resulted into morally decadent and intellectually inept child who is a threat to both parents and society (Onyidoh, 2007).

In order to eradicate these problems there is need for proper planning, monitoring and management of these facilities in the school system. In Nigeria, the management of educational facilities is facing a lot of challenges. The population growth has out grown the management capacity of various sectors. There is therefore the need for a more effective management approach to face the current challenges. The Geographic Information System (GIS) provides solution to these management problems. Since majority of information and decision in all educational institutions are land based, the Geographic Information System (GIS) becomes a very useful management tool. The spatial modelling capability offered by GIS is directly applicable to understand the spatial variations in educational facilities. Also, the GIS school mapping information forms a basic support for proper planning, monitoring and co-ordination management of the education sector at all levels. Therefore research intends to create a robust Geospatial database for education facilities for accurate decision making and the effective management of educational facilities in the study area.

II. Study Area

The study area is Oredo o Local Government Area of Edo State of Nigeria. It lies between latitude 6°00' North and 6° 30' North of the equator and longitudes 5° 25' East and 5° 35' East of the Greenwich meridian (see Figure 1.1, 1.2 and 1.3). It has a land area of about 319 square Kilometre and has its Headquarter in Benin City. The population for Oredo according to reports from the National Population Commission (NPC) 2006 Census is 374,515 as reported in the online publication of the NPC website. And going by an annual growth rate of 2.8%, the population estimate for year 2016 is 479,379. The people are predominantly traditional housing and practice subsistence farming with yam, cassava, vegetable, cocoyam, etc as their main agricultural products. They are also craft men known for their bronze casting in an area called Igun-eromwon off Sokponba road.

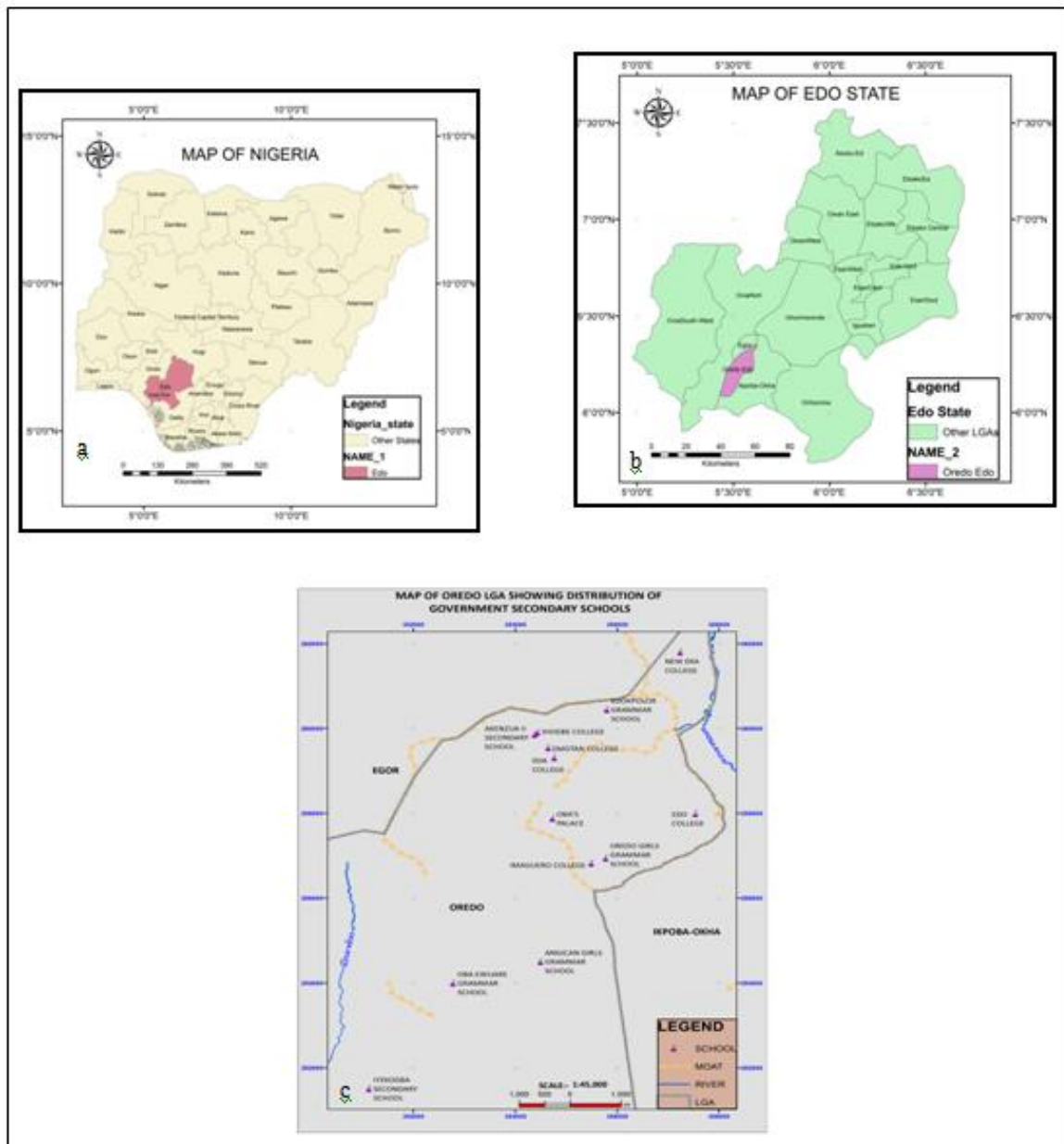


Fig 1: (a) Map of Nigeria showing Edo State, (b) Map of Edo state showing Oredo L.G.A, (c) Map of Oredo L.G.A (Study Area)

III. Methodology

This section details the methodology adopted in this study. The methodology is subdivided into various steps such as: data requirement and sources, GIS database modelling and creation, integration of data layers in the GIS database and GIS analysis.

3.1 Data Requirement and Sources

The data required for this study includes the following:

- The administrative maps of Nigeria, Edo state and Oredo Local Government Area. These were sourced from Ministry of Lands and survey Benin City.
- Educational facilities Directory for Oredo Local Government, this was sourced from the Ministry of Education, Edo State
- Location of educational facilities in Oredo LGA. Handheld GPS was used to collect the coordinates of the educational facilities.
- Demographic data was sourced from the National Population Commission, Edo state office.

3.1.1 Acquisition of Primary Datasets

The primary datasets that was obtained through field visits are:

- i. Positions or location of Educational facilities in Oredo LGA. Handheld GPS Garmin 76 was used to collect the coordinates of the educational facilities
- ii. Attribute data: This includes non-spatial descriptive information of the educational facilities. This too was collected in the field.

3.1.2 Acquisition of Secondary Datasets

The secondary datasets was gotten from digitization of available map data and attribute data such as:

- a. The administrative map of Nigeria, Edo state, and map of Oredo LGA were sourced from the Ministry of Land and Survey Benin City.
- b. The Directory of educational facilities in Oredo Local Government was sourced from the Ministry of Education, Benin City.
- c. Attribute data: This includes non spatial descriptive information of the educational facilities; these were gotten from the records kept by the Ministry of Education, Demographic data was collected from the National Population Commission.

3.2 GIS Database Creation and Modelling

The methodology that was employed in this study involves conversion of analogue map into digital map, plotting of coordinate points, Geo-database creation and queries generations. First, the analogue map of Oredo LGA was converted to digital through the process of scanning, georeferenced and digitizing. The coordinates of educational facilities gotten during field work was plotted on the map, after which a robust geospatial database was created with the attribute and demographic data. Consequently, the database was analysed and various queries generated for the study, such queries includes locational query, accessibility query, and query on suitability of location educational facilities.

In achieving the objectives of the study, a geospatial database of the educational facilities in Oredo LGA was created. To achieve this, the database creation stages was categorised into conceptual modelling, logical data modelling, and physical database design.

3.2.1 Conceptual Modelling

This is a representation of human conceptualizing of reality of the entire information content of the database. Here decision on how the view of reality was presented in a simplified manner and to the satisfaction of the information requirement of the project was made.

The stages in the conceptual data modelling involved the four steps: identification of entities, identification of attributes, determining relationships, drawing of entity-relationship diagram.

- a. Identification of Entities: Here all the entities relevant to educational facilities database were identified. In identifying the entities, the researcher ensured that the entities; are of great interest to the study, have multiple occurrence, and are unique.
- b. Identification of Attributes: The attributes/characteristics defining each entity were identified. The entities types and attributes used for this study are listed in table 3.1

Table 3.1 Entity type and their attributes

s/n	Entity	Feature class	Attribute
1	Local Government Area	Polygon	ID, name, area
2	Towns	Points	ID, name, LGA
3	Schools	Points	ID, name, LGA, Town, location, address, facilities available e.g. Library, Science laboratory. Etc
4	Moat	Polyline	ID, name, LGA, Town, location, length, depth, width
5	Roads	Polyline	ID, name, LGA, Town, location, length, width
6	Water	Polyline	ID, name, LGA, Town, location, length, width

- c. Determining Relationships: The relationships that exist between the various entities were established and determined
- d. Drawing of Entity-Relationship Diagram: The necessary entity relationship diagram was drawn after the various relationships have been determined (see figure 3.1).

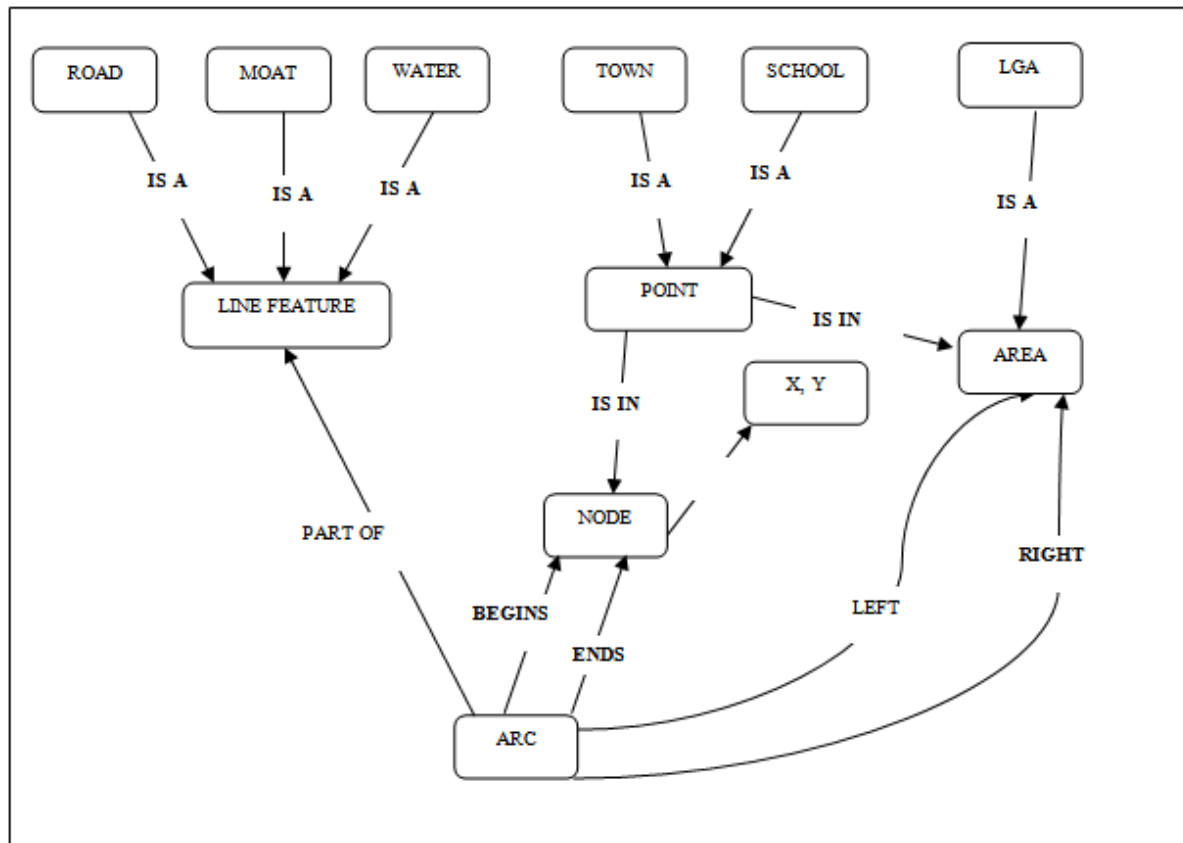


Figure 3.1 Entity-Relationship Diagram

3.2.2 Logical Data Modelling

This is a representation of the conceptualization of the reality in a data structure that can be implemented by the computer software. In this project, the relational data model was used. In a relational data model, data are separated into tables, and each table contains items of data called fields. Fields are objects (attributes of entities). The entities and attributes were translated into a geo-relational data structure and the following relations were derived.

The entity types in the study included:

- i. Oredo LGA
- ii. Educational Facilities
- iii. Roads
- iv. Settlements
- v. Moat
- vi. Water bodies

In the creation of the database, geographic features and their classes (shapes) was specified while the entity and their attributes were also modelled. Here the conceptual model schema was consolidated, refined and converted to a system specific logical schema. The stages in the Logical data modelling involved: mapping of conceptual schema to logical schema, identification of keys including primary and foreign keys.

a. Mapping of Conceptual Schema to Logical Schema.

The conceptual Schema was manually mapped to logical schema. The resulting logical schema was a suite of tables for each identified entities, relationship and attribute as shown in the Figure 3.2

Local Government Area

LG_ID	LG_name	LG_Area
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Towns

T_ID	T_name	LG_ID
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School

SC_ID	SC_ID	SC_name	SC_add	SC_loc	SC_lab	SC_lib	SC_fld
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Road

Rd_ID	Rd_name	Rd_Type	Rd_Status
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The map showed that there are about thirteen (13) post primary schools in the study area (see figure 4.2). The spatial distribution of the schools shows that no post primary school is located within or around five (5) settlements, these are: Umegba, Uguikpen, Egbire, Amagba, and Ohoghobi.

The results also showed that the schools were clustered in the northern part of the study area while southern part has limited number of schools. This can be explained with the fact that the urban area is located at the northern part of the study area where the local government headquarter is situated.

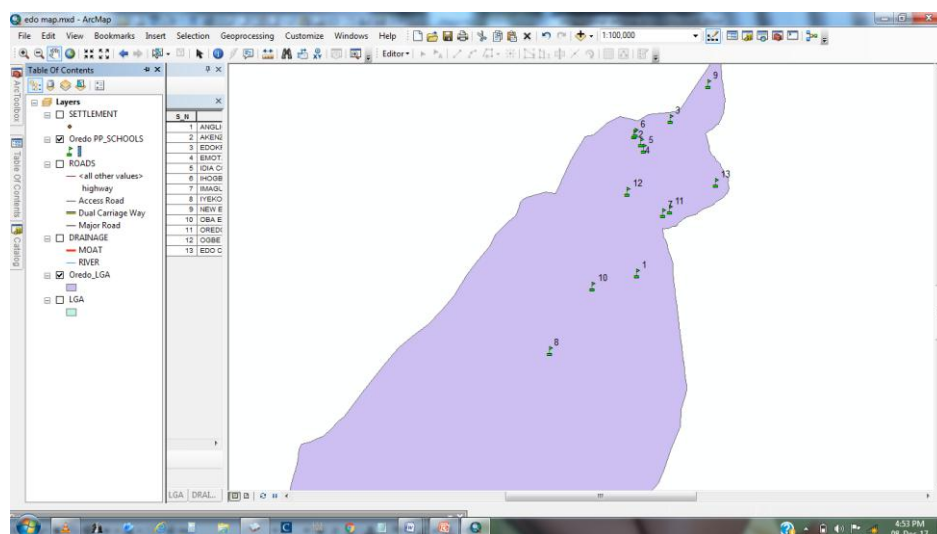


Figure 4.2 Spatial distributions of schools in the study area

4.2 Teachers and Students Population, Distribution and Ratio

From the data collected from the Ministry of Education Benin City, it was possible to determine the total population of both students and teachers in the study area. Table 4.1 and Figure 4.3 and 4.4 show the population distribution of students and teachers in Oredo LGA. The teacher/ student ratio was calculated and also shown in the table 4.1.

Table 4.1 Population distribution of students and teachers in the study area

S/N	Name of school	Total Teachers	Total Students	Ratio
1	Anglican girls grammar school	18	1364	1:76
2	Akenzua II secondary school	26	654	1:25
3	Edokpolor grammar school	39	1846	1:47
4	Emotan college	39	1616	1:41
5	Idia college	56	4212	1:75
6	Ihogbe college	46	1667	1:36
7	Imaguero college	30	1279	1:43
8	Iyekogba secondary school	14	480	1:34
9	New Era college	25	1240	1:50
10	Oba Ewuare secondary school	22	843	1:38
11	Oredo Girls grammar school	29	801	1:28
12	Ogbe Junior secondary school	12	622	1:52
13	Edo College	46	514	1:11
	Total	402	17138	1:43

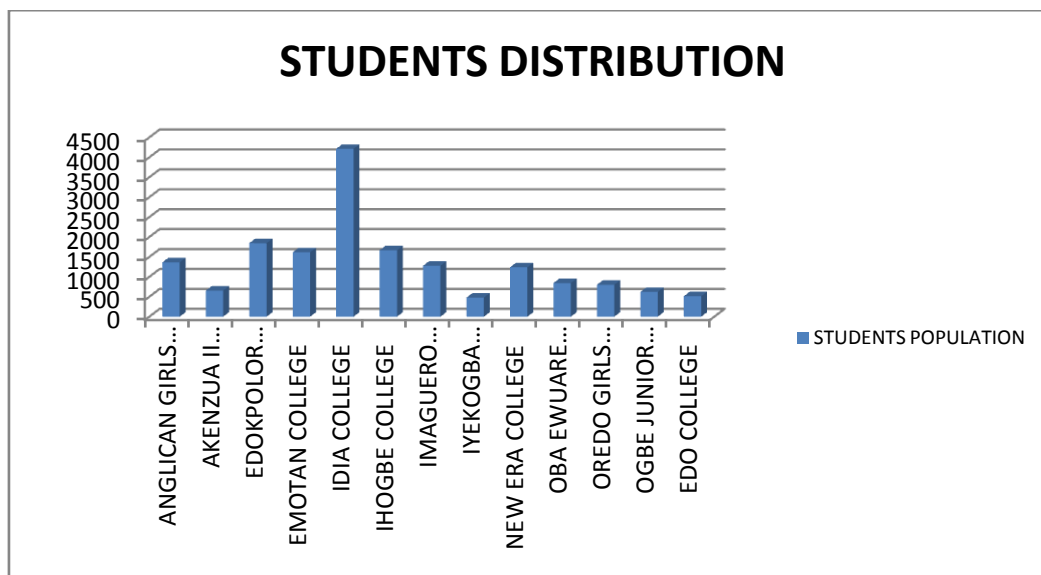


Figure 4.3 Students population and distribution

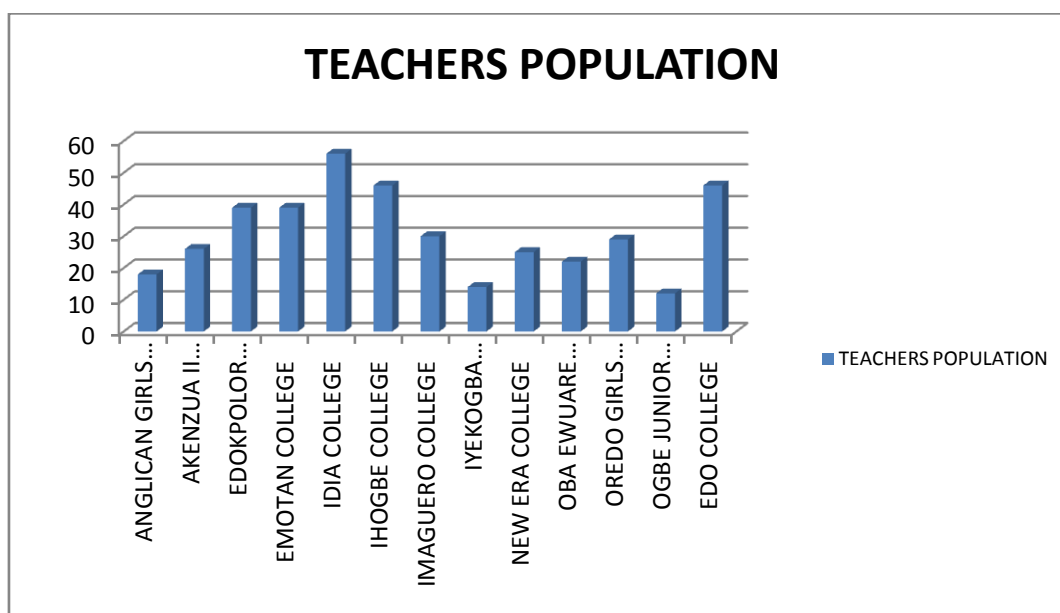


Figure 4.4 Teachers population and distribution

The result shows that Idia College has the highest number of students (4212) and also the highest number of teachers (56), with a very low teacher - student ratio of 1:76. Edokolor grammar school has a total of 1846 students, with 39 teachers. The results for other schools as shown in the table indicate that Iyekogba Secondary school has the lowest number of students (480) with 14 teachers; Edo College has 514 students with 46 teachers.

The teacher – student ratio as indicated in table 4.1 shows that apart from Edo College all other post primary school has a low teacher – student ratio when compared with the National policy of Education 2011 that stated the ideal teacher – student ratio is 1:25. This means that the teacher population is too low when compared with that of students in the study area.

The total student population for post primary schools in the study area is given as 17,138 while the total teacher population is 402. The average teacher-student ratio for the study is given as 1:43; this means that for every one teacher, there are about 43 students to cater for. This low teacher population can negatively affect the teaching and learning process in the study area.

4.3 Queries Generation

Database query is referred to as the selection of various combination tables for examination; it involves the retrieval of information stored in the database using structured query language (SQL). SQL is a database sublanguage for querying and modifying relational databases (RDBMS). The section following outline the various queries and the results.

a. Query to Determine Schools With Dilapidated Buildings

This query was formulated and performed in other to determine the schools whose buildings are dilapidated (see figure 4.5). It was done based on the fact that; conducive environment for learning enhances education and a good solid building/structure with standard roofing and ventilated classrooms is one of the key factors of conducive environment for education.

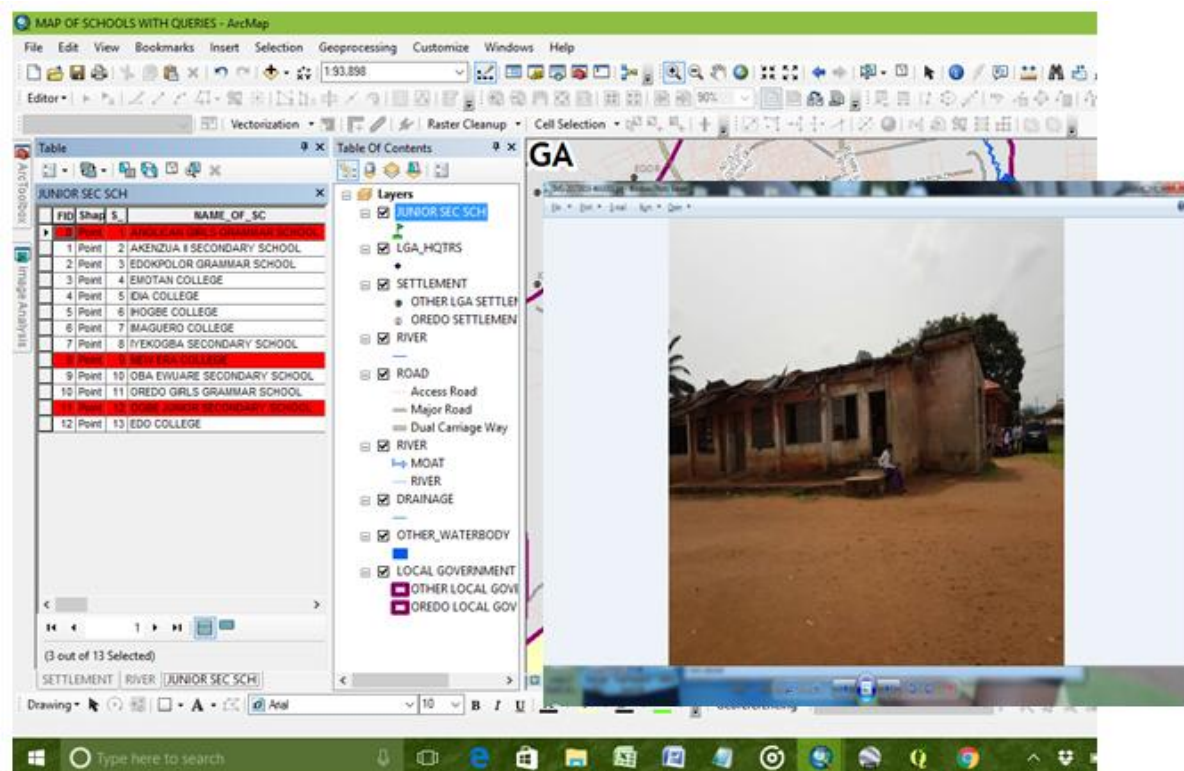


Figure 4.5 Query of Secondary Schools with dilapidated buildings in Oredo LGA

From the query result obtained in Figure 4.5, it was observed that three (3) schools namely Anglican girls' grammar, Ogbe Junior Secondary School and New Era College have their buildings in a very bad shape which can collapse at any time. These buildings are not supposed to be managed or repaired but rather be demolished or refurbished in other to avoid casualties or death of students or teachers. Out of the other ten (10) schools, three (3) schools have manageable buildings which can be repaired while the remaining seven (7) schools have solid buildings. This query result is important because conducive environment for learning enhances education. A good solid building/structure with standard roofing and ventilated classrooms is one of the key factors of conducive environment for learning.

b. Query To Determine The Schools With Laboratories

This multi-criteria query was formulated and performed in other to determine the schools having laboratories.

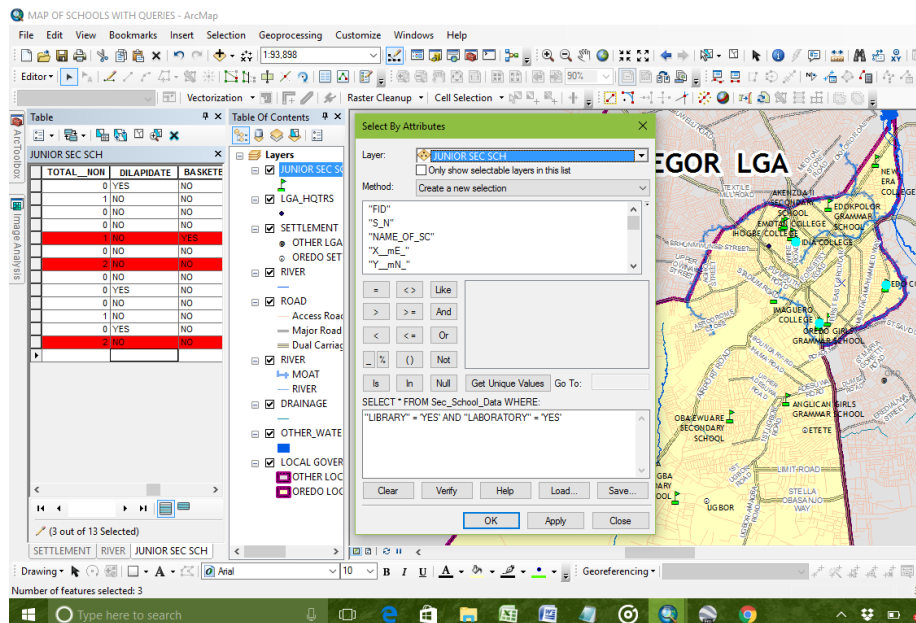


Figure 4.6 Query of Junior Secondary Schools having Laboratories and Library

From the query result obtained in Figure 4.6, about 3 schools out of 13 schools in the study area have the 3 laboratories for physics, biology and chemistry. While the remaining 10 schools either have 1 or 2 of the labs which could be sub-standard, fair and not accessible. This query is important because science students are practically inclined and as such should be provided with these 3 labs so as to enhance their practical skills.

b. Query to Determine the Schools With Equipped Libraries that are Accessible

This analysis was performed in order to determine the schools equipped with functional libraries that are accessible. This was done by the usual way of typing in the query command "LIBRARY" = "Yes", See Figure 4.7

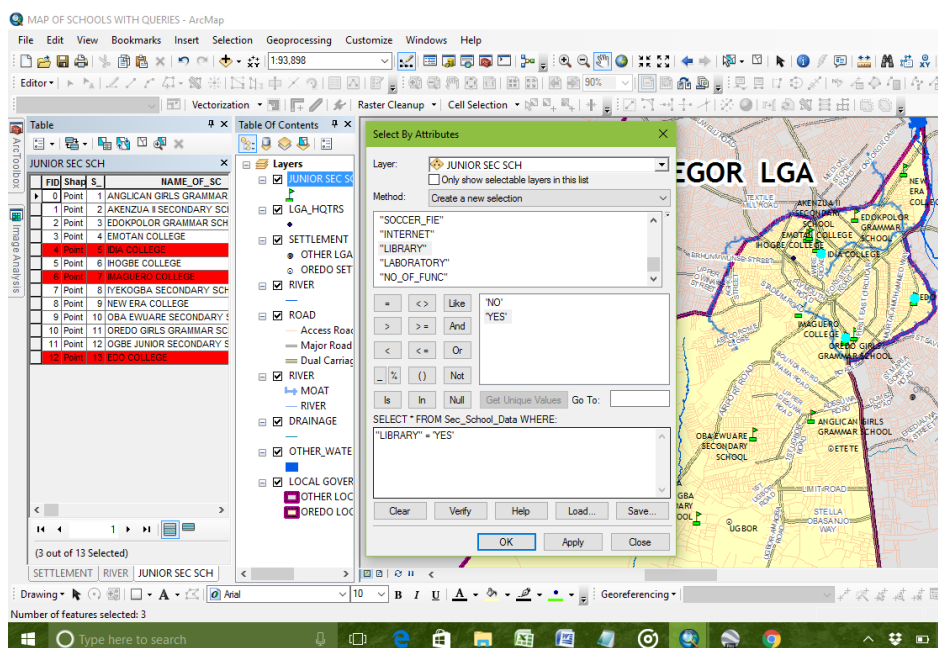


Figure 4.7 Query to show schools with equipped Libraries in Oredo LGA

From the above query result of Figure 4.7 it was realized that 3 schools have access to well-equipped libraries with modern textbooks which will enhance their level of reading and assimilation. The other 10 schools have sub-standard, fair or not libraries' at all making the level of reading and understanding low and not easy at all.

c. Query To Determine The Schools With Basic Amenities Such As Toilet Facilities

This analysis was performed in order to determine the schools having basic amenities such as toilet. This was done on the basis of how conducive and comfortable for learning when nature calls. The query command that was typed is toilet_FAC = yes

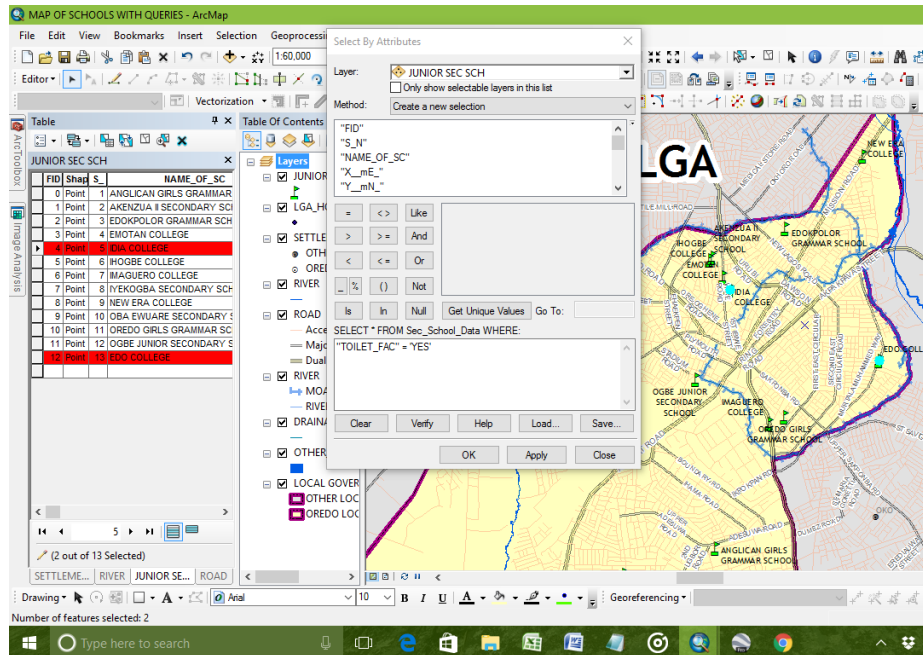


Figure 4.8 Query of Junior Secondary Schools with Toilet facilities in Oredo LGA

From the query result obtained in Figure 4.8 only two (2) schools have toilet facilities while the remaining eleven schools do not have toilet facilities. This makes the learning environment uncomfortable when the teachers and students are pressed no place to ease themselves. This can lead to both teachers and students playing truancy. The basic amenities are very important in the school system

d. Query To Determine The Distance Of Schools Close To The Moat.

This analysis was performed to determine the distance of the schools to the moat, this was done on the basis of how secured the schools were due to erosion problem caused by the moat.

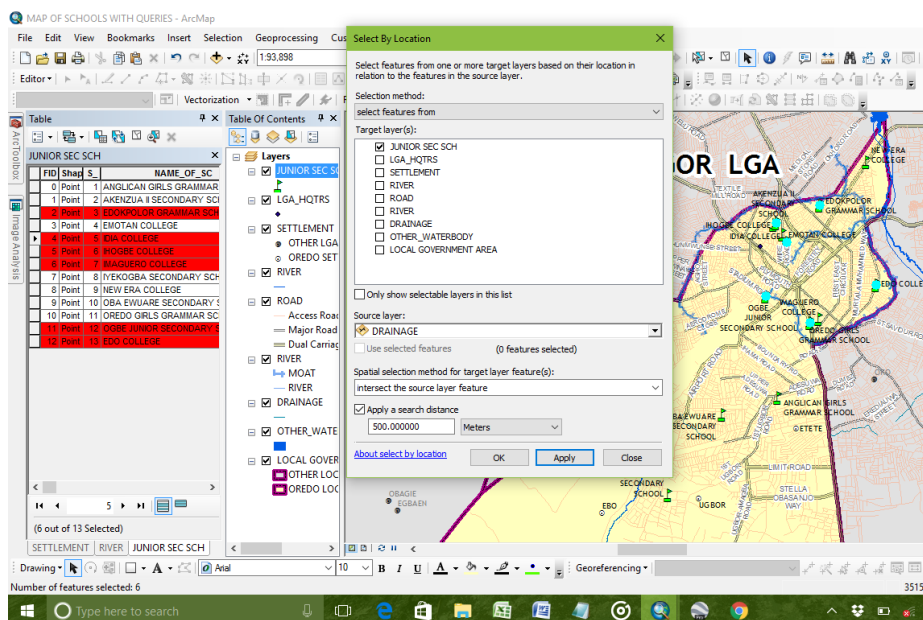


Figure 4.9 Query of Junior Secondary Schools within 500 metres to a Moat/ River in Oredo LGA

From the query result obtained in Figure 4.9 five (5) schools were closed to the moat. This serve as a threat to the school buildings because area close to the moat are prone to erosion and this can lead to the destruction of the buildings and threat to life of the students and teachers.

e. Query To Determine The Schools Having Over 1000 Students With Over 30 Teachers.

This query was performed in order to determine schools that have student population above 1000 with over 30 teachers. This is shown in Figure 4.10

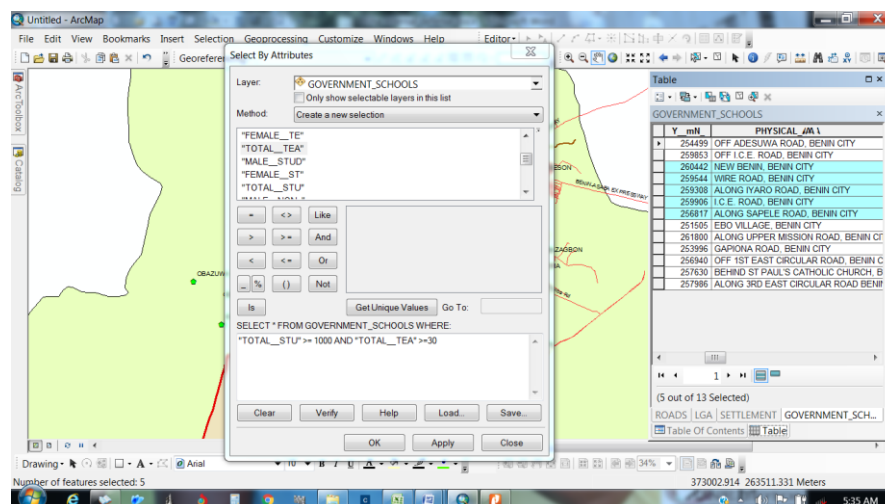


Figure 4.10 Query of Junior Secondary Schools with more than 1,000 students with over 30 teachers in Oredo LGA

From the query result obtained in Figure 5.10, about 5 schools out of 13 schools have above 1000 students with over 30 teachers. This means that schools in Oredo LGA have a very large population of students. The result implies that the teacher – student ratio will be very low and as such more qualified teachers should be provided the school.

V. Conclusion

This study has demonstrated the effectiveness of the GIS tools in the creation of geospatial database for educational facilities. The capabilities of Information System in GIS to conduct spatial search and provide answers to some generic question has been established. The database created was carefully accessed and tested with various queries invoked and the information generated can assist in decision making.

GIS use has so far provided successful results which promote importance of information over technology. The reality is that geographic data in actual world come in many different formats. In this work GIS has been established as a tool for collecting, analyzing, modelling and visual presentation of tourist data. Geographical information system is a rapidly expanding field enabling the development of applications that manage and use geographic information in combination with other media.

The use of GIS has help to manipulate and show the relationship between the attribute and spatial data through single and multiple queries. This study has shown that it is possible to store, manipulate, and analyze data relating to educational facilities distribution

This database created is effective and it satisfies all of the stated objectives. The database created has been thoroughly accessed, managed, displayed and tested through various queries. The database can also serve as a Decision Support System (DSS)

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