Research Journal of Environmental and Earth Sciences 4(3): 248-254, 2012
ISSN: 2041-0492

Submitted: November 09, 2011 Accepted: December 09, 2011 Published: March 01, 2012

Application of Geospatial Information System to Assess the Effectiveness of the Mdg Target in Amac Metropolis-Abuja, Nigeria

Y.A. Aliyu, J.O. Sule and T.T. Youngu
Department of Geomatics, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

Abstract: This study aims to assess the effectiveness of the MDG target as it concerns, the state of education in Abuja Municipal Area Council (AMAC) metropolis-Nigeria. One of the educational challenges faced in developing countries is how to know which school to send children to. This is mainly due to lack of detailed information as to, what school offers, what type of education, and at what fee. But with Geospatial Information Systems (GIS) providing information about primary and secondary schools, Millennium Development Goals' (MDGs') vision of literacy for 15-24 year olds will be achieved. The development of geospatial database information system of primary and secondary schools for Garki and Wuse districts, Abuja, was embarked upon to provide timely, consistent and accurate information to decision makers for use in achieving this particular target of the Millennium Development Goals (MDGs). The delay in achievement of this target is not because governments in developing countries aren't putting maximum effort, but because these governments are choosing to put the cart before the horse. Sustainable literacy level cannot be achieved without an effective framework charged with the collection, storage, query, analysis and management of the relevant data. What is needed is a system that provides government with data about all educational facilities within required proximity and determines availability of the required facilities. GIS is that decision making technology, which integrates 'spatially referenced data' with a problem solving environment. The method employed was to acquire both spatial and attribute data of every primary and secondary school in Garki and Wuse districts. The spatially referenced database was created using Microsoft Access 2007 and ArcGIS 9.2 software. The database was queried and the results of the queries analyzed. The results showed that 60% of the schools didn't have access to Internet. Twenty-one (21) percent had no library. Sixty-three (63) percent of schools were also found to lack Elementary Science Laboratory as stipulated in the National Policy on Education. It was also observed that, the closest distance between public schools to Area 1 and Wuse Central bus-stops, are 0.769 and 1.15 m, respectively.

Key words: GIS and planning, MDG, quality education and assessment, referenced database

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. 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. No society has ever achieved significant human development for its citizens without substantial and steady investment in education. The severe decline of the oil market in the early eighties, combined with the Structural Adjustment Programme (SAP), led to drastic reductions in spending on education. The results are, unpaid teacher salaries, degradation of education facilities at all levels and strikes in universities and schools. The end result is declining literacy rates in the country.

Several studies have been carried out on the poor state of education in Nigeria because they help not only in creating awareness, but also serves as instrument for economic empowerment and development of sustainable economy.

According to the available records, school mapping originated in France in 1 963 (Caillods, 1983; Galabawa *et al*., 2002; Govinda, 1999). School Mapping (SM) is a normative approach to the micro planning of school locations. SM is also used to investigate and ensure the efficient and equitable distribution of resources within and between school systems when large scale reform or significant expansion of an educational system takes place (Caillods, 1983).

Igbuzor (2006) aptly captured in the National Empowerment Development Strategy as follows:

> "The delivery of education in Nigeria has suffered from years of neglect, compounded by inadequate attention to policy frameworks within the sector. The national literacy rate is currently 57%. Some 49% of the teaching force is unqualified. There are

Corresponding Author: Y.A. Aliyu, Department of Geomatics, Ahmadu Bello University, Zaria, Kaduna State, Nigeria, Tel.: +2348034642728

acute shortages of infrastructure and facilities at all levels. Access to basic education is inhibited by gender issues and socio-cultural beliefs and practices, among other factors. The system emphasizes theoretical knowledge at the expense of technical, vocational, and entrepreneurial education. School curricula need urgent review to make them relevant and practice oriented."

Another study in India carried out by Subrahmanian (2002) states that, the progress of the proposed 93rd Constitutional Amendment, which makes elementary education a fundamental right in India, provides an interesting starting point for exploring the challenges of achieving 'rights' in education, in the context of a history of poor provision, and entrenched forms of social and economic exclusion..

Makino and Watanabe (2002) concluded that "integrating all the school data and converting it to the digital format will make us easily and efficiently do present condition analyses or simulation on future school building planning. In addition to this, creating the database that can be linked to features in GIS is very significant, since the features without detail attributes cannot help us do further analyses".

According to Onyidoh (2007). "In the area of educational curriculum and policy, the main problem is not with formulation as such but implementation. 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 all these, the National Policy on Education which sought to inculcate the ideals enumerated earlier has rather turned around to churn out morally decadent and intellectually inept child who is a threat to both parents and society. The Nigerian youth are yet to imbibe the right type of values and attitudes. Rather, Nigerian schools and campuses have become breeding grounds for cultism, gangsterism, hooliganism, armed robbery, sexual promiscuity, examination malpractices, and a host of other vices.

But with GIS, the following possibilities of using GIS to improve education micro planning were identified by DeGrauwe (2002):

- GIS helps in making the presentation of data more attractive than traditional static maps.
- Projecting tabular data onto maps helps in recognizing "unexpected" situations which, now noticed, call for closer examination.
- Through considering geographical (spatial) factors, the analysis becomes "finer" and more precise, increasing the likelihood that ensuing strategies will be more pertinent.
- More flexible assistance can be provided in prospective planning at multiple levels or units of analysis: national, regional, provincial/district, and local.

To this list the following might be added for consideration (Hite and Hite, 2004):

- Expanded "holistic" representation and exploration of the contexts of schooling through the direct and dynamic use of multiple sources of influential data such as those found in census, transportation, utilities, health care, land use, and agricultural databases which are otherwise very difficult to include in education planning and management.
- Increased public appeal and utility.
- Extensive control of scale of complexity: extensive flexibility in how much data are displayed or explored at a given time, with changes in unit of analysis virtually immediate.
- Dynamic ability to facilitate "what if" analysis, exploratory inquiry, and creation of planning and management "scenarios".

The main use for GIS is, as in most other fields, for the easy visualization of data. GIS is good at displaying data once manipulated and allowing the identification of patterns, but its wider implementation is hampered by the usual personnel and financial constraints common in many parts of the public sector (Wikipedia, 2009).

The word GIS has wider application; especially land based location references of object phenomena in space. It has a stronger relationship for geographical location in space (Wikipedia, 2009).

Significance of study: The poor state of education system in Abuja and Nigeria at large is mainly because of the low status of teaching as a profession in the country (Ejieh, 2009). It is common knowledge that, candidates for teacher education are the generally academically weak students, who do not aspire to more prestigious professions (Akinpelu, 1972; Fadipe, 1992).

When considering GIS in micro planning, an obvious question is whether GIS is simply a better, more precise and flexible spatial analysis tool for representing schools and their physical, social and geo-political contexts or whether GIS provides a different way to understand and plan those contexts geo spatially?

The challenge of this study is to assist local authority in identifying areas within the metropolis that lack schools. Such assistance is a cost effective approach to improve and monitor the distribution of schools. This

would involve collection of up-to-date school data within the metropolis. Such data will consist of spatial database showing location of every school within the metropolis, as well as attribute data showing details of school capabilities.

Because GIS helps in projecting tabular data onto maps, this will not boost monitoring of schools. It will attract government support, thereby enhancing development in the country.

Study area: The study area is roughly defined by UTM - 32 coordinates 330000.00E, 1006000.00N**;** 339000.00E, 1006000.00N**;** 339000.00E, 998000.00N**;** 330000.00E, 998000.00N. It covers Garki and Wuse districts of Abuja Municipal Area council (AMAC) with areas 1, 2, 3, 7, 8, 10, 11 and Garki II in Garki district and zones 1, 2, 3, 4, 5, 6, 7 and Wuse II in Wuse district.

METHODOLOGY

This study was carried out in 2010 by first acquiring from the Office of the Abuja Geographic Information System (AGIS), a digital map of the study area (AMAC metropolis, Abuja - Nigeria) in AutoCAD format. Questionnaires were issued to every school in order to acquire facility information. A geodatabase was created using Microsoft Access 2007 and ArcGIS 9.2 software. The location of each school was used to determine general spatial distribution of schools within the metropolis.

A comprehensive list of schools in the districts was collated from the Department for Policy Implementation (DPI) Education Secretariat Abuja, for private schools are as follow:

- Local Education Authority (LEA)
- Wuse Zone 5 for schools owned by Abuja Municipal Area Council (AMAC), as well as Universal Basic Education (UBE)
- Area 2 Garki Abuja for UBE Schools

In addition to the above list, a street by street search was conducted, in order to have a full cover of the schools.

Data collected include: Name of the school, Address, Tuition fee, Classes, Availability of Laboratories/Internet facilities. Certain principles guided the database design process. The first principle is that duplicate information (also called redundant data) was avoided in order not to introduce errors and inconsistencies in the database. The second principle is that the correctness and completeness of information is important. If the database contains incorrect information, any report that pulls information from the database will also contain incorrect information. As a result, any decision made that is based on these reports will then be misinformed.

The database design involved gathering all of the types of information desired to be recorded in the database, such as Name/Address of school, System of study, Average number of pupils\students per class room, Internet/Laboratory access, Tuition fees. Information items were divided into major entities or subjects, such as Brochure, Directory, Facilities and Clubs. Each subject then becomes a table. The database was designed such that the positional data is well organized. It also provides for adequate linking, retrieval, updating of data.

Tables were created by dividing the collected data into subject-based tables to minimize redundant data. The primary key for each table is specified. This is a unique identifier for each entry which distinguishes each point. The tables were created in Microsoft Access.

Data for the database was entered in Microsoft Access and saved in data base four (dbf IV) format which is recognizable and acceptable to the ArcCatalog extension of ArcGIS. ArcCatalog allows the user to easily access and manage geographic data that is stored in folders on local disks or relational databases that are available on the user's network. Data can be copied, moved, deleted, and quickly viewed before it is added to a map. The data and the digital map were stored in the ArcCatalog extension.

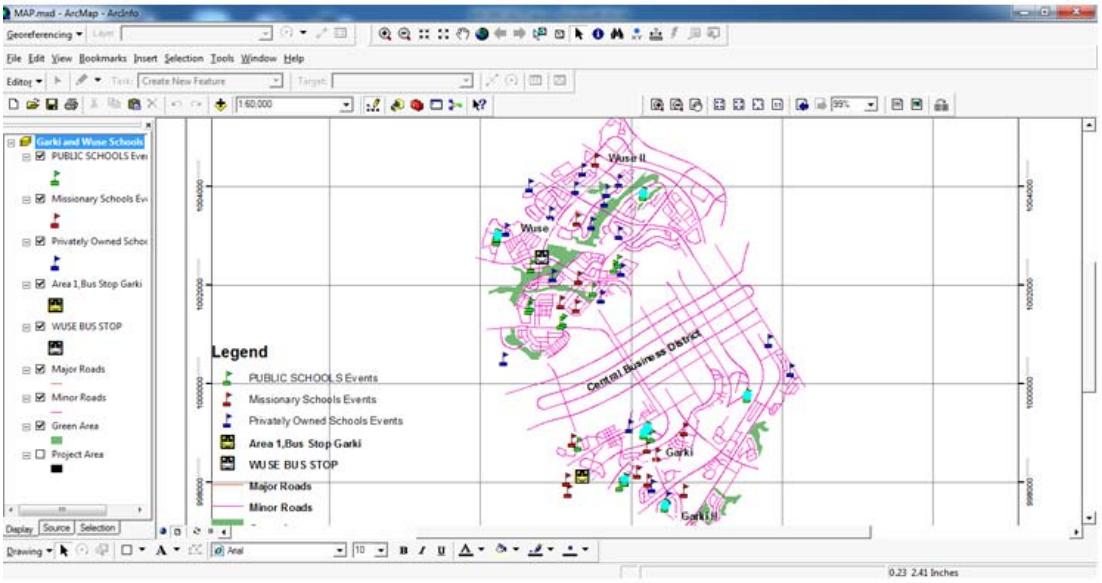
The digital map for the project was saved in AutoCAD‘s drawing exchange format (dxf), a format that is compatible to ArcGIS. The map was opened in the ArcMap extension where it was discovered that the entire layout was digitized in one layer. The map had to undergo another round of digitization in ArcGIS in order to create layers for the features on the features (major roads and minor roads)and the tables held in the ArcCatalog extension were added, using the add XY, Command at the tools menu. There were three tables, one for private schools,one for public schools and one for missionary schools.

The system can be updated to reflect changes in any school information such as tuition fees etc, as well as appending more attributes in ArcGIS interface by an authorized ArcGIS application user.

The query was carried out using the query builder. The query builder tool is accessed by clicking on selection on the menu bar and pointing to ‘Select By Attributes’ and clicking. A dialog box appears. The query expression is built either by typing it in or clicking on the required fields, operators and values in the dialog box.

RESULTS AND DISCUSSION

The figures below display the result of the queries for Public, Private and Missionary schools without internet facilities; Public schools without a science laboratory; Public schools without a Library and their results in map format.



Selected Attributes of Public Schools Events

OID	SERIAL_NO	SCHOOL_NAM	INTERNET_F	DISTRICT
0	1	LEA PRIMARY SCHOOL,AREA 1	NO	GARKI
2	3	JUNIOR SECONDARY DURUMI,AREA 10	NO	GARKI
3	4	FESTIVAL ROAD PRIMARY SCHOOL,AREA 10	NO	GARKI
4	5	MODEL SCIENCE PRIMARY SCHOOL,GARKI II	NO	GARKI II
5	6	JUNIOR SECONDARY APO,AREA 3	NO	GARKI
6	7	GOVERNMENT SCIENCE TECHNICAL COLLEGE,AREA 3	NO	GARKI
7	8	JUNIOR SECONDARY SCHOOL,AREA 11	NO	GARKI
8	9	LEA PRIMARY SCHOOL,ZONE 6	NO	WUSE
9	10	JUNIOR SECONDARY SCHOOL,ZONE 6	NO	WUSE
10	11	PILOT SCIENCE PRIMARY SCHOOL,ZONE 5	NO	WUSE
11	12	LEA PRIMARY SCHOOL,ZONE 3	NO	WUSE
13	14	JUNIOR SECONDARY SCHOOL,ZONE 3	NO	WUSE
14	15	JUNIOR SECONDARY SCHOOL,ZONE 2	NO	WUSE
15	16	LEA PRIMARY SCHOOL,ZONE 2	NO	WUSE
16	17	GOVERNMENT SECONDARY SCHOOL TUDUN WADA,ZONE 4	NO	WUSE
17	18	JUNIOR SECONDARY SCHOOL TUDUN WADA,ZONE 4	NO	WUSE

Fig. 1: Queries on public schools without internet (list of schools with spatial representation)

Table 1: Results of queries

Theme of query	Number	Percentage
Schools without internet	32	60.38
Public schools without science laboratory	12	63.16
Overpopulated public schools	7	36.8
Public schools without library	4	21.05

From Fig. 1, 2, 3 and Table 1, 60.38% do not have internet facilities. From Fig. 4 and Table 1, it can be seen that 12 out of the 19 public schools in the districts do not have a science laboratory; only 7 have, indicating that approximately 63.16% of schools in the districts do not have a science laboratory. Out of the seven, 6 were secondary schools and 1 primary school.

Figure 5 reveals that 7 out of the 19 public schools are overpopulated. They exceed the maximum number of pupils/students set at 45 per class room by the Local Education Authority (LEA) and the Universal Basic Education (UBE) for the schools.We can infer that 36.84% of the schools in the districts have over crowded class rooms.

Table 2: Spatial (distance) analysis of schools to the central bus stop (area "1" Garki)

Name of school	Approximate distance (Km)	Description
JSS Apo,area "3"	1.15	Closest public school
Little angels academy,area "3"	1.63	Closest private school
Stellar maris pry juniour high ,area "1"	0.323	Closest missionary school

Table 1 displays that 4 out of the 19 schools do not have a library complex, representing 21.05% are in need of a library.

According to Table 2, the closest public school to the central Bus stop Area "1" Garki, is JSS Apo, Area "3" which is 1159 m to the Bus stop, the closest Private school is Little Angels Academy which is 1631 m from the central Garki Bus Stop, while the closest Missionary School (Stellar Maris Primary School and Junior High) is about 322 m from Central Garki Bus stop Area "1".

According to Table 3, the closest public school to the central Wuse Bus stop is Pilot Science Primary School

Selected Attributes of Public Schools Events

OID	SERIAL_NO	SCHOOL_NAM	AVERAGE_NO	SCHOOL_LIB	SCIENCE_LA	MECH_WKSHP
1	2	GOVERNMENT SECONDARY SCHOOL,AREA 10	60	YES	YES	NO
2	3	JUNIOR SECONDARY DURUMI,AREA 10	90	YES	YES	NO
4	5	MODEL SCIENCE PRIMARY SCHOOL,GARKI II	50	YES	YES	NO
6	7	GOVERNMENT SCIENCE TECHNICAL COLLEGE,AREA 3	100	YES	YES	YES
7	8	JUNIOR SECONDARY SCHOOL,AREA 11	50	YES	NO	NO
9	10	JUNIOR SECONDARY SCHOOL,ZONE 6	49	YES	NO	NO
18	19	GOVERNMENT DAY SECONDARY SCHOOL,WUSE II	50	YES	YES	NO

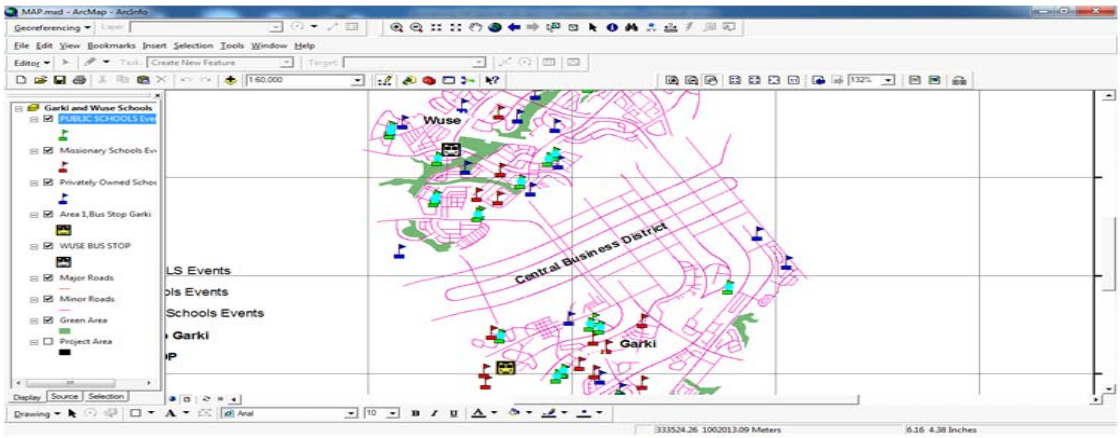


Fig. 2: Queries on private schools without internet

Selected Attributes of Privately Owned Schools Events

SCHOOL_NAM	SPORT_CLUB	ORHIC_CLUB	BIBLE_CLUB	SCHOOL_LIB	INTERNET_F
ACES NURSERY AND PRIMARY SCHOOL	Yes	No	Yes	Yes	No
WONDERFUL DAYCARE NURSERYAND PRIMARY SCHOOL	Yes	No	No	No	No
LITTLE ANGELS ACCADEMY	Yes	No	No	No	No
RABERTO SCHOOLS	Yes	No	No	Yes	No
BALIZ SCHOOLS TRUST	Yes	No	No	Yes	No
LALA INTERNATIONAL SCHOOL	Yes	No	No	Yes	No
POWA INTERNATIONAL SCHOOL	Yes	No	No	Yes	No
ARWA BASIC SCHOOLS	Yes	No	No	Yes	No

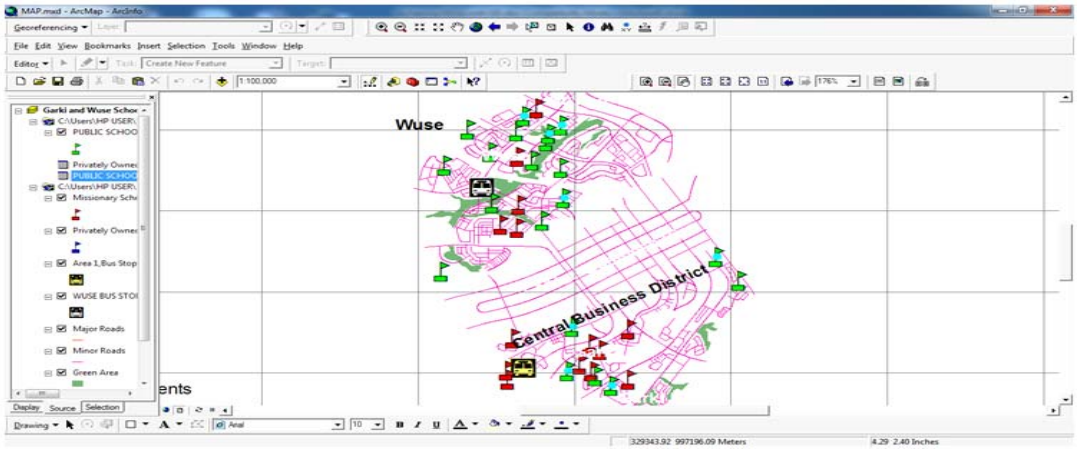


Fig. 3: Queries on public schools without science laboratory

Selected Attributes of Public Schools Events

OID	SERIAL_NO	SCHOOL_NAM	SCHOOL_LIB	SCIENCE_LA	MECH_WKSHP
0	1	LEA PRIMARY SCHOOL,AREA 1	NO	NO	NO
3	4	FESTIVAL ROAD PRIMARY SCHOOL,AREA 10	YES	NO	NO
5	6	JUNIOR SECONDARY APO,AREA 3	NO	NO	NO
7	8	JUNIOR SECONDARY SCHOOL,AREA 11	YES	NO	NO
8	9	LEA PRIMARY SCHOOL,ZONE 6	YES	NO	NO
9	10	JUNIOR SECONDARY SCHOOL,ZONE 6	YES	NO	NO
10	11	PILOT SCIENCE PRIMARY SCHOOL,ZONE 5	YES	NO	NO
11	12	LEA PRIMARY SCHOOL,ZONE 3	YES	NO	NO
13	14	JUNIOR SECONDARY SCHOOL,ZONE 3	YES	NO	NO
14	15	JUNIOR SECONDARY SCHOOL,ZONE 2	NO	NO	NO
15	16	LEA PRIMARY SCHOOL,ZONE 2	NO	NO	NO
17	18	JUNIOR SECONDARY SCHOOL TUDUN WADA,ZONE 4	YES	NO	NO

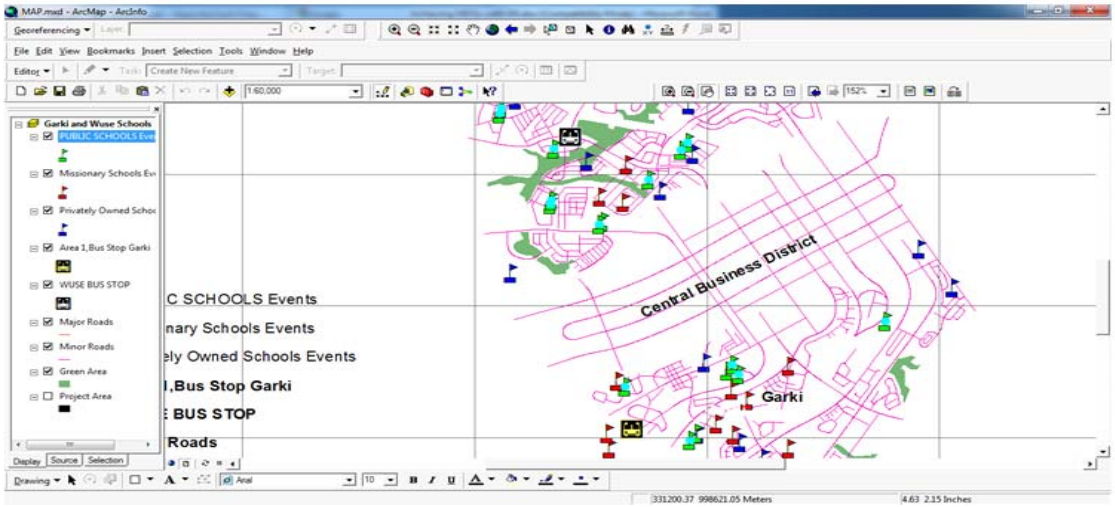


Fig. 4: Queries on public schools without library

Selected Attributes of Public Schools Events

OID	SERIAL_NO	SCHOOL_NAM	SCHOOL_LIB	SCIENCE_LA	MECH_WKSHP	FOOTBALL_F
0	1	LEA PRIMARY SCHOOL,AREA 1	NO	NO	NO	YES
5	6	JUNIOR SECONDARY APO,AREA 3	NO	NO	NO	NO
14	15	JUNIOR SECONDARY SCHOOL,ZONE 2	NO	NO	NO	NO
15	16	LEA PRIMARY SCHOOL,ZONE 2	NO	NO	NO	NO

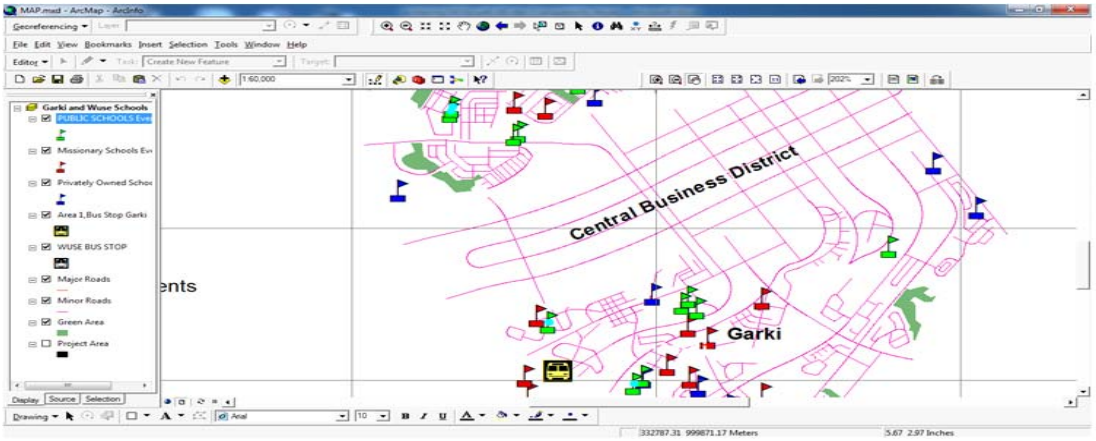


Fig. 5: Queries on overpopulated public schools

Table 3: Spatial (distance) analysis of schools to the central bus stop (Wuse).

Name of school	Approximate distance (km)	Description
Pilot science primary school, Zone 5, Wuse	0.769	Closest public school
Lightway accademy, parakou crescent, Wuse	1.038	Closest private school
Wesley nursery and primary school, Wuse	0.997	Closest missionary school

Wuse, which is 769 m to the bus stop. The closest private School is Lightway Accademy Wuse which is 1038 meters to the bus stop, while the closest missionary school to the bus stop is Wesley Nursery and Primary School which is 997 meters away.

CONCLUSION

The study presents three classes of schools (Private, Public and Missionary) in AMAC- Abuja with a total of fifty-three (53) schools. Private schools contribute the bulk with 20 schools. It is closely followed by Public schools which are 19 in number.

Adequate analysis can be made through queries there by enhancing decision making by parents/guardians and policy makers. For example, to effectively implement the MDG target for primary education, policy makers must increase the number of primary schools within the metropolis. This is due to the fact that out of the nineteen (19) public schools, only seven (7) were primary.

The GIS database for public/private primary and secondary schools in Garki and Wuse districts of Abuja Municipal Area Council (AMAC) has been produced successfully using ArcGIS 9.2 software.

A map showing the distribution of schools in the Abuja Municipal Area Council has also been produced. The database system allows for easy access, storage and retrieval of schools records in the districts.

REFERENCES

Akinpelu, J.A., 1972. Recruitment of students to train for the teaching profession. Paper presented at the ATEA Conference, Addis Ababa.

Caillods, F., 1983. Module I: School Mapping and Micro planning Concepts and Processes. In: Caillods, F., J. Casselli, T.N. Châu and G. Porte, (Eds.), Training Materials in Educational Planning, Administration and Facilities: School Mapping and Micro Planning in Education. Paris, France: IIEP/UNESCO, Retrieved from: http://www.iiep.unesco.org/filead min/user-upload/Research-Challenges-andTrends /pdf/symposium/StevenHite.pdf (Accessed on: September 27, 2011).

DeGrauwe, A., 2002. Introduction. In: Attfield, I., M. Tamiru, B. Parolin and A. DeGrauwe (Eds.), Improving Micro Planning in Education through a Geographical Information System: Studies on Ethiopi a and Palestine Paris, France, pp: 7 17, UNESCO Publishing International Institute for Educational Planning, Retrieved from: http://unesdoc.unesco. org/images/0012/001292/129288e.pdf, (Accessed on: September 27, 2011).

Ejieh, U.C.M., 2009. The Universal Basic Education as an Effective Strategy for Meeting the Millennium Development Goals in Nigeria. Retrieved from: http://www.nobleworld.biz/images/Ejieh.pdf, (Accessed on: September 27, 2011).

Fadipe, J.A., 1992. The Achievements and Shortcomings of the Teacher Education Programme in Nigeria: An administrator's view. Educational Policy and Implementation in Nigeria. Awka: The Nigerian Association for Educational Administration and Planning.

Galabawa, J.C.J., A.O. Agu and I. Miyazawa, 2002. The impact of school mapping in the development of education in Tanzania: An assessment of the experiences of six districts. Evaluation Program Planning, 25: 23 33.

Govinda, R., 1999. Reaching the Unreached through Participatory Planning: School Mapping in Lok Jumbish, India. Paris, France, IIPE/UNESCO. Retrieved from: http://www.iiep.unesco.org /fileadmin/user-upload/Research-Challenges-and-Trends/pdf/symposium/StevenHite.pdf , (Accessed on: August 27, 2011).

Hite, S.J. and J.M. Hite, 2004. Geographical Information Systems in Education Planning and Management: A Training Module Created for the IIEP/UNESCO. Paris, France, IIEP/UNESCO.

Igbuzor, O., 2006. The State of Education in Nigeria. A Keynote Address Delivered at a Roundtable Organized by Civil Society Action Coaliton on Education for All (CSACEFA). Retrieved from: www.dawodu.com/igbuzor14.htm, (Accessed on: July 15, 2011).

Makino, Y. and S. Watanabe, 2002. The Application of GIS to the School Mapping in Bangkok. Asian Center for Research on Remote Sensing (ACRORS). Retrieved from: www.a-a-r-s.org/acrs/proceeding/ ACRS2002/Papers/ ED02-4.pdf, (Accessed on: September 27, 2011).

Onyidoh, H., 2007. The Decline of the Education System in Nigeria. Retrieved from: http:// www.helium.com /items/525840-the-decline-of-the-education-system-in-nigeria (Accessed on: March 13, 2010).

Subrahmanian, R., 2002. Citizenship and the 'Right to Education': Perspectives from the Indian Context. Research for Development (R4D)/Department for International Development (DFID) journal article. IDS Bull., 33(2): 74-82.

Wikipedia-The free Encyclopedia, 2009. Geographic Information System. retrieved from: http://en.wikipedia.org/wiki/Geographic information system, (Accessed on: February 12, 2010).