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Database Management and Mapping of Secondary Education Infrastructure in Sabon-Gari and Zaria Local Governments, Kaduna State, NigERIA

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Abstract The learning conditions in schools are alarming with lack of teaching materials, overcrowded classrooms and generally run-down condition of many of the school buildings. In spite of the relative availability of data, educational data in Nigeria still suffers from the following issues relating to the quality and completeness: erroneously recorded and reported data, inconsistent coding systems for information on schools and teachers, prolonged periods between data collection and data release, poor school record keeping. The aim of this research was to develop a GIS database for private and public secondary schools in the study area so as to enable effective and efficient planning and management of these schools. The aim of the research was achieved through identification of private and public secondary schools in the study area, mapping the secondary schools in the study area, with some basic facilities, generating the attribute data of the public and private secondary schools and finally, creation of GIS database for schools. The attribute data was obtained through the administration of questionnaires to the schools. A satellite image of the study area was obtained using Google earth to derive the base map through the digitizing process. The coordinates of each school were obtained using a hand-held GPS receiver to geo code the schools on the base map. Finally, a GIS database was therefore created and the spatial and attribute data encoded and analysis carried out using Arc GIS 9.2 software. The result of the database provides the users with a working environment for data management and also allows efficiency query of information needed for school management.

Keywords GIS, Data Base, Facilities, Management

1. Introduction

Education is one of the most important factors in Nigeria's quest to become one of the largest economies by the year 2020. However, with the recent state of education in Nigeria, measures need to be taken to overhaul the system in order for it to serve as a reliable and efficient vehicle for the attainment of the vision. Secondary education is a program of public education immediately following elementary schooling. It begins generally at the age of 12 to 14 and continues for four to six years. Some secondary education, such as vocational schooling, is terminal and prepares the student for employment upon graduation. Others lead to advanced training in colleges, universities, or technical schools (Encarta, 2009).

According to Encarta (2009) public school is an elementary or secondary school controlled and maintained by civil authority, acting through official board expending public money, and open to all local children. Public schools include grade or grammar schools, junior and senior high school, and vocational schools. Private school is program of instruction that is created and controlled, operated, and principally financed by private individuals and groups rather than by government. Unlike public elementary and secondary schools, which are free, nearly all private schools charge some form of tuition.

Geographic information system (GIS) is a system of hardware, software, and procedures to facilitate the management, manipulation, analysis, modeling, planning and management of resources (NCGIA, 1991). It is also a "system for management, analysis, and display of geographic knowledge, which is represented using a series of information set such as maps and globes, geographic data sets, processing and work flow models, data models, and meta data" (ESRI, 2004). In terms of economic, an implementation of GIS will enhance the outcome for school analysis as well as application development (Hoxby, 2000).

A GIS database for private and public secondary schools in Zaria and environs will be of great importance to the state government as well as the cooperation of all Nigerians, non-governmental organization and private sector in achieving objectives of education.

It is extremely important to access the facilities through

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the use of a GIS database. With this database there is a potential to improve efficiency of schools through the planning and management of resources and the display of geographic knowledge. Analysis from the database can be carried out in several significant ways.

A GIS database created can assist the present government in proper distribution of schools, improve the existing infrastructure and provide additional infrastructure for planning and management of educational resources.

The research will enable us to know the spatial and temporal distribution of private and public Secondary schools in the study area

The aim of this research is to map and develop a GIS database for private and public secondary schools in Zaria and Sabon Gari local government areas of Kaduna state.

The above aim was achieved through the following objectives:

Identification of private and public Secondary Schools in Zaria and Sabon Gari Loal Government Areas.

Mapping the private and public Secondary Schools in the study area.

Mapping the private and public secondary schools in the study area with some basic facilities.

Generate the attribute data of the private and public Secondary Schools.

Creation of GIS database for private and public Secondary Schools.

The scope of this research covers Zaria and Sabon Gari Local Government areas of Kaduna State. The spatial extent of the research covers Zaria City, Gelesu, Sabon Gari, Samaru, Palladan, Basawa, Gaskiya and Tudun Wada. The temporal extent of the study covers private and public schools as at 2011. The knowledge extent of the research covers identification, mapping, and generating of database about the private and public secondary schools in the study area.

This study makes available a comprehensive database for efficient management of private and public Secondary Schools in Zaria and Sabon Gari Local Government Areas. A digital map of the study area will also be produced which presents the picture of the Schools at a glance and ensure updating.

The study area is located between latitude 11° 15′ N and 11° 3′ N of the equator and longitude 7° 30′ E and 7° 45′ E of the Greenwich meridian. It is situated in Kaduna state of Nigeria. The area is bounded to the North by Funtua Local Government of Katsina State, to the West by Birnin Gwari Local Government Area, while to the East and South-East by Ikara and Lere Local Government areas of Kaduna State respectively The region transverse about 70Km from the West to East and roughly covers 8,950 square kilometer. The area include; Samaru, Palladan, School of Aviation, Basawa, A.B.U, Kubani Dam and around Kubani, River Galma, Sabon Gari, Zaria city and Kongo This study was restricted to Urban Zaria and Sabon Gari Local Government areas as defined by Mortimore (1970).

The settled population in Zaria and Sabon Gari was predominantly Hausa and Fulani. According to the 1991 population census, the population of Zaria and Sabon Gari were 248,318 people. The density of population ranges from 50-200 persons per square kilometer, the heaviest population concentration was found in Sabon Gari and Samaru (NPC, 2006).

2. Data and Methodology

A trip was made to schools in the study area and coordinates of each school were obtained using the Germin 75S Handheld GPS Receiver. A trip was also made to the schools for the administration of questionnaires. The questionnaires contain data such as school name, year of establishment, number of teaching and non teaching staff, number of students in each class (JSS 1 to SSS 3), number of classrooms in each class (JSS 1 to SSS 3). These data are useful for various types of analysis which will greatly assist in the efficient and effective planning and management of school resources.

The digital base map was obtained by digitizing Google Pro 2008 satellite image. A list showing the private and public secondary schools in the study area was obtained from the state Ministry of Education.

In digitizing the feature classes, the Google satellite image was used to map the features classes. First, it was downloaded from the internet so that the satellite image could be seen for accurate mapping. The digitizing exercise then started by adding the layers that were created in Arc Catalog. The start editing was activated in the editor tool and features classes were digitized by selecting the “create New Features” in the Task drop-down menu. The pencil icon was clicked and the pointer becomes a small crosshair symbol. A homogeneous area was picked and the vertices of the polygon were created by “tracing” the boundary and clicking at each vertex.

2.1. Database Creation

The following data were collected and used in the development of the database. They are:

i. Satellite image showing the study area

ii. Schools control points.

iii. List showing school names and addresses

iv. Questionnaires administered to schools in the study area

All the necessary information for each school was entered into its layer’s attribute table and stored for analysis. This was done by adding required number of fields (columns) to the table and entering the data for all the schools in their corresponding records (rows).

2.2. Plotting the Coordinates

The coordinates of the schools were copied in notepad and saved as a .txt (plain text) file format. The coordinate used is shown in table 1.

The following steps were taken to import the files into Arc Map:

● In the main bar "tools" was right – clicked, a dialog box appeared and the "Add XY Data" was selected.

● The "Add XY Data" window appeared and the browse to folder button was clicked. The folder in which the school coordinates file was saved was browsed and added.

● The filed for the X and Y coordinates (i.e. easting and northing) were specified and the coordinate system of the input coordinate was selected, applied and ok.

● The locations of the schools were automatically added to the map as points.

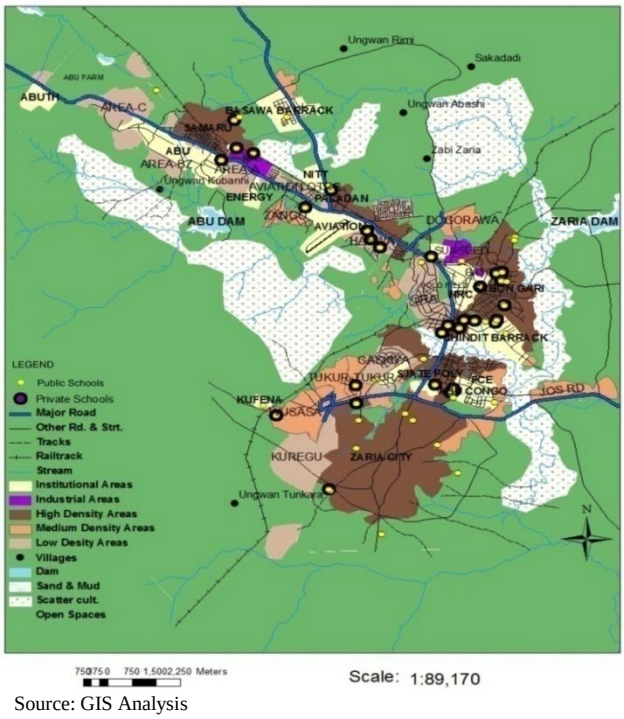
Table 1. Coordinates used to Geo-reference the Satellite Image

Land Mark	Easting	Northing
M1	357041.4	1247358.54
M2	374016.48	1220834.28
M3	356832.56	1236460.43
M4	339768.44	1236460.43
M5	357716.06	1231358.04

3. Results and Discussion

To achieve the objective of Identifying and mapping the private and public secondary schools in the study area, table 2 and figure 1 were produced.

Table 2 shows the list of private and public secondary schools in the study area. From the table, it can be seen that a total of 55 secondary schools were in the study area with a total of 31 being private while the remaining 24 were public schools. The table also contains the names of the schools and their geographical locations. The geographical distribution of the schools is also shown in figure 1.

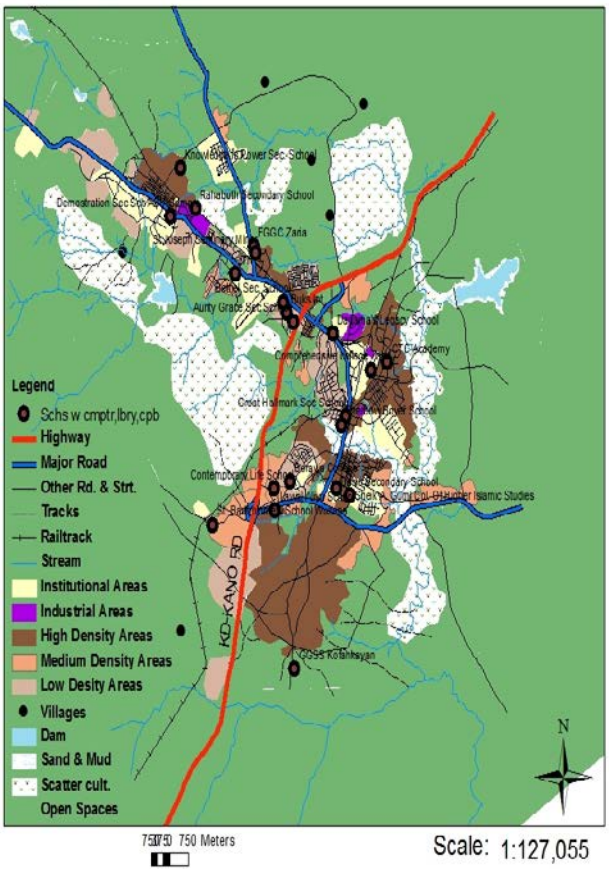


Source: GIS Analysis

Figure 1. Spatial distribution of the secondary schools in the study area

A GIS Database for the Secondary Schools in Zaria and Sabon-Gari LGAs was created as shown in table 3 after the information collected through the use of questionnaire were incorporated with the information in table 2. Queries of some basic facilities from the database created were done and the resultant results are shown in figures 2 to 5.

Query operations were performed on the database created and the results show that 20 (36%) schools out of 55 schools had library, computer, chemistry, physics, and biology laboratories while the remaining 35 (64%) schools did not have all the facilities as shown in figure 2; out of 55 schools, 25 schools which represent about 45% of the total number of schools had examination hall with capacity ≥250, while 53.36% had <250 or none from table 3 and figure 3; that there were 41 schools which represent 73.21% of the total number of schools in the study area that had the total number of classes ≥ 12, while about 25% had as shown in table 3 and figure 4 less than 12 classes; the buffer of 2km was performed which shows that most of the schools were within a distance of 2km from residential areas as shown in figure 5 and table 3 except for Unguwan Abashi and Zabi Zaria that did not have schools close to them so the students had to travel more than 2km to the nearest school to them. Table 3 also shows the number of students in JSS1, JSS2, JSS3, SSS1, SSS2 and SSS3 in each of the schools. More so, it indicates the schools with some basic facilities such as football, volley ball, basket ball and tennis.



Source: GIS Analysis

Figure 2. Distribution of Schools having library, Computer, Chemistry, Physics and Biology Laboratories

Table 2. List of Private and Public Secondary Schools in the Study Area

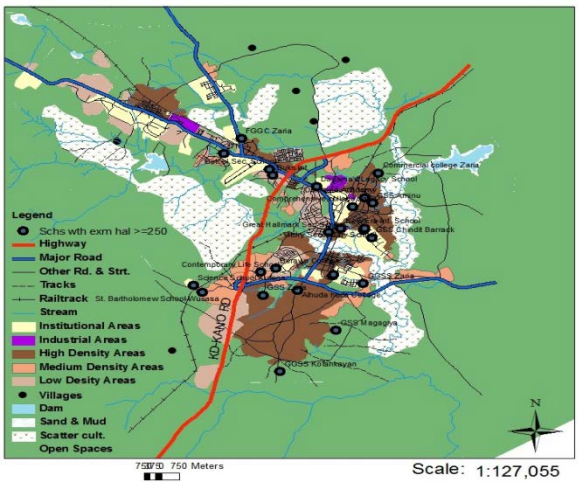
ID	Shape	Easting	Northing	Scho_Name	Own_ship
1	Point	360459	1228669	Williams School Zaria	Private
2	Point	361159	1228920	Comprehensive college zaria	Private
3	Point	362258	1230695	Commercial college Zaria	Public
4	Point	362229	1230579	GSS Muchia	Public
5	Point	360593	1229853	GSS Chikaji	Public
6	Point	361852	1229450	Judy Secondary school	Private
7	Point	361660	1229392	Diamond Academy	Private
8	Point	361826	1229132	CTC Academy	Private
9	Point	362004	1229111	GSS Aminu	Public
10	Point	361916	1228253	Goodwill Secondary School	Private
11	Point	3616331	1227645	Triumph Compressive Sec. Sch	Private
12	Point	361679	1227753	Victory Secondary School	Private
13	Point	361325	1227694	GGSS Dogon Bauch	Public
14	Point	361004	1227729	Royal College	Private
15	Point	360680	1227754	New Era Int. School	Private
16	Point	360541	1227459	Progress Secondary School	Private
17	Point	361975	1227263	GSS Chindit Barrack	Public
18	Point	360477	1222343	GSS Magagiya	public
19	Point	359839	1223326	GGSS Pada	Public
20	Point	358858	1224449	Alhuda huda college	Public
21	Point	359090	1224199	GSS Kofan Doka	Public
22	Point	356540	1221695	GSS Kuyanbana	Public
23	Point	356489	1221742	Alhuda centre for Islamic and Sci	Private
24	Point	358120	1220159	GGSS Kofan Kofankayan	Public
25	Point	357336	1223223	GSS Kofan Jatau	Public
26	Point	357406	1224297	GSS Zaria	Public
27	Point	359777	1225450	Basic secondary school	Private
28	Point	361621	1224832	GGSS Zaria	Public
29	Point	360339	1225002	GSS T/Wada	Public
30	Point	360343	1225226	Sheik A. Gumi Col. Of Higher Islamic studies	Private
31	Point	360247	1225181	Master Builder secondary school	Private
32	Point	360349	1225308	Abdurahman Memorial Col. Of Islamic studies	Private
33	Point	354170	1233645	Rahabuth secondary school	Private
34	Point	353628	1233822	Gods Time Comprehensive School	
35	Point	353723	1234947	GGSS Samaru	Public
36	Point	353557	1234820	Knowledge is Power Sec. School	Private
37	Point	351172	1235893	GSS Bomo	
38	Point	353171	1233413	Demonstration Sec. Sch ABU Samaru	Private
39	Point	36177	1227558	Great Hallmark Sec school	Private
40	Point	359981	1227305	Therbow Boyer School	Private
41	Point	359420	1226364	GSS T/Jukun	Public
42	Point	359640	1229979	Dagama's Legacy School	Private
43	Point	359346	1229791	GSS Kwagila	Pubic
44	Point	357796	1230588	Buks International schools.	Private
45	Point	357686	1230901	Bethel Sec. School	Private
46	Point	358083	1230324	Aunty Grace Sec. School	Private
47	Point	354464	1224725	Science School Wusasa	Private
48	Point	354864	1224378	St. Bartholomew School Wusasa	Private
49	Point	357344	1224802	Lawal Aliyu School	Private
50	Point	357320	1225431	Contemporary Life School	Private
51	Point	357958	1225632	Barewa College	Public
52	Point	355197	1234935	GSS Basawa Barrack	Public
53	Point	356495	1232521	FGGC Zaria	Public
54	Point	356572	1232335	St. Joseph Seminary Minor	Private
55	Point	355753	1231730	ITN	Private

Source: Field work, 2011

Table 3. A GIS Database for Private and Public Secondary Schools in the Study area

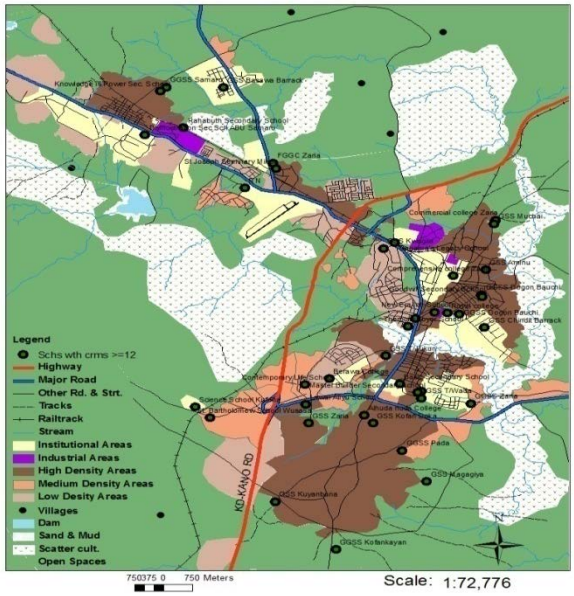
ID	N_Fm Ntchs	N_M-_Ntchs	Cmptr_ Lab	C_p_b_ Lab	Li-brary	N_Cl asRm	Exm_H _Capa	N_S_ JSS1	N_S_JS S2	N_S_ JSS3	N_S_S SS1	N_S_S SS2	N_S_S SS3	S_W_FV BTO
1	0	2	No	Yes	No	12	0	31	52	46	61	63	66	Fv
2	2	2	Yes	Yes	Yes	12	500	52	65	55	84	76	88	Fv
3	6	19	Yes	No	Yes	16	400	70	156	140	131	136	185	Fvbo
4	0	1	No	No	No	18	0	375	270	245	168	178	188	Fvb
5	0	3	No	No	No	9	0	303	230	225	30	32	28	F
6	2	2	Yes	No	Yes	8	0	57	48	40	20	30	20	Fvb
7	1	2	No	Yes	Yes	6	300	21	30	40	36	30	44	F
8	3	2	Yes	Yes	Yes	6	100	46	50	26	31	41	30	Fbt
9	0	0	No	Yes	Yes	12	670	30	45	38	350	970	400	F
10	1	2	Yes	Yes	No	12	0	43	39	57	57	53	69	V
11	1	1	No	Yes	Yes	8	300	45	53	48	72	66	40	Fvt
12	2	1	No	Yes	No	9	300	33	40	38	50	67	48	Fo
13	1	4	No	Yes	Yes	18	0	40	35	30	420	450	418	None
14	1	2	No	Yes	Yes	12	30	71	48	42	18	20	18	F
15	2	3	No	Yes	Yes	21	50	65	66	62	72	66	38	All
16	1	2	No	Yes	Yes	6	120	36	43	33	25	30	27	Ft
17	9	1	No	Yes	Yes	38	250	437	442	658	120	351	221	Fvo
18	0	5	No	Yes	No	17	420	292	375	382	48	92	78	Ft
19	1	2	No	Yes	Yes	15	0	190	295	200	125	160	150	Fo
20	3	15	No	Yes	Yes	36	350	170	217	209	480	48	443	Fv
21	1	3	No	Yes	No	16	0	212	199	270	280	192	197	F
22	0	2	No	Yes	Yes	14	0	231	250	270	176	189	205	Fv
23	1	6	No	Yes	Yes	6	0	45	40	37	19	30	30	F
24	2	8	Yes	Yes	Yes	24	350	350	290	431	350	290	280	Vt
25	0	0				0	0	70	68	50	40	32	28	F
26	0	9	No	Yes	Yes	30	750	235	489	385	400	540	550	Fv
27	3	4	Yes	Yes	Yes	15	130	116	116	54	100	84	66	Fvt
28	10	9	No	Yes	Yes	32	600	100	102	96	115	135	125	Fvb
29	68	30	No	No	No	12	0	150	68	65	30	25	32	V
30	0	5	Yes	Yes	Yes	24	300	350	350	350	240	245	240	None
31	1	1	No	Yes	Yes	8	0	28	36	37	30	20	24	None
32	0	6	No	Yes	Yes	20	350	275	273	280	241	243	245	None
33	0	1	Yes	Yes	Yes	7	60	60	25	36	68	61	28	Fv
34	2	1	No	Yes	Yes	12	0	70	52	50	66	76	60	Fvt
35	1	4	No	Yes	No	18	0	60	54	36	420	420	418	None
36	1	2	Yes	Yes	Yes	8	0	39	44	40	40	41	47	F
37	3	5	No	Yes	Yes	28	0	300	297	341	148	246	152	Fv
38	4	20	Yes	Yes	Yes	42	200	419	472	517	609	412	526	Fv
39	12	18	Yes	Yes	Yes	18	590	390	556	480	440	553	360	All
40	6	10	Yes	Yes	Yes	14	0	123	106	95	116	100	86	All
41	0	0	No	Yes	No	18	0	162	171	165	254	241	215	F
42	3	3	Yes	Yes	Yes	22	500	152	231	132	172	248	222	Fvt
43	1	1	No	Yes	Yes	18	0	168	186	223	228	226	212	Fv
44	5	5	Yes	Yes	Yes	6	270	40	26	45	46	58	42	All
45	0	0	Yes	Yes	Yes	4	260	30	13	30	30	17	15	F
46	1	1	Yes	Yes	Yes	8	0	28	17	37	28	16	15	V
47	5	5	No	Yes	Yes	24	400	32	175	157	250	242	244	Fvt
48	5	5	Yes	Yes	Yes	20	320	64	53	70	81	53	60	Fvbt
49	0	0	Yes	Yes	Yes	12	0	41	33	32	45	37	32	Fv
50	4	4	Yes	Yes	Yes	16	250	83	74	55	87	93	56	All
51	4	4	Yes	Yes	Yes	37	470	275	285	271	300	285	261	All
52	0	0	No	Yes	No	24	0	398	223	371	218	237	304	Fv
53	19	19	Yes	Yes	Yes	32	270	187	205	199	143	167	123	Vto
54	4	4	Yes	Yes	Yes	12	150	59	57	55	45	41	32	Fvbo
55	0	0	Yes	Yes	Yes	18	350	224	208	178	133	121	96	None

Source: GIS Analysis



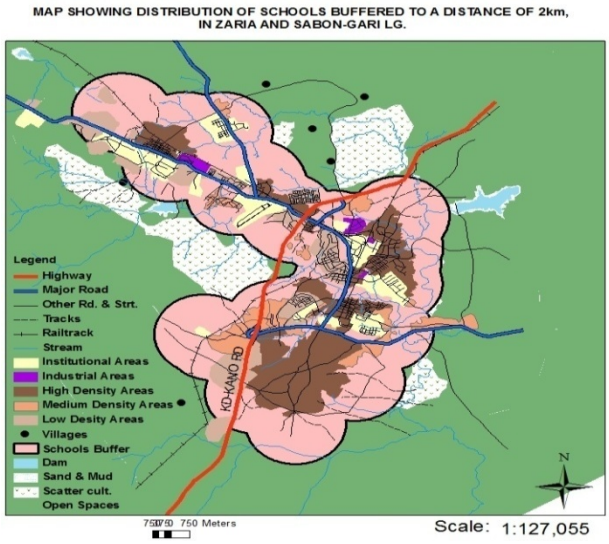
Source: GIS Analysis

Figure 3. Schools with examination hall of capacity ≥ 250 students



Source: GIS Analysis

Figure 4. Distribution of Schools Having Number of Classes ≥ 12



Source: GIS Analysis

Figure 5. Distribution of Schools Buffered to a walking distance of 2km

4. Conclusions

The learning conditions of most schools in the study area has shown that governments, non-governmental organizations, private sectors and the communities should support the educational sector through the provision of learning facilities most especially in those schools that lack facilities in order to assist the nation to attain its educational objective. The use of GIS in school data handling should be encouraged especially as it assists in carrying out various analyses which can indicate where these facilities are inadequate, lacking or not properly distributed. This makes decision making easier and also enhance the proper distribution of these facilities.

The aim of this project has been achieved by mapping and creating a GIS database of public and private secondary schools in Zaria and Sabon Gari Local Government areas has been developed using Arc GIS 9.2 software. The database provides the users with a working environment for data management. It also allows efficient query of information needed for school processing. The result of the research carried out has shown that most of the schools are concentrated in Sabon Gari areas while Kuregu and Ungwan Abashi did not have Secondary Schools at all. This research goes to strengthen the importance of GIS in mapping and data base creation.

Abbreviations Used in Database

1. Sch_Name: School Name
2. Sch_Addres: School Address
3. Sch_Cat: School Category
4. Own_Ship: Ownership
5. Yr_of_Estb: Year of Establishment
6. N-M_Tchr: Number of Female Teachers
7. N_Fm_Tchr: Number of Male Teachers
8. N_M_Ntchs: Number of Male Non_teaching Staffs
9. N-Fm_Ntchs: Number of female non teaching staffs
10. N_MS_JSS1: Number of Male Students in JSS1
11. N_Fms_JSS1: Number Of Femlae Students in JSS2
12. N_MS_JSS2: Number of Male Students in JSS2
13. N_FmS_JSS2: Number of Female Students in JSS2
14. N_MS_JSS3: Number of Male Students in JSS3
15. N_fmS_JSS3: Number of Female Students in JSS3
16. N_MS_JSS1: Number of Male Students in SSS1
17. N_FmS_JSS1: Number of Male Students in SSS1
18. N_MS_JSS2: Number of Male Students in SSS2
19. N_FmS_JSS2: Number of Female Students in SSS2
20. N_M_SSS3: Number of Male Students in JSS3
21. N_FmS_JSS3: Number of Female Students in SSS3
22. Cmptr_Lab: School with Computer Lab
23. C_P_B_Lab: School with Chemistry , physic, and Biology Lab
24. Library: School with Library
25. N_ClasRm: Total Number of classroom
26. S_W_Fvtb: School with Football, Volleyball, Tennis, Basketball, and other Sport Facilities
27. N_MS_LJSCE: Number of Male Students that sit for the last JSCE
28. N_FS_LJSCe: Number of Female Students that Sit for

the last JSCE

29. JSCE_4c_M: Male Students that passed JSCE with 4C and above

30. JSCE_4C_FM: Female Students that passed JSCE with 4C and above

31. N_MS_LSSCE: Number of Male Students that sit for the last SSCE

32. N_FmS_LSSC: N_MS_LESSCE: Number OF Female Students that sit for the last SSCE

33. N_MS_LSSCE: Number Of Male Students That Sat For The Last SSCE

34. N SSCE_5C_M: Male Students That passed SSCE with 5C above

35. SSCE_5C_F: Female Students that passed SSCE with 5C and above

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