GIS AS A TOOL FOR SUSTAINABLE DEVELOPMENT IN PUBLIC SECONDARY SCHOOL MAPPING

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The paper focuses on using GIS as a tool for sustainable development in public secondary school mapping of Ilorin west local government area of Kwara State, Nigeria. The purpose is to map and carry out geospatial analysis of the public secondary schools in the study area to enable effective and efficient planning and management of the public secondary schools in a sustainable manner. This has been achieved through identification of the public secondary schools in the study area, mapping of the schools through the satellite imagery and global positioning system (GPS) technology, generating the attribute data of the schools, creation of GIS database for the schools and finally carry out geospatial analysis of the school data. The base map of the study area was obtained using SAS planet software package. The school addresses were obtained from the Kwara State ministry of education while the geospatial locations were obtained by field observations using GPS receivers and the attribute data through the administration of questionnaires and interviews with major stakeholders of the schools. A GIS database was created, the spatial and attribute data encoded, and geospatial analysis carried out including production of relevant maps using QGIS software. The resulting school location, student gender ratio, staff-student ratio, year of establishment and school type maps provides stakeholders with relevant maps and working environment for data management and also allows efficient query of information needed for decision making that would aid in sustainable development of the schools and education sector.

Keywords*: Geospatial Analysis, GIS, School Mapping, GPS, Sustainable Development* [29]

1.0 INTRODUCTION

Education is a key factor to measure the development of any society. The development of a society could be measured by the quality of its education. High quality human resources could be generated by good education very well linked to the nature and management of the schools. Education affects development through various dimensions of cognitive competence: literacy (reading and writing), numeric, modernity, and problem-solving behaviors (Lockheed and Verspoor, 1990). For these reasons, sustainable development become expedient in the education sector of any society. Therefore, government needs an efficient system that can help it in analyzing the current state of education vis-a-vis the public secondary schools being managed and its progress. It also needs a system that can support in decision-making and policy framing. Geographic Information System (GIS) as a geospatial technique can serve the mentioned requirements not only for government but also for individuals and corporate bodies.

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GIS is a collection of tools and techniques that works on the geospatial data and is used in the analysis and decision-making. GIS is required for very diverse fields from government to common public, from commercial to social service, from science to defense. According to Bolstad (2012), GIS is "a computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information" whereas Burrough (1986) defined GIS as "a powerful set of tools for storing and retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes". GIS is a system that works on the spatial as well as attribute data.

Because of the need to know the existing state of the public secondary schools and make sound decision while proffering solution to problems the public secondary schools are facing, it has become necessary for the government and decision makers to have a proper understanding and analyze the existing school locations and facilities. Geospatial mapping and analysis of the schools play an important role in this aspect. Geospatial analysis in this sense consists of creating geospatial database of schools that supports in the infrastructural development, policy analysis and decision-making.

The paper focuses on using GIS as a tool for sustainable development in public secondary school mapping of Ilorin west local government area of Kwara State, Nigeria. This paper indicates the status of the existing public secondary schools, available human resources and facilities. Therefore, this paper tried to demonstrate how to integrate spatial, attribute data together, and apply GIS to analyze the public secondary schools. This paper attempts to support particularly the government and other stakeholders in public school management in Ilorin west local government area, Ilorin, Kwara State, Nigeria by providing information on the spatial patterns as well as attribute character of the schools for decision support.

2.0 STUDY AREA

The study covers Ilorin West Local Government Area, Kwara State, Nigeria which is situated between latitude 40°33’29.84”E and longitude 80°27’40.18”N of the equator. It has an estimated land area of 54.25% of the whole city of Ilorin. It has a total landmass of 105km2 and population of 365,221 (NPC, 2006). The local government was created in October, 1991 and divided into 12 electoral wards (Adewole, Ajikobi, Alanamu, Badari, Baboko, Mogaji-Ngeri, Ogidi, Oko-Erin, Oloje, Ojuekun/Sarumi, Ubandawaki, and Wara/Osin/Egbejila and serves as the headquarters of Ilorin emirate council.). Of the Ilorin emirate, comprising Ilorin West, Ilorin East and Ilorin South local government area, Ilorin west is importantly known for its educational and religious significance. Public secondary schools in the local government spread across all its 12 electoral wards.

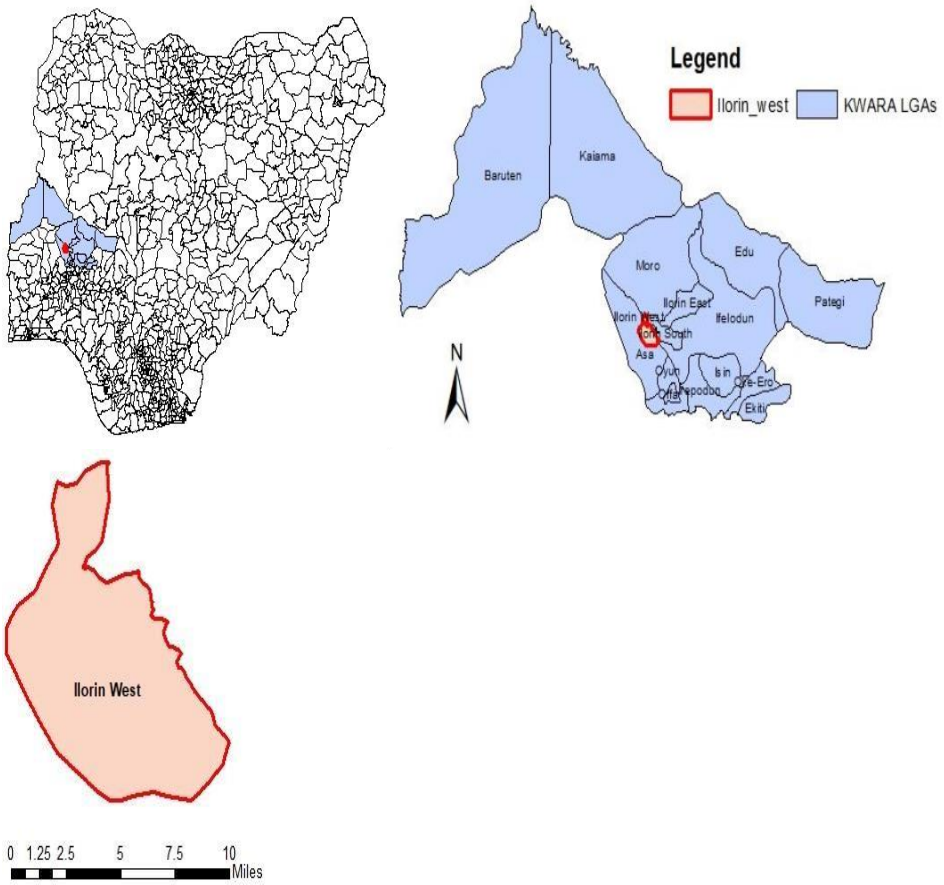

Figure 1: Map showing the study area

3.0. METHODOLOGY

The spatial extent of the study covers Adewole, Alanamu, Baboko, Mogaji-Ngeri, Oko-Erin, and Wara/Osin/Egbejila. The temporal extent of the study covers the public senior secondary schools in the study area as at 2017.

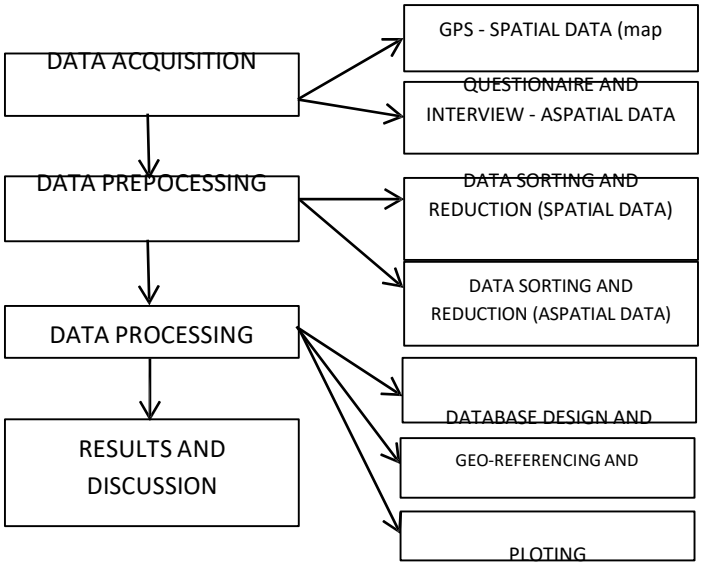

Figure 2: The Methodology Flow Chart

3.1 Data Acquisition

Two data type employed for the study include the spatial and aspatial data. Spatial data obtained include the base map acquired using SAS Planet software and spatial location data of 23 senior secondary schools in the study area using Garmin 76csx GPS Receiver. The base map data of the study area was obtained using SAS planet software. The aspatial data otherwise called attribute data gives the description of spatial data. The aspatial data were collected by combination of on-the-spot assessment, questionnaires and personal interviews with the school administrators, staff and students. An attribute table was built that consist of school name, school addresses, school year of establishment, school type, the number of male and female students, number of staff, etc.

3.2 Data Sorting and Reduction

Data sorting and reduction are integral part of data preprocessing. This include arranging the data in alphabetical order, arranging them in a way that support easy processing and queries. Data reduction carried out involved bringing the large amount of data down to the meaningful parts. Both data sorting and reduction were done for the obtained school data. This was carried out using Microsoft excel software and it was done for clarity and easy data usage.

3.3 Data Processing

The data processing stage involved the processing of the data and extraction of relevant information about the study focus and area. The database design and creation was carried out and it involved definition of related and each of the data types in a systematic manner for easy querying, analysis and efficient use of the data.. All the necessary information for each school was entered into its layer's attribute table and stored for analysis within the QGIS software environment. QGIS 3.2 software was used for the processing, plotting and map production.

4. RESULTS AND DISCUSSION

The results of the processed data are as presented in the form of tables, figures, and are discussed below.

4.1 School Location Map

Figure 3 shows the locations of the public senior secondary schools within the study area. The location map helps to shows locational spread of the schools within the study area. This could aid the government and all stakeholders in decision making for future location of public schools in a manner that supports sustained development within the study area. Table 1, table 2 show the spatial location and aspatial information of the Public Senior Secondary Schools in the study area. Figure 3 shows the school location map.

Table 1
Spatial Location of the Public Senior Secondary Schools

S/N	School Name	Address	Eastings(m)	Northings (m)
1.	Ansar-U-Deen Senior Secondary School, Ilorin	Adamu Road Off Taiwo Road, P.O. Box, 146 Ilorin	670824	937851
2.	Community Secondary School, (Senior Secondary School) Baboko, Ilorin	Abul Azeez Attah Road	669465	938717
3.	Baptist Senior Secondary School, Surulere, Ilorin	Surulere Area, Ilorin	669366	937936
4.	Barakat Community Senior Secondary School, Ilorin	Adam Al Ilory Road, Yahaya Area Ilorin	666675	939390
5.	College Of Arabic And Islamic Studies Adewole, Ilorin	Near Yebumot Hotel Adewole Ilorin	664842	937913
6.	Ecwa Senior Secondary School, Oja Iya, Ilorin	78 Oja Iya Streeet Beside Ecwa Church Oja Iya Ilorin	670227	938203
7.	Government Day Secondary School, Adeta Ilorin	P.M.B 1541 Alfa Yahaya Road Aromaradu Ilorin	666750	938878
8.	Government Day Secondary School, Adewole Ilorin	P.O. Box 13751 Adewole Estate Ilorin	667589	937734
9.	Government Day Secondary School, Airport Ilorin	Airport Area, Ilorin	665862	931790
10.	Government Girls Day Secondary School, Oko-Erin, Ilorin	P.M.B 1461 Oko-Erin	668893	936939
11.	Government Day Secondary School, Odo-Okun, Ilorin	Saw Mill Area	668391	937304
12.	Government High School, Adeta Ilorin	Adeta Round About	666870	938377
13.	Ilorin Grammar School, Ilorin	Umoru Saro Road Private Mail Bag 1368, Ilorin	667909	936105
14.	Iman Senior Secondary School, Ilorin	Irewolede Area, Ilorin	671052	936052
15.	Local Government Senior Secondary School, Osin Aremu, Ilorin	Osin Aremu	673180	932379
16.	Local Government Secondary School, Odore, Ilorin	Off Airport Rd	669035	930897
17.	Mandate Senior Secondary School, Ilorin	Apalara Area Adeta	666441	938316
18.	Queen Elizabeth Secondary School, Ilorin	Ummaru Saro Rd P.Mb 1357	668807	937299
19.	Senior Secondary School, Ita-Alamu, Ilorin	Ita-Alamu	674299	933492
20.	Senior Secondary School, Gbagba, Ilorin	Off Airport Road Near Airport Hotel Gbagba, Ilorin	666298	933247
21.	Sheikh Abdulkadir College, Ilorin	Off Former University of Ilorin Mini Campus	668386	937421
22.	St. James Cac Senior Secondary School	New Yidi Road, Ilorin	670840	936888
23.	Waziri Senior Secondary School, Babaoko Ilorin	University Mini Campus Junction, Ilorin	668431	668431

Table 2
Aspatial Information about the Schools.

S/N	School Name	Year of Establis Hment	School Type	No. of Teaching b Staff	No. of Male Students	No. of Female Students	Total No. of Students
1.	Ansar-U-Deen Senior Secondary School, Ilorin	2012	Day	40	150	169	319
2.	Community Secondary School, (Senior Secondary School) Baboko, Ilorin	1980	Day	63	390	408	798
3.	Baptist Senior Secondary School, Surulere, Ilorin	2013	Day	30	143	113	256
4.	Barakat Community Senior Secondary School, Ilorin	1980	Day	61	533	292	825
5.	College Of Arabic And Islamic Studies Adewole, Ilorin	2006	Day	53	341	286	627
6.	Ecwa Senior Secondary School, Oja Iya, Ilorin	2012	Day	30	185	161	346
7.	Government Day Secondary School, Adeta Ilorin	1997	Day	73	510	570	1080
8.	Government Day Secondary School, Adewole Ilorin	1996	Day	65	480	432	912
9.	Government Day Secondary School, Airport Ilorin	1983	Day	80	346	355	701
10.	Government Girls Day Secondary School, Oko-Erin, Ilorin	1984	Day	61	0	681	681
11.	Government Day Secondary School, Odo-Okun, Ilorin	1997	Day	87	529	453	982
12.	Government High School, Adeta Ilorin	1967	Day	62	684	432	1116
13.	Ilorin Grammar School, Ilorin	1967	Day	78	530	399	929
14.	Iman Senior Secondary School, Ilorin	2013	Day	24	101	98	199
15.	Local Government Senior Secondary School, Osin Aremu, Ilorin	2003	Day	31	297	234	531
16.	Local Government Secondary School, Odore, Ilorin	1983	Day	39	81	117	198
17.	Mandate Senior Secondary School, Ilorin	2010	Day	43	414	414	828
18.	Queen Elizabeth Secondary School, Ilorin	1956	Boarding	78	0	780	780
19.	Senior Secondary School, Ita-Alamu, Ilorin	2006	Day	41	185	195	380
20.	Senior Secondary School, Gbagba, Ilorin	2006	Day	28	132	116	248
21.	Sheikh Abdulkadir College, Ilorin	2006	Day	62	290	340	630
22.	St. James Cac Senior Secondary School	2010	Day	44	305	351	656
23.	Waziri Senior Secondary School, Babaoko Ilorin	2010	Day	40	340	325	665

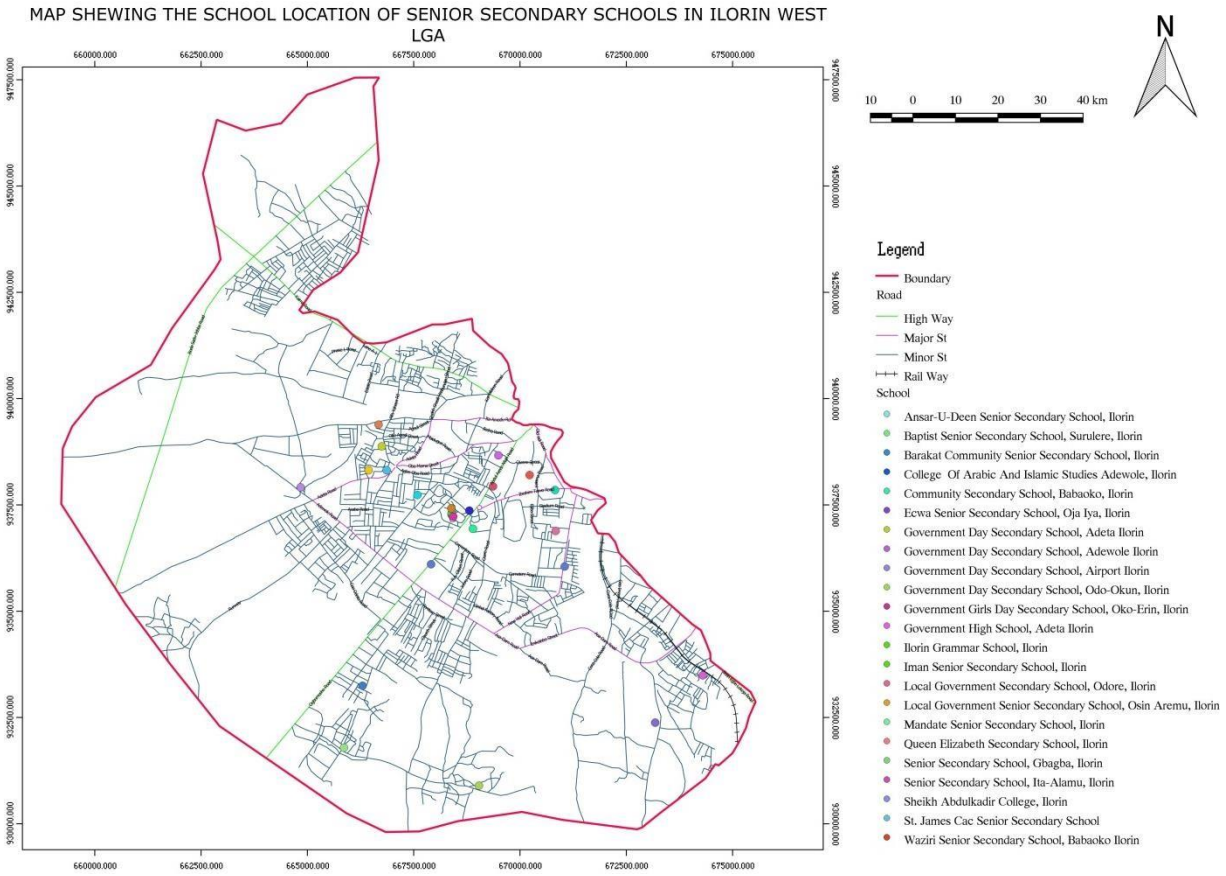

Figure 3: The School Location Map

Analysis based on the spatial distribution of the schools within the local government showed that out of the 6 of the 12 electoral wards covered, 26.09% of the schools are located in Adewole, 21.74% in Alanamu, 21.74% in Baboko, 17.39% in Oko-Erin, 8.70% in Warrah/Osin/Egbejila and 4.35% in Mogaji-Ngeri wards respectively. Adewole ward with 6 of the 23 schools contains more number of senior secondary schools than other wards. Mogaji Ngeri ward has the least number with 1 school located in the ward.

4.2 School Student Gender Ratio Map

Figure 4 shows the gender ratio of the students in each of the schools. The gender ratio is the number of males per the females' student in the schools. Generally, it was observed that the female literacy level is lower than the male literacy in the study area; this map can help in identifying the areas where there is need to promote female literacy in order to reduce this imbalance. It can also be observed that at many of the schools, the number of female students

is almost at pal with that of male, which reflects the changing mindset of the people towards the girl-child education. This is very important for sustainable development in the education sector as the role of the female folks cannot be underestimated. Figure 4 shows the student-gender ratio map and table 3 student-gender and staff-student ratios.

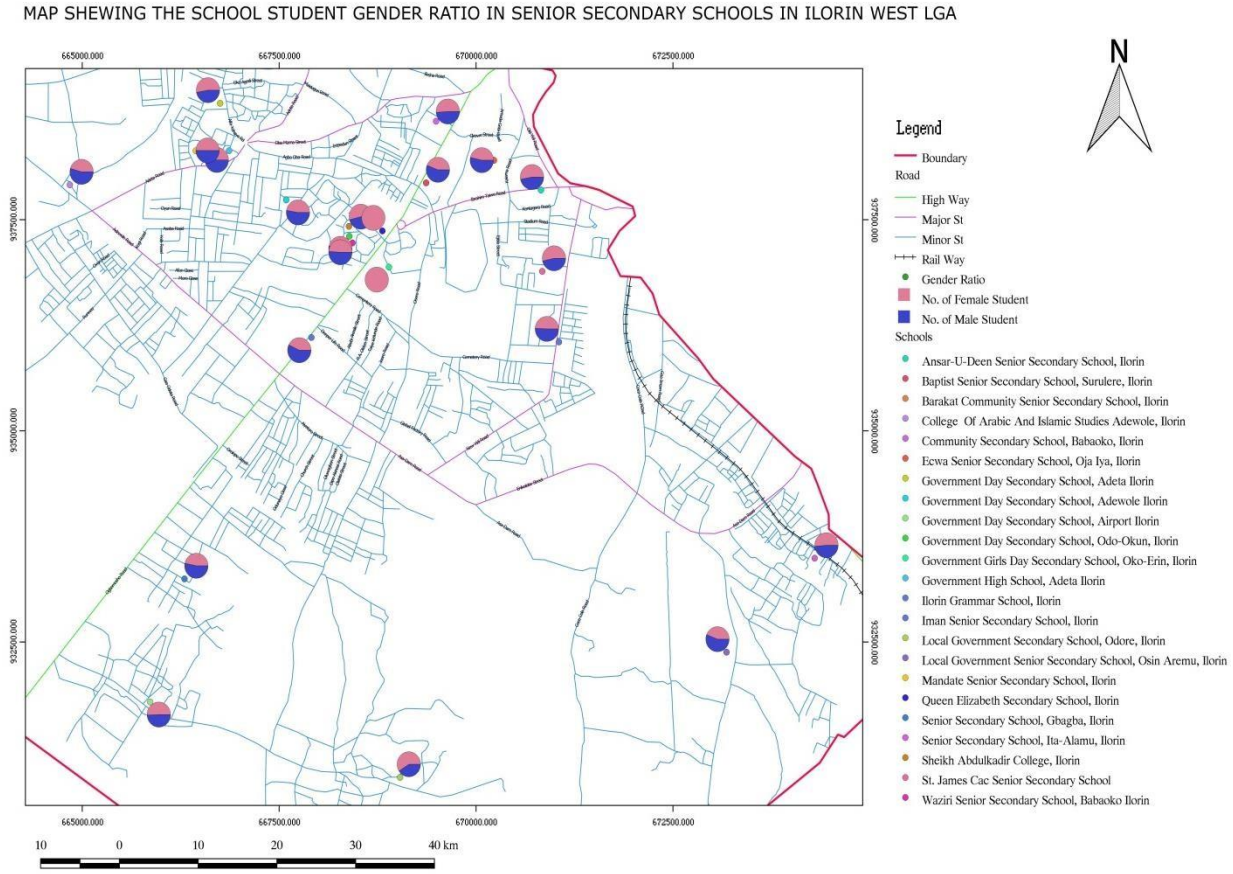

Figure 4: Student Gender Ratio Map.

Table 3
Student-gender and Staff-student ratios.

S/N	School Name	Student Gender Ratio (Male/Female)	Staff-Student Ratio
1.	Ansar-U-Deen Senior Secondary School, Ilorin	1: 1.1	1: 8
2.	Community Secondary School, (Senior Secondary School) Baboko, Ilorin	1: 1.1	1 : 13
3.	Baptist Senior Secondary School, Surulere, Ilorin	1 : 0.8	1 : 9
4.	Barakat Community Senior Secondary School, Ilorin	1 : 0.6	1 : 14
5.	College Of Arabic And Islamic Studies Adewole, Ilorin	1 : 0.8	1 : 12
6.	Ecwa Senior Secondary School, Oja Iya, Ilorin	1 : 0.9	1 : 12
7.	Government Day Secondary School, Adeta Ilorin	1: 1.1	1 : 15
8.	Government Day Secondary School, Adewole Ilorin	1 : 0.9	1 : 14
9.	Government Day Secondary School, Airport Ilorin	1 : 1.0	1 : 9
10.	Government Girls Day Secondary School, Oko-Erin, Ilorin	0	1 : 11
11.	Government Day Secondary School, Odo-Okun, Ilorin	1 : 0.9	1 : 11
12.	Government High School, Adeta Ilorin	1 : 0.6	1 : 18
13.	Ilorin Grammar School, Ilorin	1 : 0.8	1 : 12
14.	Iman Senior Secondary School, Ilorin	1 : 1.0	1: 8
15.	Local Government Senior Secondary School, Osin Aremu, Ilorin	1 : 0.8	1 : 17
16.	Local Government Secondary School, Odore, Ilorin	1 : 1.4	1 : 5
17.	Mandate Senior Secondary School, Ilorin	1 : 1.0	1 : 09
18.	Queen Elizabeth Secondary School, Ilorin	0	1 : 10
19.	Senior Secondary School, Ita-Alamu, Ilorin	1: 1.1	1 : 9
20.	Senior Secondary School, Gbagba, Ilorin	1 : 0.9	1 : 9
21.	Sheikh Abdulkadir College, Ilorin	1 : 1.2	1 : 9
22.	St. James Cac Senior Secondary School	1: 1.2	1 : 15
23.	Waziri Senior Secondary School, Babaoko Ilorin	1: 1.0	1 : 17

4.3 School Staff-Student Ratio Map

The staff considered are the teachers. Figure 5 shows the school staff-student ratio map. The map can be used to identify the schools where there is a need to employ more teachers. It can be deduced from the map that not all the schools did meet up with the standard ratio set by the Kwara state government ministry of education based on Kwara Annual Education Sector Performance Report (KAEPR), 2010. According to KAEPR, the average ratio ought to be 1:12 teacher to students' ratio in the secondary schools. Furthermore, the study shows that out of the 23 schools investigated, only 9 schools, representing 39% met and are above the standard ratio. 3 schools representing 13% are exactly within the standard ratio and 10 schools representing 44% of the school falls below the ratio and are the schools where there is an urgent need of teachers as there is only one teacher on more than 12 students.

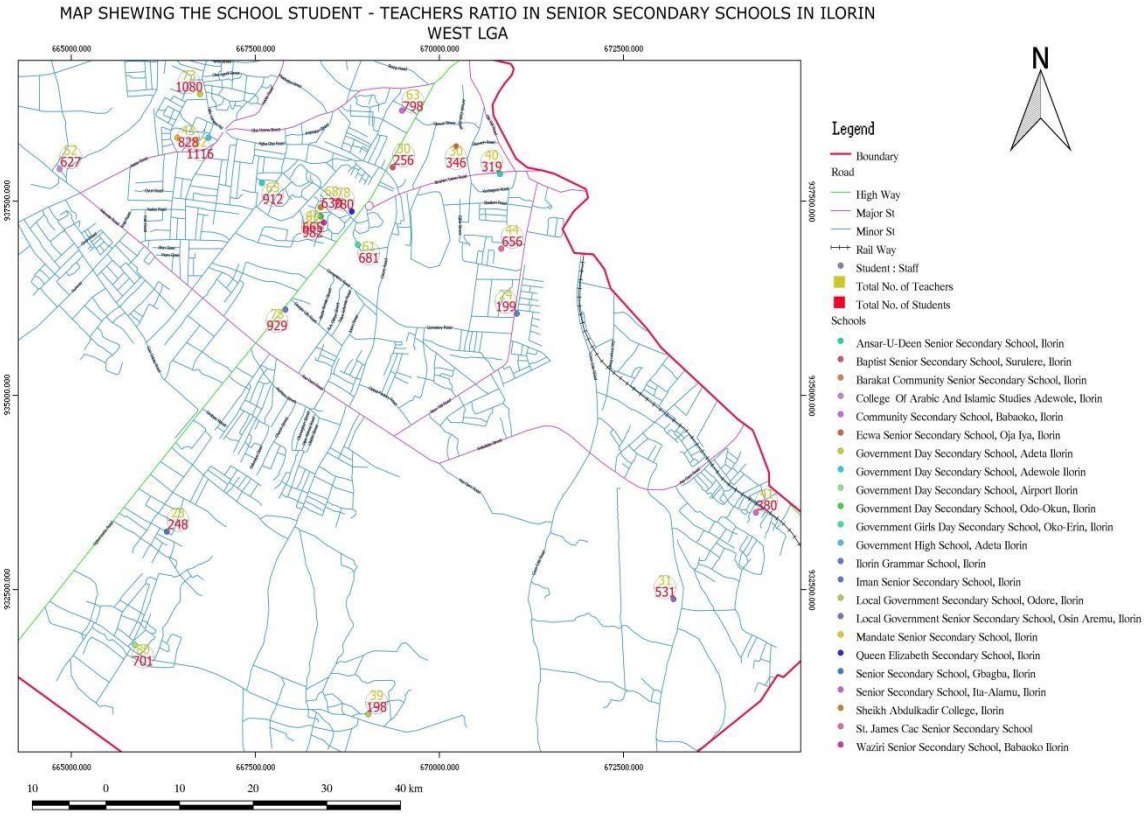

Figure 5: Staff-Student Ratio Map

4.4 School Year of Establishment Map

Table 2 shows the year of establishment of the schools under review in the study area and figure 6 shows School Year of Establishment Map in the study area.

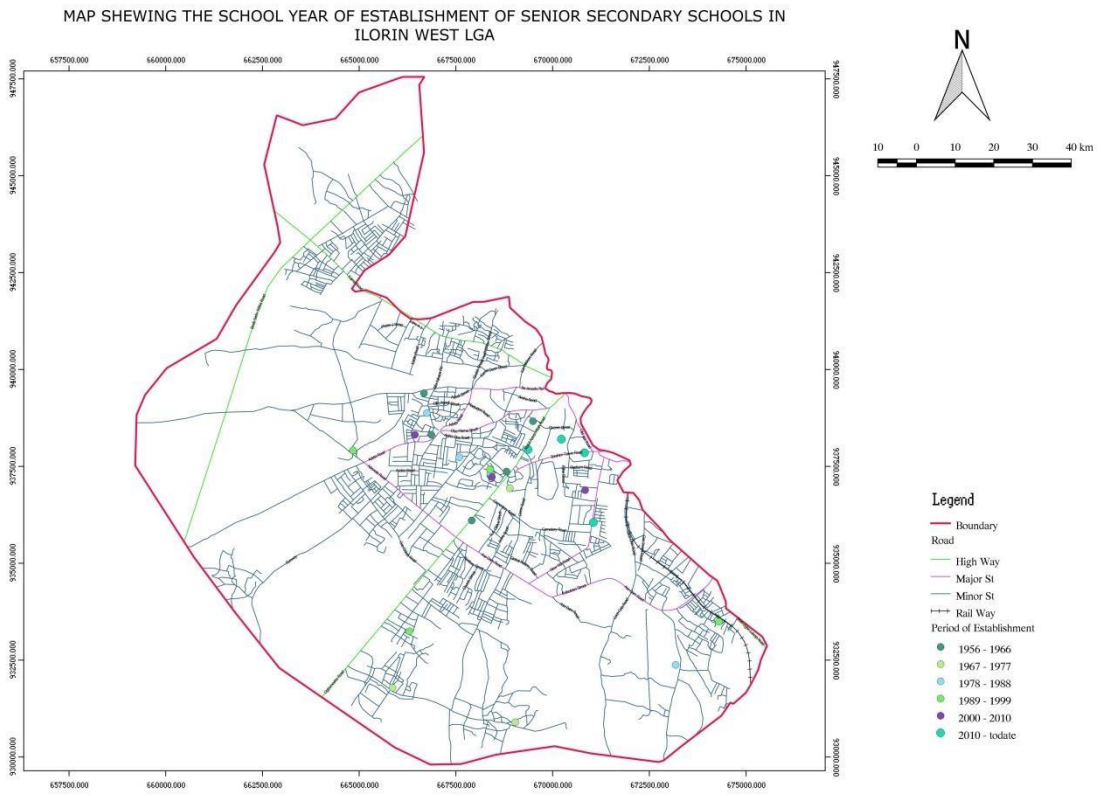

Figure 6: School Year of Establishment Map

The first and oldest Public Senior Secondary School that was established in Ilorin West Local Government is Queen Elizabeth Senior Secondary School in 1956. The last public school established being Baptist Senior Secondary School and Imam Senior Secondary, Ilorin in 2013. Analyzing the rate of establishment of public senior secondary schools since 1956 in the LGA using ten years interval, the result shows from 1956-1966 only one (1) school was established. Between 1967 and 1977, 1978-1988, 1989-1999, 2000–2010 and 2011-2017, two (2) (8.69%), five (5) (21.74%), three (3) (13.04%), five (5) (21.74%) and seven (7) (30.43%) schools were established respectively.

Table 4
Period of Establishment of Public Secondary Schools in the Study Area.

S/N	YEAR INTERVAL	NUMBER OF PUBLIC SENIOR SECONDARY SCHOOLS	PERCENTAGE (%)
1.	1956-1966	1	4.35%
2.	1967-1977	2	8.69%
3.	1978-1988	5	21.74%
4.	1989-1999	3	13.04%
5.	2000-2010	5	21.74%
6.	2010-2017	7	30.43%

4.5 School Type map

Of all the 23 public secondary schools under investigation, only one school is of boarding school type, the school is Queen Elizabeth Senior Secondary School, and it is an all-girls school. All the other schools operate Day school type. By implication, it means no school is a set-aside only boy's school and no boarding school type for the boys within the study area.

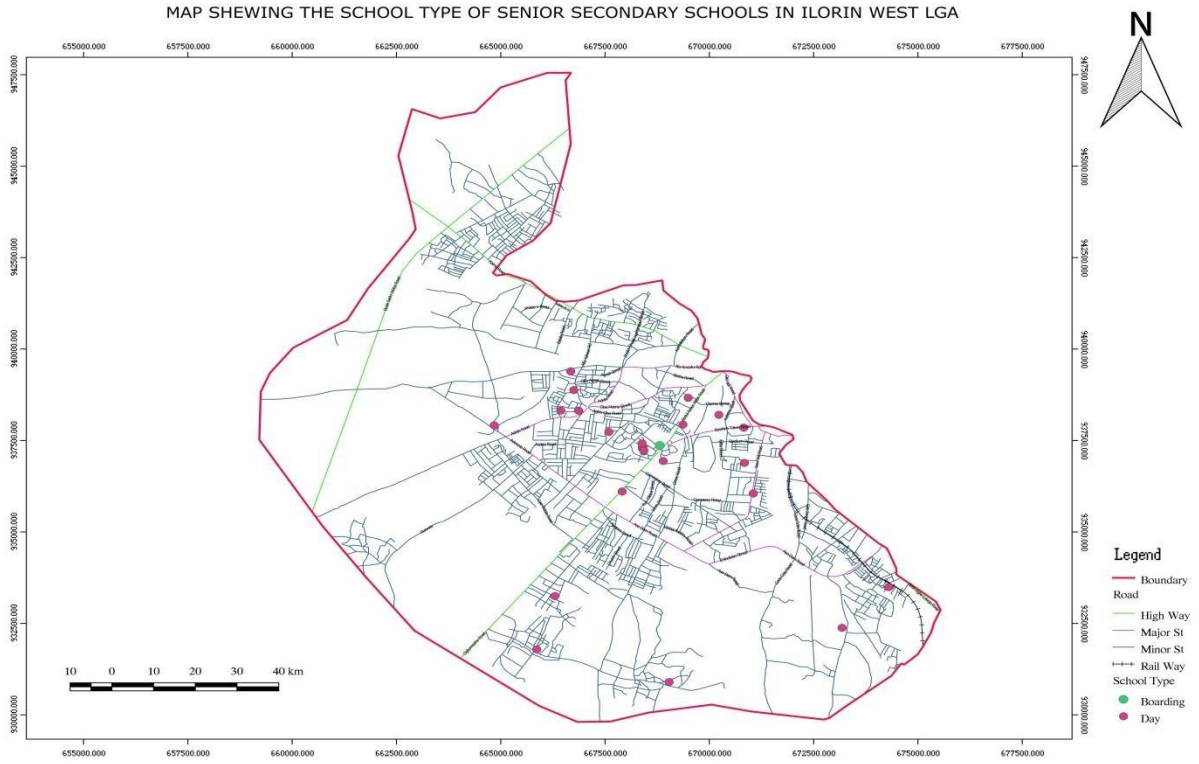

Figure 7: School Type Map

5. CONCLUSIONS AND RECOMMENDATIONS

GIS as a geospatial technique provides opportunity for analysts and decision makers to manage and plan as well as solve geospatial related problems. The study has demonstrated the capability of GIS for geospatial analysis of public secondary schools in Ilorin West Local government area for sustainable development of the education sector. Different geospatial analysis has been carried out and maps produced on the schools. It is expected that the government and relevant bodies in the education sector would find the issues highlighted in the study useful for effective and efficient decision making on the schools and public education administration in the local government and the state at large.

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