MAPPING OF EDUCATIONAL FACILITIES IN UNWANA, EBONYI STATE, NIGERIA

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ABSTRACT

Educational facility mapping is the process of identifying, recording, and analyzing the location and characteristics of schools in relation to the communities they serve. It is an important tool for planning and decision-making in the education sector. According to Olubadewo and Abiodun (2018), school mapping helps to identify areas where facilities are lacking and supports government in allocating resources more equitably. Adepoju (2018) further explained that facility mapping gives a clearer picture of spatial inequality in education, which makes it possible to design interventions that can improve accessibility and fairness in the distribution of schools. By showing the actual locations of schools on maps, decision-makers can better evaluate whether the facilities available meet the needs of the population. The use of GIS has become a major advancement in the mapping and analysis of educational facilities. GIS is a computer-based system that can collect, store, analyze, and display spatial data. This makes it a suitable tool for planning and managing schools. Longley, Goodchild, Maguire, and Rhind (2015) pointed out that GIS allows planners to visualize the distribution of schools and to measure accessibility to them. This study is designed to fill this gap by mapping the primary and secondary schools in Unwana and analyzing their spatial distribution.

Keywords: Data Search, Data Acquisition, Data Imagery and Attribute Data

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Introduction

Education is widely recognized as a fundamental driver of individual growth and national development. Access to quality education is not only a human right but also a key instrument for social transformation, economic advancement, and the reduction of inequality (UNESCO, 2015). For this reason, governments, policymakers, and development agencies continually seek accurate information on the distribution and accessibility of educational facilities to ensure equitable service delivery.

In Nigeria, as in many developing countries, the availability and spatial distribution of schools play a vital role in determining educational opportunities. When schools are unevenly distributed, certain communities may experience limited access, leading to disparities in enrolment, attendance, and overall literacy levels (Egunjobi, 2019). To address these challenges, accurate spatial data and reliable maps are essential tools for planning, monitoring, and improving educational services.

Geographic Information System (GIS) provides a powerful platform for collecting, managing, analyzing, and presenting spatial data. Through GIS, locations of schools can be precisely mapped and linked with their attributes, thereby enabling stakeholders to assess patterns of accessibility, identify gaps in educational infrastructure, and make informed decisions for sustainable educational development (Longley, Goodchild, Maguire, & Rhind, 2015).

Unwana, a town in Afikpo North Local Government Area of Ebonyi State, is a fast-growing community with increasing demand for primary and secondary education. Despite the presence of several schools in the area, there has been limited documentation of their exact locations, distribution patterns, and accessibility. Most available records are often in textual or tabular form, lacking the spatial detail needed for effective planning. This absence of comprehensive

spatial data creates challenges for government agencies, planners, and researchers who require accurate information to guide decisions on infrastructure development, resource allocation, and policy implementation (Okpala-Okaka, 2020).

Against this backdrop, mapping the primary and secondary schools in Unwana using modern geospatial techniques is both timely and significant. The study will provide a digital map and database that will not only serve as a reference for educational planning but also as a foundation for further research and development initiatives in the community.

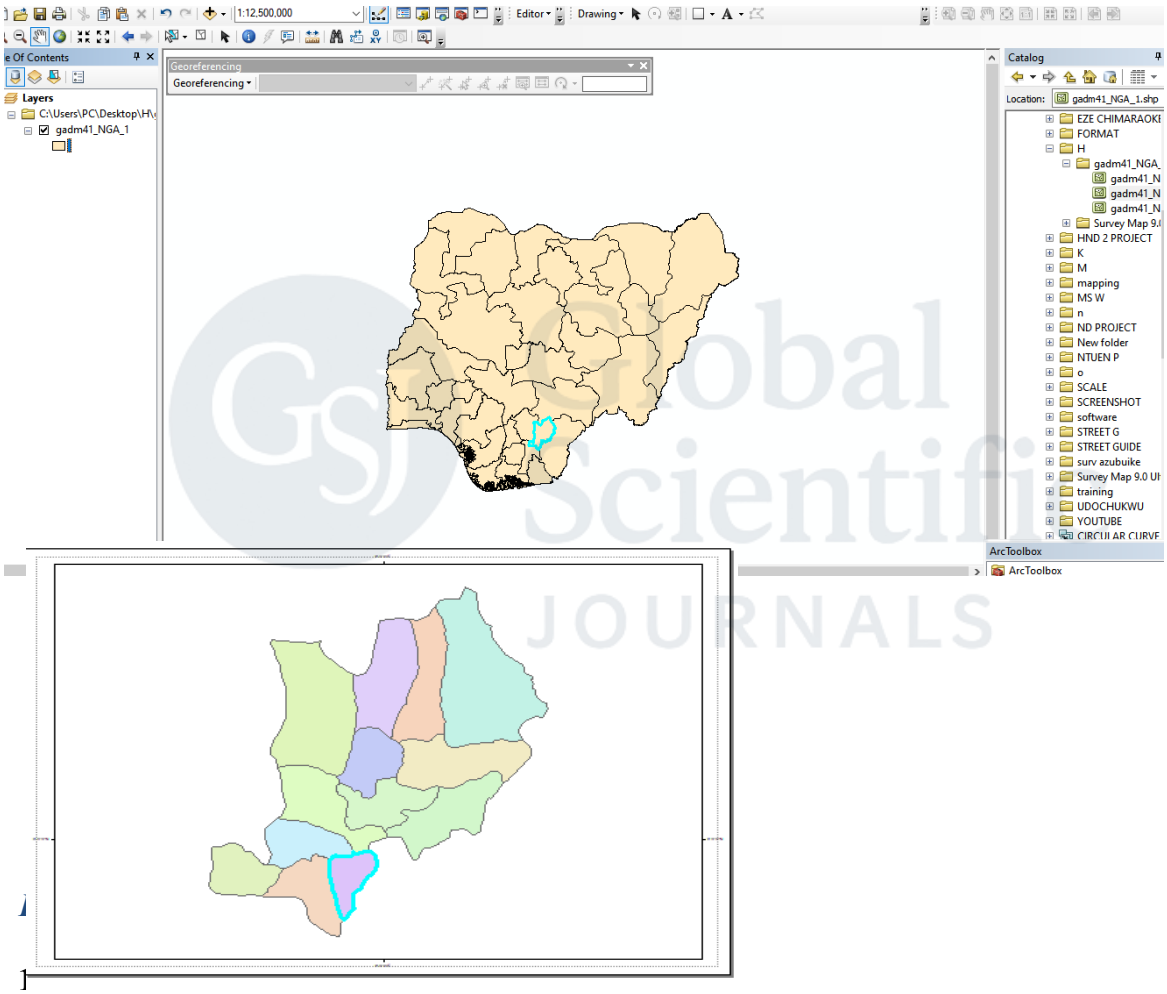
1.2 Statement of the Problem

One of the major challenges in educational planning in Unwana is the absence of updated and accurate maps showing the locations of primary and secondary schools. This creates difficulties in determining the level of accessibility to schools, identifying underserved communities, and ensuring equitable distribution of resources. The result is often an imbalance where some areas face overcrowded schools while others have facilities that are under-utilized (Adepoju, 2018). By addressing this challenge, this project seeks to provide reliable spatial information that will support planners, government agencies, and community stakeholders in making informed decisions concerning school infrastructure and accessibility in Unwana.

1.3 Study Area/Location

Unwana is a semi-urban settlement located in Afikpo North Local Government Area of Ebonyi State, in the southeastern part of Nigeria. The community is popularly known for hosting Akanu Ibiam Federal Polytechnic, one of the major institutions of higher learning in the state. The local economy is sustained mainly by education, agriculture, petty trading, and other small-scale activities (Mindat.org, 2025). Geographically, Unwana lies at about 5° 47′ 45″ North (5.7958° N) latitude and 7° 56′ 13″ East (7.9372° E) longitude. The area experiences a tropical climate with

two main seasons, wet and dry, which influence both agricultural and human activities. According to the 2006 National Population Census, Unwana has an estimated population of around 120,000 people (National Population Commission [NPC], 2006; Wikipedia, 2025). The study area covers all accessible locations within Unwana where both primary and secondary schools are situated, providing a reliable spatial framework for this research.



The Aims of these projects is to produce a location map of primary and secondary schools in Unwana

1.5 Objectives of Project

The specific objectives of this project are:

1. To carry out reconnaissance of the project area or site
2. To acquire the base map of the project location
3. To obtain X,Y,Z coordinates of those primary and secondary schools
4. To produce a digital map using GIS tools
5. To map out the primary and secondary schools

1.6 Significance of the project

This study is significant because it provides a reliable geospatial database of primary and secondary schools within Unwana, which has never been comprehensively mapped before. By producing a digital map of these educational facilities, the project offers a tool that can be used by government agencies, planners, and policymakers to assess the current distribution of schools and to identify areas that are underserved or overconcentrated.

For the local community, the study is important as it highlights spatial inequalities in access to education and supports evidence-based decisions for the establishment of new schools or the upgrading of existing ones. This contributes directly to the achievement of Sustainable Development Goal 4 (Quality Education), which emphasizes inclusive and equitable access to learning opportunities (United Nations, 2015).

Academically, the project demonstrates the practical application of Geographic Information Systems (GIS) and modern surveying techniques in solving real-life challenges. It enriches existing literature by showing how spatial analysis can be integrated into educational planning at the community level. For students and researchers, the work serves as a reference material and methodological guide for similar studies in other regions.

Furthermore, the project has practical planning and administrative value. With accurate coordinates and attribute information, education boards and local authorities can effectively plan

transportation routes, allocate resources, and monitor school infrastructure. This digital database also provides a foundation for future updates, thereby ensuring sustainability of planning efforts in Unwana.

In summary, the significance of this research lies in its contribution to community development, academic knowledge, and policy formulation. It bridges the gap between spatial science and social needs, ensuring that education planning in Unwana is supported by accurate, up-to-date, and decision-driven geospatial information

1.7 project duration

The execution of this project commenced on 19th August, 2025, and reached completion on 30th September, 2025.

1.8 Scope of the Project

This project is limited to the mapping of all primary and secondary schools within Unwana community, Afikpo North Local Government Area, Ebonyi State. The scope covers the acquisition of spatial data using handheld GPS receivers to obtain the geographic coordinates of each school, as well as the collection of relevant attribute data such as school name, type (primary or secondary), ownership (public or private), and location description.

The data will be processed and analyzed using Geographic Information System (GIS) software (ArcGIS 10.8) for the purpose of producing thematic maps that show the distribution, accessibility, and spatial relationship of the schools across the study area. The final output will include digital and hard-copy maps supported with descriptive analysis.

The project is restricted to:

- Geographical coverage: Unwana community only.

- Institutions considered: Formal primary and secondary schools (excluding nursery, vocational, and tertiary institutions).
- Data sources: GPS field survey, reconnaissance, existing maps/plans, and relevant literature.
- Deliverables: Geo-referenced school maps, attribute tables, and analytical report.

1.9 Order of the project and size

Order of the Project: The project falls under a third-order survey, which provides a moderate degree of accuracy and precision. This order of survey is widely applied in topographic mapping, land subdivision, property surveys, and construction works. It typically relies on conventional surveying tools such as handheld GPS receivers and total stations.

Size of the Project: The size of the project corresponds to the total landmass within the study area.

Area Covered: Unwana covers an estimated land area of about 19,000 hectares

PLANNING AND METHODOLOGY

2.1 Office Planning

The project was planned to be a success by our supervisor and the group members on how to execute the project in a space of six weeks from the month of August to October and in the course of the planning we also discuss the instrument choice to carry out the project such as GPS handheld (GERMIN), field book and PPE personnel protective equipment was noted and also the base to be used for the project was discuss and how to the satellite imagery since there is no base map of the project located, the satellite imagery was the option discussed to be used as the base of our project.

2.1.1 Data Search

The data that were used for this project includes satellite image of the study area, Primary and Secondary schools in Unwana Google earth, GPS coordinate of the primary data, GPS coordinator of the feature to be mapped, Hotel site gotten from the grounds

Primary Data

GPS coordinate of school sites in the study area

Secondary Data

Satellite image of the study area acquired from Google earth and read network is the study area digitized firm the satellite image

2.2 Reconnaissance

The reconnaissance exercise was an essential preliminary stage in this study, designed to facilitate effective planning and execution of subsequent data acquisition. My team and I carried out systematic field inspections across the study area to identify and verify the spatial distribution of both primary and secondary schools in Unwana. During this phase, we examined site accessibility and evaluated terrain characteristics, settlement patterns, and other environmental variables that could influence GPS signal reception and positional accuracy.

Furthermore, the reconnaissance enabled us to determine suitable control points for ground-truthing and guided the selection of optimal routes for field navigation. Logistical arrangements were also made, including the preparation and calibration of instruments such as the GPS receiver, the organization of base maps and reference imagery, and the allocation of specific responsibilities among team members.

The information obtained during this reconnaissance not only enhanced our spatial understanding of the study area but also ensured that subsequent processes, such as geo-

referencing, coordinate plotting, and database creation, were conducted with improved accuracy, efficiency, and scientific reliability.

2.3 Instrumentation

Instrumentation involves the selection of appropriate tools that will ensure the required accuracy for the production of a digital map. During the reconnaissance survey, the choice of instruments was guided by the following factors:

1. The modern method of survey being adopted
2. The instrument's ability to satisfy the required accuracy
3. The availability of the instruments
4. The time frame allocated for the project

Based on these considerations, the following instruments were selected for the project:

1. Garmin handheld GPS
2. Field book, pen, and safety jackets
3. Laptop with relevant software (Google Earth, ArcMap)

2.3.1 Instrument Test

Before embarking on the main data acquisition exercise, it was essential to subject the instruments to a preliminary test in order to ascertain their accuracy, reliability, and overall suitability for field operations. Instrument testing forms a critical stage in geospatial research because it ensures that all data collected are precise and free from systematic errors that could compromise the validity of the study.

For this project, the primary instrument employed was the Garmin eTrex 10 Handheld Global Positioning System (GPS) receiver. The GPS device was tested to verify its capacity to capture positional data in terms of latitude, longitude, and elevation with acceptable levels of accuracy.

The procedure involved switching on the instrument in an open environment to allow it connect with multiple satellites. Once a stable connection was established, a series of waypoints were recorded at a fixed location over a short time interval. The consistency of the coordinates obtained was then evaluated by comparing the multiple readings. The minimal variation observed between the values confirmed that the GPS was functioning optimally and was suitable for field data collection

In addition, the instrument's battery life and memory storage were examined to ensure they were adequate for the duration of the survey exercise. Fieldwork often requires long hours of operation; therefore, it was important to ascertain that the device could retain sufficient charge and store large datasets without interruption. A trial navigation was also carried out by inputting known coordinates and tracing the direction indicated by the GPS. This practical test further demonstrated the dependability of the device in both data acquisition and navigation within the study area.

The process of instrument testing not only minimized potential errors but also built confidence in the reliability of the dataset to be generated. By ensuring the integrity of the instrument before actual fieldwork, the study guaranteed that subsequent spatial analyses, such as plotting, digitization, and map production, would be based on accurate and verifiable coordinates.

Thus, the instrument test served as a quality control measure and laid a solid foundation for the credibility of the entire research.

Table 2.0 showing the instrument test

S/N	EXISTING COORDINATE		OBSERVED COORDINATE	DIFFERENCES	REMARK
A	N650854.286	B	N650853.618	0.668	OK
	E380847.197		E380848.276	0.921	OK

2.4 Methodology

Data Acquisition

Data acquisition refers to the process of gathering both geometric and attribute information needed for the study.

In the course of the fieldwork, the coordinates of the school facilities were collected using a Garmin eTrex 10 handheld GPS with an accuracy of about 2 cm. The instrument was properly initialized before use, after which the coordinates of the identified schools were recorded. The X and Y values were taken with reference to WGS 84 Zone 32N projection, and later transferred to a computer system for further processing.

Attribute Data Acquisition

Attribute data is an essential aspect of any spatial database. For this project, the attributes obtained include the names of the schools, student population, category of school, availability of ICT facilities, and the specific location of each school.

2.5 Base Map

A base map serves as the foundation for any digital map. It usually contains essential geographic features such as roads, buildings, water bodies, and administrative boundaries. The base map provides the necessary background and context for other thematic layers that are subsequently added (https:/rodkb.srgrc.selkrirkica).

The following steps outline how the satellite imagery used as the base map was obtained:

1. Visit a platform that provides free satellite imagery, such as Google Earth.
2. Identify and zoom in to the project area of interest.
3. Choose the appropriate time frame for the imagery.

4. Download and save the satellite image to the computer for further use.

Table 2.1 shows the control point chosen

POINT ID	EASTING	NORTHING (M)
Afikpo road	380998	641541
Police station road	382194	641011
The Presbyterian road	381933	640555
Inside AUFPU	380595	380545

2.6 Geo-Spatial Data Capture

Geo-spatial data capture refers to the process of collecting, recording, and organizing location-based information that can be used for mapping and analysis. In this project, the main aim of data capture was to obtain the spatial positions (X, Y coordinates) and relevant attributes of primary and secondary schools within Unwana.

The data capture involved the following procedures:

1. Field Data Collection

A Garmin handheld GPS receiver was used to obtain the geographic coordinates (latitude and longitude) of each school.

Ground-truthing was conducted to confirm the actual locations of schools and to identify features not visible on existing maps or satellite imagery.

2. Satellite Imagery and Base Maps

High-resolution satellite imagery from Google Earth and other online sources was used to visualize the study area.

The imagery served as a base map upon which the captured data was overlaid.

3. Attribute Data Recording

Alongside positional data, attribute information such as the name of the school, type (primary or secondary), ownership (public or private), and location details were recorded in a field notebook and later transferred into a digital database.

4. Data Integration into GIS

The spatial and attribute data were imported into ArcGIS 10.8 software.

Data was properly geo-referenced using UTM Zone 32N, Minna Datum, to ensure accuracy and consistency.

Through this systematic process of geo-spatial data capture, both positional and descriptive information about schools in Unwana were collected and prepared for subsequent mapping and analysis.

3.0 Data Analysis, Results and Presentation

This chapter presents the analysis of both spatial and attribute data obtained from fieldwork and secondary sources, as well as the results and their presentation in the form of maps, tables, and charts. The essence of the analysis is to transform the raw data collected into meaningful information that explains the spatial distribution and characteristics of primary and secondary schools within Unwana.

School Name	Primary	Secondary	Private	public	ICT	Coordinate (NM)	Coordinate (EM)
Comprehensive Secondary sch. Unwana		secondary		public	yes	641607	381018
Akanu Ibiam Staff Poly. Sec. School Unwana		secondary	private		yes	641530	379866
Akanu Ibiam Staff Poly. Pri. School Unwana	primary		private		yes	641583	380265
Lady OlayinkaIbiamMemoralPri.Sch Unwana	primary			public	No	641063	382157
Wisdom & Excellence child academy Nur/pri	primary		private		No	640737	382212
St Thomas Nursery/primary sch. Unwana	primary		private		No	640258	382099
The Presbyterian Nur/Pri& secondary Unwana	primary	secondary	private		No	640555	381933
Unwana community Primary school Unwana	primary		private	public	No	641011	382194
AmakomNur/primary School Unwana	primary		private		No	640615	381996
Genius (solid) foundation Academy Nur/Prim. Sch.	primary		private		No	640972	381358

Fig: Showing number of student in each school in Unwana, Afikpo Ebonyi state

3.0.1 Data Analysis

The data collected for this study were analyzed in two major categories: spatial data and attribute data.

(a) Spatial Data Analysis

The spatial data, which comprised the geographic coordinates (latitude and longitude) of primary and secondary schools, were processed using ArcGIS 10.8. The coordinates were plotted on a base map of Unwana derived from Google Earth. Spatial techniques such as overlay and proximity analysis were employed to evaluate the distribution of schools in relation to existing features such as roads, settlements, and rivers.

(b) Attribute Data Analysis

The attribute data included information such as the school name, category (primary or secondary), and ownership (public or private). These were arranged in tabular format using Microsoft Excel and linked to their corresponding spatial points in the GIS environment. Queries were performed to determine the total number of schools, their distribution based on type, and ownership pattern across the study area.

The combined analysis of both spatial and attribute data provided the basis for understanding the accessibility, concentration, and distribution pattern of schools in Unwana.

Result

The field survey and geospatial data processing produced a comprehensive digital map showing the distribution of primary and secondary schools in Unwana. The results revealed the exact geographic locations (coordinates) of each school, along with their attribute information such as school name, type (primary or secondary), and ownership (public or private).

A total of 11 schools were identified within the study area, comprising 8 primary schools and 3 secondary schools. The spatial analysis indicated that the majority of schools are concentrated around the central part of Unwana, particularly in areas with higher population density and better accessibility to road networks, while fewer schools are located in the peripheral parts of the community.

The processed satellite imagery and digitized features (roads, rivers, and settlement areas) provided the base for overlaying the school data, making it possible to visualize their distribution patterns clearly. The final map serves as a decision-making tool for identifying underserved areas and for planning future educational infrastructure in Unwana.

Tables and figures (maps) generated from the data analysis are presented in the subsequent sections to illustrate these findings.

Data Presentation

The data obtained for this study were presented in both tabular and cartographic forms for better understanding and analysis. The presentation was aimed at showing the spatial distribution and attributes of the primary and secondary schools within Unwana.

1. Tabular Presentation:

The attribute data collected (such as school name, category, ownership, and GPS coordinates) were organized into tables. This tabular arrangement provides a clear and concise record of each school in the study area.

2. Graphical Presentation:

Graphs and charts were used to summarize the data, such as the proportion of primary to secondary schools, the ownership structure (public vs private), and the distribution of schools across different communities in Unwana. These visualizations enhanced the interpretation of the findings.

3. Cartographic Presentation:

Using ArcGIS 10.8, the spatial data captured through handheld GPS devices were processed and plotted on a base map of Unwana. The maps produced showed the precise locations of the schools, their spatial distribution patterns, and their relationship with other features such as roads

and settlements. The digital maps also incorporated symbology to distinguish between primary and secondary schools, as well as public and private institutions.

4. Descriptive Presentation:

In addition to maps, tables, and charts, descriptive explanations were provided to highlight notable spatial patterns observed. For example, the concentration of schools along major roads, the clustering of institutions in densely populated areas, and the relative scarcity of schools in certain peripheral zones were discussed.

Through these multi-dimensional methods of data presentation, the study provides a comprehensive picture of the educational facilities in Unwana, making it easier for policymakers, planners, and stakeholders to interpret and utilize the findings effectively.

3.1 Geo-Referencing

Geo-referencing is the process of associating geographic coordinates, such as latitude and longitude with a particular spatial dataset or image. Geo-referencing is simply the assigning of geographical information to an image.

Peo assistant (2025d) geo-referencing.

To achieve this, the following was done;

a. The arch map 9.02 was launched

Fig 4: Screenshot OfArcmap Earth Launched

b. A new blank map was selected

c. The coordinate system was set to WGS 84 by clicking on the table of content pane; then properties to select the desired coordinated system.

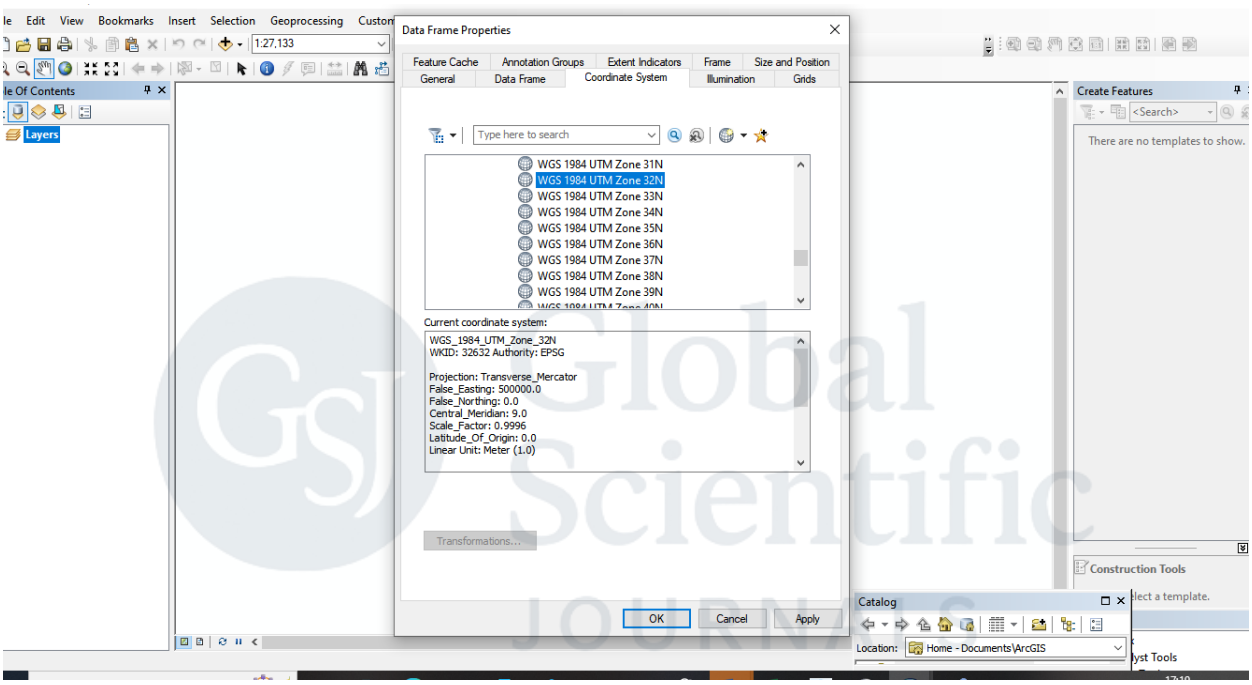


Fig 5: Screenshot of Coordinate System

d. The Google Earth image was added to the data frame of the Arc Map through the add data icon in the home panel by selecting the image from the Group A folder.

e. Add control point was selected from geo-references to X and Y coordinate were assigned to the image.

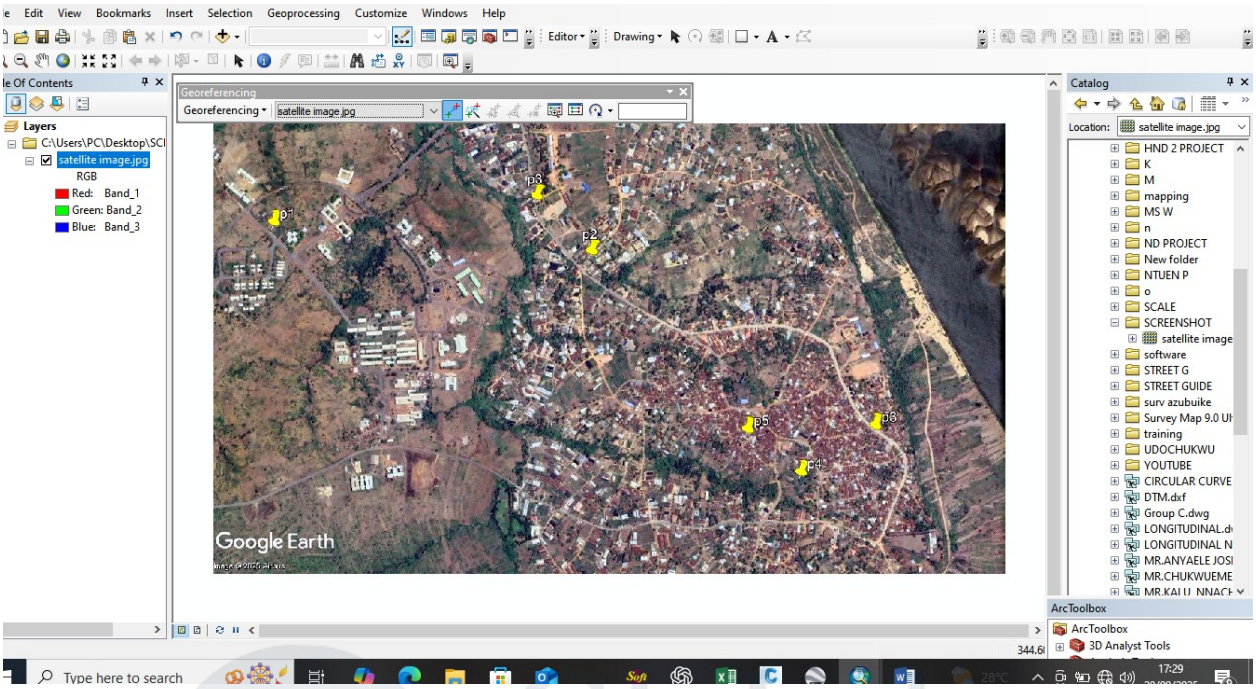


Fig 6: Screenshot Of Control point Selected from Georeferencing Tool

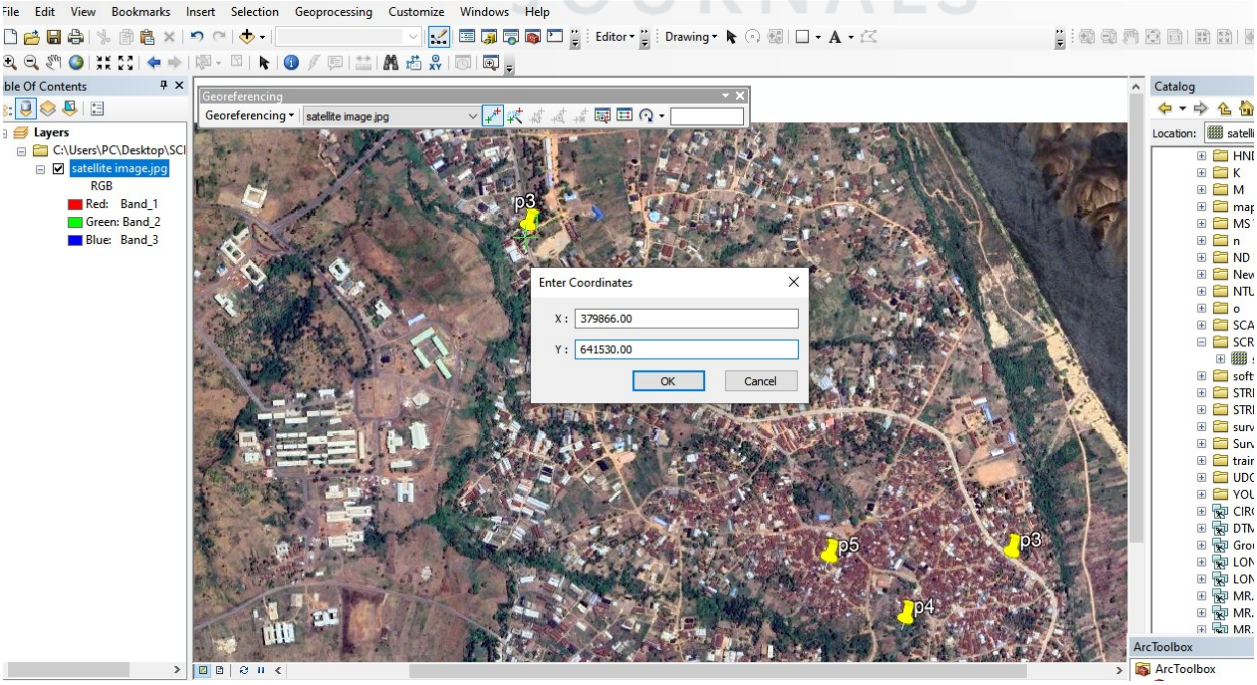


Fig 7: Screenshot of rectified map from Georeferencing

3.2 Digitization and Data Conversion

Digitizing involves converting analogue information (maps, images) into digital format to produce vector data that can be manipulated within ArcGIS software.

The following procedures were carried out:

1. The geo- data base which serve as the container was created in the Arc catalogue by connecting it to the group Project folder.

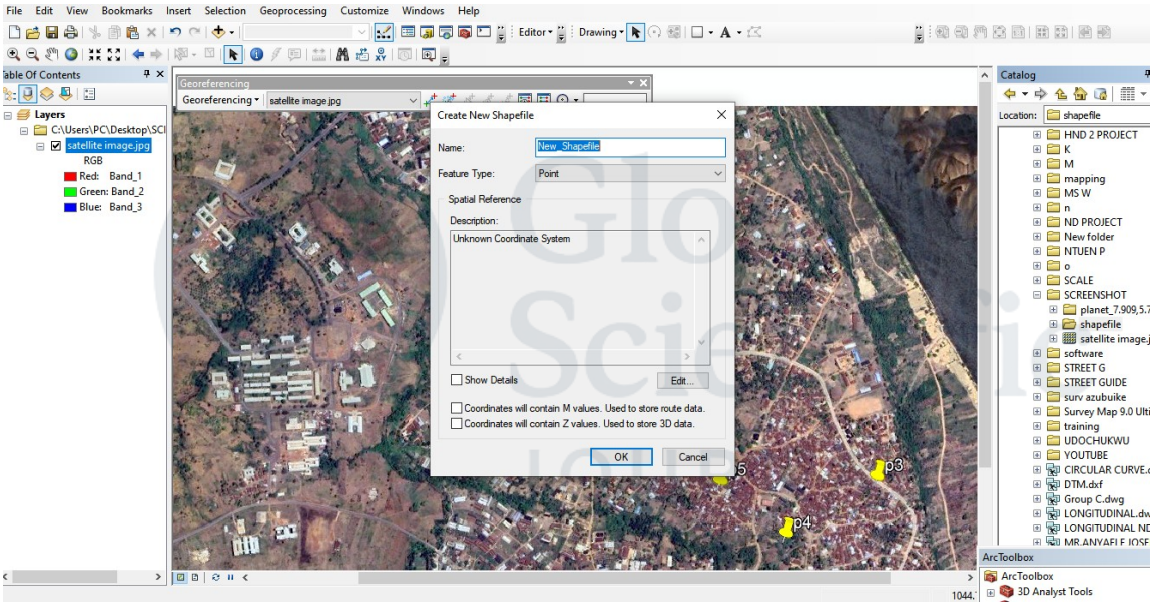


Fig 8: Database Creation Process in ArcGIS 10.8 Environment

2. Feature classes for all the elements to be digitized, such as buildings, roads, and others, were created inside the Geo-database.
3. The Editor tool was activated, and each feature was digitized individually by selecting Create Features in the Home panel.
4. Coordinates were added using the Go to XY tool in the Home panel, ensuring that the location of each feature was properly identified for accurate detailing.

5. The map was switched to the Layout View, and the appropriate paper size was set.
6. Attribute information was included by selecting Insert; then the names and descriptions of the features were added.
7. Map elements such as the legend, scale bar, north arrow, and coordinate system were inserted using the options in the Insert tab.
8. Grid coordinates for the map were added through the Data Frame Properties.

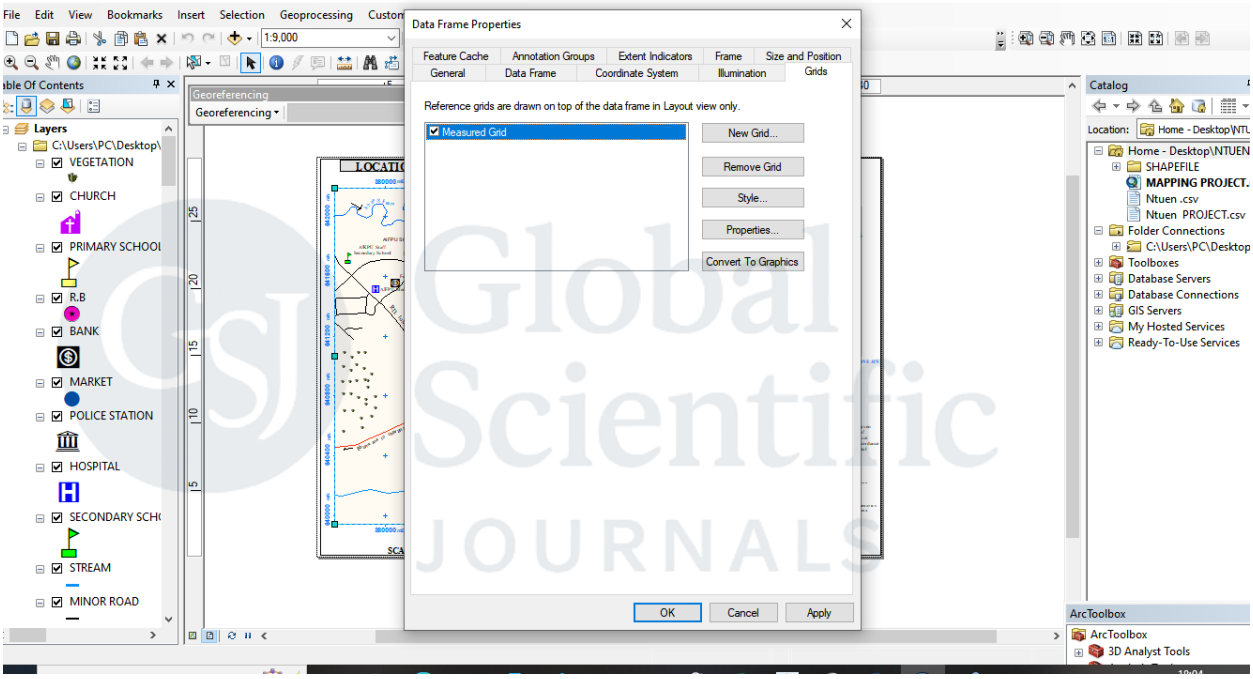


Fig 9: screenshot of grid added to map

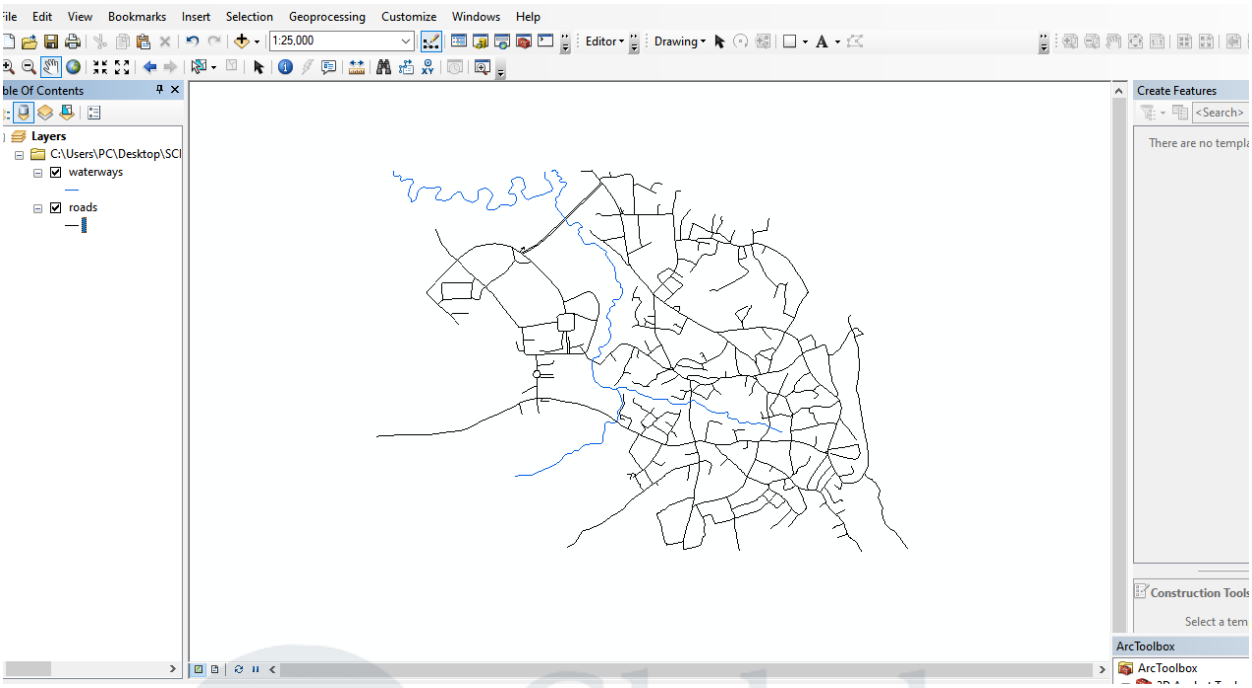


Fig 10: Screenshot of Digitized road in arcgis 10.8

9. Finally, the completed digital map was exported as a PDF file by selecting File Export Map from the Home panel.

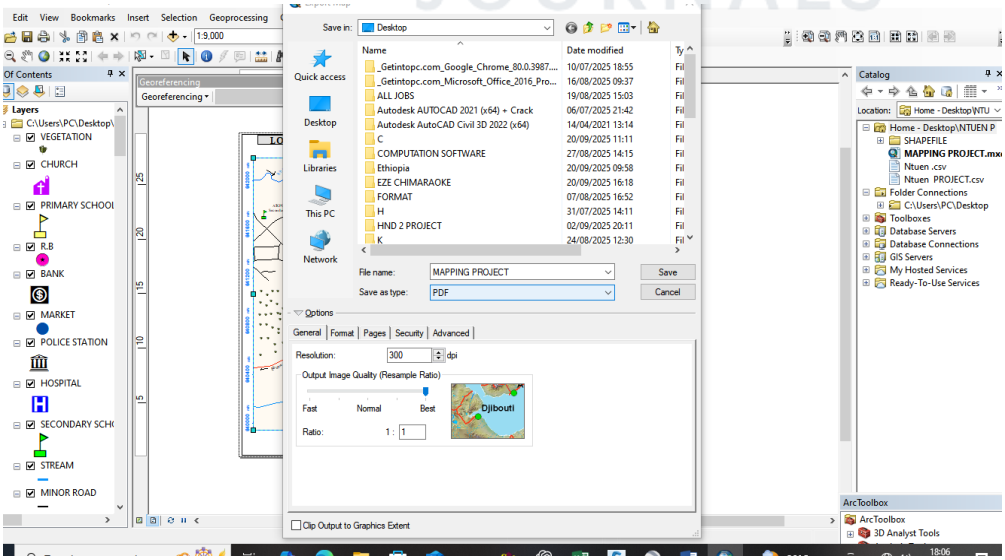
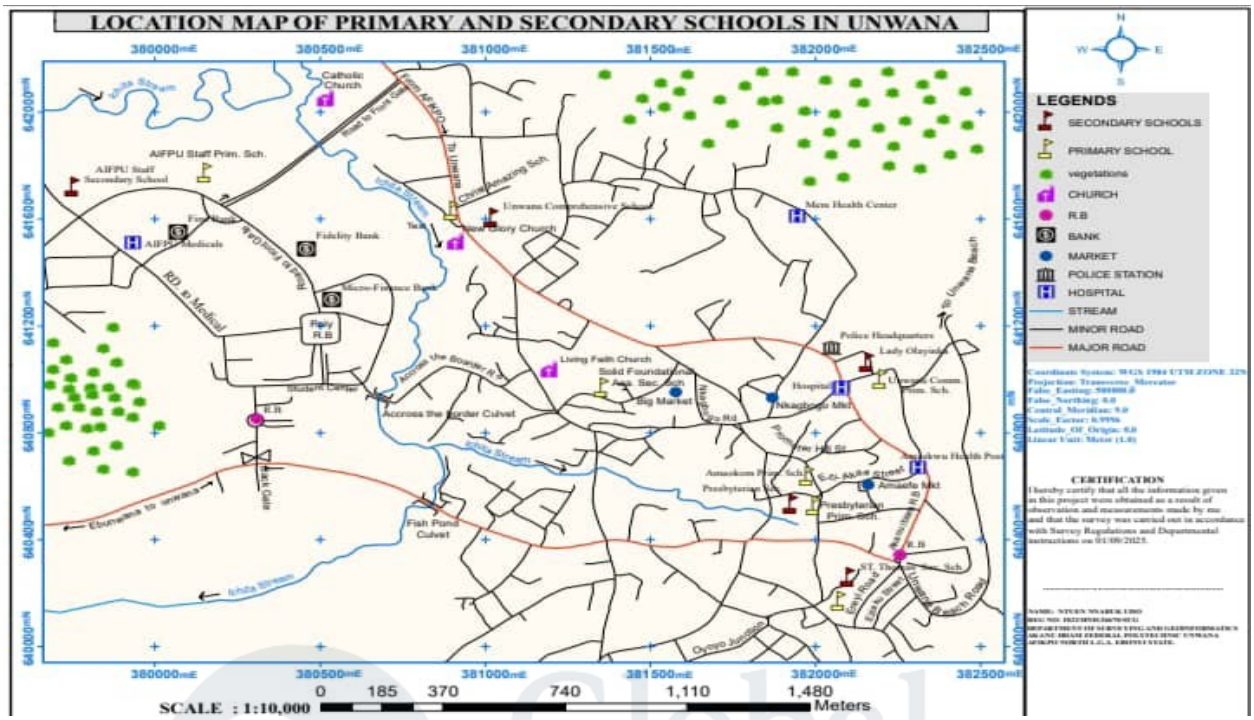


Fig 12: Screenshot of the map exported into PDF file



3.3 Coordinate Plotting

The steps involved in plotting the coordinates are outlined below:

a. A map of Afikpo North was acquired and imported into the ArcMap environment using the "Add Data" function of the software.

b. A shapefile was generated for the XY coordinates by importing them into ArcCatalog and subsequently adding the data to ArcMap.

c. Specific points were identified on the map, and the Callout Tool was applied to display their locations. After review, the positions of key features such as hotels, markets, restaurants, and churches were clearly shown on the map.

3.4 GIS Database Design and Creation

Designing a GIS database involves structuring and storing spatial data in a way that ensures efficiency, accessibility, and ease of analysis.

Steps:

- Identify the required data types (e.g., vector data for schools, raster data for base maps) and determine how they will be organized (tables, layers, relationships).
- Choose a suitable Database Management System (DBMS) to manage and store the ArcGIS data.
- Establish the database and create tables to contain spatial features along with their attribute information.
- Load the digitized data into the database, applying proper spatial indexing to enable fast and accurate queries.
- Define relationships between tables (e.g., linking schools with their facilities or attributes).
- Perform routine backups of the database and maintain clear documentation of the schema for future use.

3.5 Ground Truthing

Ground truthing is a critical stage in geospatial studies that ensures the accuracy and reliability of data acquired from secondary sources such as satellite imagery and digital maps. It involves the process of validating and verifying the positional accuracy of mapped features through direct field observation and measurement. This step bridges the gap between remotely sensed data and actual conditions on the ground, thereby enhancing the quality and credibility of the final map outputs.

In this study, ground truthing was conducted by physically visiting the identified locations of primary and secondary schools in Unwana. Using a handheld GPS device, the precise geographic coordinates of each school site were recorded and compared with the previously digitized and

georeferenced data. Discrepancies observed between the field data and the mapped features were corrected to ensure spatial accuracy.

Furthermore, essential attribute information such as the name of the school, type (primary or secondary), ownership (public or private), and notable facilities were collected on-site. This exercise not only confirmed the spatial locations of the schools but also enriched the attribute database with first-hand information that could not be derived from imagery alone.

The incorporation of ground truthing in this project therefore guarantees that the mapped distribution of schools in Unwana is both spatially accurate and contextually relevant, making the database a dependable tool for future planning, policy formulation, and educational development within the study area.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

4.1 Discussion

The study successfully mapped the distribution of primary and secondary schools within Unwana community using modern geospatial techniques. The results revealed both the spatial spread and locational attributes of schools in the study area. Analysis of the spatial data showed that while some schools are strategically located to serve large portions of the population, others are concentrated in specific zones, leaving certain areas under-served. This has implications for equitable access to education, as proximity plays a significant role in enrolment and attendance rates.

Furthermore, the integration of GPS data, digitized road networks, and satellite imagery provided a reliable and up-to-date geodatabase for educational planning. The findings confirm that GIS is not only an effective tool for data storage and visualization but also a decision-support system

that can guide government agencies, non-governmental organizations, and local communities in addressing infrastructural gaps.

4.2 Problems Encountered

During the course of this project, several challenges were experienced, which affected both the pace and accuracy of data acquisition and processing. First, the field data collection exercise was hindered by accessibility issues, as some schools were located in remote or partially inaccessible areas, making navigation and ground-truthing difficult. In addition, signal obstruction and poor satellite reception occasionally occurred while using the Garmin eTrex 10 handheld GPS, especially in areas with dense vegetation and built-up environments. This sometimes led to coordinate fluctuations and required repeated measurements to ensure reliability.

Another problem was the inadequacy of up-to-date spatial and attribute data, as existing maps and records of educational facilities in Unwana were either outdated or incomplete. This made it necessary for the research team to depend largely on primary field data. Furthermore, time and financial constraints limited the number of revisits to certain locations for verification. The team also faced weather-related disruptions, such as heavy rainfall, which delayed movement and prolonged data collection.

4.3 Solutions to the Problems Encountered

To overcome these challenges, several measures were adopted. Accessibility difficulties were addressed by conducting prior reconnaissance and engaging with community members and school authorities, who provided useful directions and support for reaching difficult locations. For the problem of weak GPS signals, the research team employed multiple waypoint readings at different times of the day, after which the most consistent values were averaged to enhance positional accuracy.

The lack of reliable secondary data was resolved by extracting satellite imagery from Google Earth and carefully georeferencing it to complement the field observations. Time and financial limitations were mitigated by proper task scheduling, teamwork, and resource sharing, which ensured that the available resources were utilized efficiently. Weather disruptions were reduced by planning fieldwork during favorable conditions and rescheduling activities when necessary.

Through these adaptive strategies, the research team was able to generate accurate, consistent, and reliable data for the mapping of primary and secondary schools in Unwana, thereby ensuring the overall success of the project.

4.4 Conclusion

This research has demonstrated the effectiveness of geospatial techniques in identifying, analyzing, and presenting the distribution of educational facilities. The mapping exercise revealed both the strengths and weaknesses in the spatial pattern of schools across Unwana. While some areas enjoy relative accessibility, others require urgent intervention in terms of siting new schools or improving transport links. The study therefore concludes that GIS-based mapping provides a scientific and practical framework for sustainable educational planning in the study area.

4.3 Recommendations

Based on the findings of this study, the following recommendations are made:

1. Equitable Distribution of Schools: Educational authorities should ensure that new schools are established in underserved areas to achieve balanced accessibility.
2. Integration of GIS in Planning: Government and policy makers should adopt GIS as a standard tool for monitoring and evaluating educational infrastructure.

3. Upgrading of Existing Facilities: Schools with poor accessibility should be supported with improved road networks, transportation facilities, and teaching resources.
4. Periodic Updating of Data: A continuous update of the GIS database is recommended, so as to reflect population growth, infrastructural development, and changing needs of the community.
5. Stakeholder Collaboration: Community leaders, NGOs, and government bodies should work together to promote inclusive educational planning in Unwana and beyond.

4.4 Contribution to Knowledge

This study has made the following contributions to the existing body of knowledge:

- It has provided a comprehensive geospatial database of primary and secondary schools in Unwana, which can serve as a reference for future academic research, urban planning, and educational policy.
- It demonstrated the practical application of GIS in the education sector, thereby broadening the scope of geoinformatics beyond traditional environmental and urban studies.
- sIt revealed the spatial disparities in school distribution, thereby contributing empirical evidence to discussions on equity and access in educational development.
- It serves as a model methodology for similar studies in other regions, highlighting the importance of GPS data acquisition, satellite imagery, and ArcGIS tools in educational mapping.

4.5 Suggestions for Further Research

While this study has achieved its objectives, it also opens opportunities for further investigations. Future researchers may consider the following:

1. Extending the study to cover the entire Afikpo North Local Government Area for a broader understanding of educational infrastructure distribution.
2. Incorporating socio-economic and demographic variables (such as population density, enrolment rates, and literacy levels) to provide a more comprehensive educational planning tool.
3. Conducting temporal analyses to examine changes in school distribution patterns over time.
4. Applying advanced GIS techniques such as network analysis and spatial modeling to evaluate accessibility in terms of travel time and distance.
5. Comparing public and private school distributions to assess disparities in educational access and quality.

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APPENDIX I

S/N	Name Of School	Category	Ownership	(Nm)	(Em)	Address/Location description
1	Akanu Ibiam federal polytechnic unwana staff primary school	Primary	Private	641583	380265	Inside Federal poly. Unwana
2	Akanu Ibiam Federal polytechnic Unwana Staff Secondary School	Secondary	Private	641530	379866	Inside Federal poly. Unwana
3	Comprehensive Secondary School Unwana	Secondary	Public	641607	381018	Along Afikpo Road
4	Lady Olayinka Ibiam Memoral Primary School Unwana	Primary	Public	641063	382157	Back of Unwana police station
5	Unwana community Primary School Unwana	Primary	Publc	641011	382195	Inside Unwana police state
6	Wisdom and excellennnnnnce child academy nursery/Pimary School Unwana	Primary	Private	640737	382212	Near Unwana police station
7	St Thomas Nursery and Primary School Unwana	Primary	Private	640258	382099	St Thomas Parish Oyo Juction to Akanu Ibiam rundabout
8	Presbyterian Nursery and Primary	Primary	Private	640615	381996	Near Oyoyo Juction
9	The Presbyterian Secondary School	Primary	Private	640615	381996	Near Oyoyo Juction

	Unana					
10	Amaokom Nursery and Primary School Unwa	Primary	Private	642972	381358	Near Oyoyo Juction
11	Genius (Solid) foundation AcademyNur/primary school	Primary	Private	640972	381358	Near Akanu Ibiam filling station
12	St thomas secondary school unwana	Prima5ry	Private	640258	382099	St Thomas Parish Oyo Juction to Akanu Ibiam rundabout

APPENDIX II

S/N	Name Of School	Category	Ownership	Coordintate (Nm)	Coordinate (Em)
1	Akanu Ibiam federal polytechnic unwana staff primary school	Primary	Private	641583	380265
2	Akanu Ibiam Federal polytechnic Unwana Staff Secondary School	Secondary	Private	641530	379866
3	Comprehensive Secondary School Unwana	Secondary	Public	641607	381018
4	Lady Olayinka Ibiam Memoral Primary School Unwana	Primary	Public	641063	382157
5	Unwana community Primary School Unwana	Primary	Publc	641011	382195
6	Wisdom and excellennnnnnce child academy nursery/Pimary School Unwana	Primary	Private	640737	382212
7	St Thomas Nursery and Primary School Unwana	Primary	Private	640258	382099
8	Presbyterian Nursery and Primary	Primary	Private	640615	381996
9	The Presbyterian Secondary School Unana	Primary	Private	640615	381996

10	Amaokom Nursery and Primary School Unwa	Primary	Private	642972	381358
11	Genius (Solid) foundation Academy Nursery and primary school	Primary	Private	640972	381358
12	St Thomas secondary school unwana	Primary	Private	640258	382099