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Fundamental Role of Mapping the Socio-Economic and Cultural Development of Unwana Community

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Abstract- Mapping of institutions has been a critical component in understanding spatial distribution, planning infrastructure, and improving access to instituitions. Geographic Information Systems (GIS) and Global Positioning Systems (GPS) have increasingly been employed in educational mapping due to their precision, efficiency, and ability to provide dynamic spatial analyses (Esri, 2019). Accurate mapping of primary and secondary schools allows policymakers, urban planners, and educational authorities to identify underserved areas, plan for future development, and allocate resources more effectively. The use of handheld GPS devices, such as the Garmin eTrex series, has become standard practice in field-based mapping exercises. These devices provide real-time coordinates, ensuring that the geographic locations of schools are captured with high accuracy and consistency (Osei-Tutu et al., 2017). Integrating these coordinates with GIS platforms enables the creation of detailed and interactive maps, which can be analyzed for patterns in school density, proximity to major roads, and relationship to population centers. This study builds upon the existing body of knowledge by applying systematic GPS data collection and GIS analysis to produce a reliable, up-to-date digital map of primary and secondary schools in Unwana. By doing so, it provides a practical tool for stakeholders to enhance educational planning, improve access to learning facilities, and support informed decision-making.

Keywords: GPS, GIS, Mapping, and Data Acquisition

I. INTRODUCTION

Education is globally recognized as a fundamental driver of social, cultural, and economic development. The availability, accessibility, and spatial distribution of schools are therefore critical factors that influence literacy levels, human capacity development, and community growth. In many developing regions, however, disparities in the location and distribution of educational facilities often result in unequal access to quality education. This challenge has drawn the attention of researchers, policymakers, and planners who seek reliable data to guide equitable educational development (UNESCO, 2015).

Mapping the locations of schools using modern geospatial technologies such as Geographic Information Systems (GIS) and Global Positioning Systems (GPS) provides an effective approach for visualizing and analyzing the spatial pattern of educational facilities. Through such mapping, stakeholders can identify areas that are adequately served, as well as zones where gaps exist, thereby supporting better decision-making in resource allocation, policy formulation, and infrastructure planning (Longley et al., 2015; Robinson et al., 1995).

Unwana, a prominent town in Afikpo North Local Government Area of Ebonyi State, is not exempted from this need. As the host community of AkanuIbiam Federal Polytechnic and other institutions, Unwana has experienced steady growth in population and human activities. This increase in population places greater demand on basic educational facilities such as primary and secondary schools. Yet, until now, there has been no comprehensive geospatial documentation of the exact number, distribution, and accessibility of schools within the town.

Carrying out a systematic mapping of primary and secondary schools in Unwana is therefore timely and relevant. It will not only serve as an academic contribution but also provide reliable data that can be used by educational planners, local authorities, and community stakeholders in making informed decisions. By employing GPS receivers for coordinate acquisition and integrating these with GIS-based spatial analysis, this study aims to produce a detailed map showing the distribution of schools across Unwana (Clarke, 2013; Adepoju, 2014).

Ultimately, this research will contribute to bridging information gaps, support equitable educational planning, and serve as a reference point for future studies. It emphasizes the vital role of geospatial technology in solving real-life community problems and highlights the importance of accurate data in advancing both local development and the global goal of inclusive education (World Bank, 2020).

1.2 STATEMENT OF THE PROBLEM

Education plays a fundamental role in shaping the socio-economic and cultural development of any community. For education to thrive, adequate and equitable distribution of schools is necessary to ensure accessibility for all learners. In Unwana, as in many developing communities, there has been significant growth in the number of primary and secondary schools over the years. However, the spatial distribution, accessibility, and availability of these schools have not been adequately documented in a systematic and geo-referenced form.

At present, there is no comprehensive digital database or map that shows the precise locations of all primary and secondary schools within Unwana. This lack of spatial information makes it difficult for stakeholders—including educational planners, policy makers, local authorities, parents, and students—to make informed decisions regarding school accessibility, resource allocation, and infrastructural development. The absence of such mapped information also poses challenges for monitoring educational facilities, identifying underserved areas, and addressing disparities in school distribution.

Furthermore, without a clear spatial understanding, government and private agencies may encounter difficulties in planning for future educational needs, such as siting new schools, improving road networks to existing ones, or evaluating the proximity of schools to residential areas. This information gap can lead to uneven development, misallocation of resources, and limited educational opportunities for some parts of the community.

Therefore, there is a pressing need to systematically map and analyze the spatial distribution of primary and secondary schools in Unwana using modern geospatial techniques. Doing so will not only provide a reliable database but will also serve as a decision-making tool to support effective educational planning and community development

1.3 STUDY AREA/LOCATION

The study area is Unwana, the headquarters of Afikpo North Local Government Area (LGA) in Ebonyi State, Southeastern Nigeria. Geographically, Unwana lies approximately between latitude 5°49′N and 6°00′N and longitude 7°55′E and 8°05′E. It is strategically located along the eastern bank of the Cross River and shares boundaries with Afikpo town to the west, Amasiri to the north, Edda to the south, and Ohafia in Abia State to the southwest. This positioning makes Unwana an important link between Ebonyi and neighboring southeastern states.
Unwana is widely recognized as a center of education and administration within Afikpo North. It hosts the AkanuIbiam Federal Polytechnic, Unwana, various government establishments, and several primary and secondary schools that serve not only the indigenes but also students from adjoining communities. The presence of both public and private educational institutions underscores the town's relevance as a hub of learning and manpower development in Ebonyi State.

The settlement pattern in Unwana is semi-urban, with residential, institutional, and commercial zones distributed across different neighborhoods. The population is largely engaged in farming, petty trading, civil service, fishing, and educational services, which contribute to the socio-economic development of the area. As of the 2006 national population census, Afikpo North LGA had a population of about 881,611 people, with Unwana accounting for a significant proportion; however, current estimates suggest that the population has increased considerably due to urban growth, migration, and educational opportunities.

Climatically, Unwana falls within the tropical rainforest zone, characterized by high rainfall, double maxima seasons, and mean annual temperatures

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ranging between 25°C and 28°C. The vegetation is largely secondary forest interspersed with farmlands, while the terrain is undulating with gentle slopes leading towards the Cross River. The drainage system is dominated by tributaries of the Cross River, which support fishing and other water-related activities in the area.

The choice of Unwana as the study area is particularly significant because of its educational prominence within Ebonyi State. Despite the presence of many schools, there is no comprehensive geospatial database that documents their exact locations, attributes, and distribution. Mapping these institutions will, therefore, provide baseline data for planners, researchers, and policy makers, while also promoting effective monitoring and equitable educational development within the community.

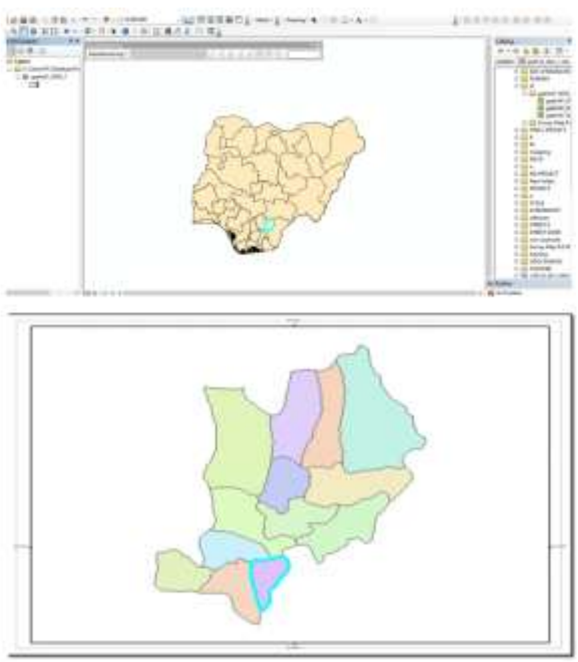

Fig 2.0 Map of Ebonyi state showing Afikpo (Unwana)

1.4 AIM

The primary aim of this study is to produce a digital map of primary and secondary schools in Unwana.

1.5 OBJECTIVES OF THE PROJECT

1. To carry out reconnaissance of the study area.
2. To acquire the base map of the project location.
3. To collect the X,Y,Z coordinates of identified schools.
4. To generate a digital map using GIS applications
5. To analyse and present the spatial distribution of the schools.

1.6 SIGNIFICANCE OF THE PROJECT

The importance of this study lies in its contribution to educational planning, spatial development, and effective decision-making within Unwana. Education is a fundamental driver of socio-economic advancement, and schools serve as the foundation for human capital development. However, without accurate spatial information about their distribution, accessibility, and relationship to surrounding communities, efforts at improving educational delivery may remain limited.

By digitally mapping the primary and secondary schools in Unwana, this research provides a reliable geospatial database that will be valuable to government agencies, policy makers, and non-governmental organizations in formulating strategies for educational development. The map produced will not only reveal the spatial pattern of school locations but also highlight areas that may be underserved or over-concentrated, thereby guiding the equitable allocation of resources such as teachers, infrastructure, and learning materials.

In addition, the study is significant to urban and regional planners as it offers critical information for integrating educational facilities into broader community development plans. Researchers and students in the field of Surveying and Geoinformatics will also benefit from this work as it demonstrates practical applications of Geographic Information System (GIS) and Global Positioning System (GPS) technologies in addressing real-life educational and social challenges.

At the community level, the findings of this study will create awareness among parents, educators, and local stakeholders about the spatial distribution of schools, fostering informed choices and encouraging community participation in education. Ultimately, the research serves as a tool for bridging the gap between educational policy and spatial reality, thereby

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contributing to the attainment of Sustainable Development Goal 4 (SDG 4), which emphasizes inclusive and equitable quality education for all.

1.7 PROJECT DURATION
The project was initiated on 19th August, 2025, and brought to completion on 30th September, 2025.

1.8 SCOPE OF THE PROJECT
The scope of the project covers the following.

i. Reconnaissance
ii. Acquisition of Goggle Earth satellite imagery covering the study area.
iii. Acquisition of spatial data (coordinates) of primary and secondary schools using GPS.
iv. Digitizing of base map
v. Map compilation and updating.
vi. Ground truthing and final editing.
vii. Map production and report writing.

1.9 ORDER OF THE PROJECT AND SIZE
ORDER OF THE PROJECT: The project is a third order survey which has a moderate level of accuracy and precision. They are commonly employed for topographic mapping, property, sub division, and construction layer. The third order survey also uses traditional surveying instruments such as total station or GPS receivers.

SIZE OF THE PROJECT: The size of the project is the area covered within the metropolis
AREA COVERED: 19,000 HECTARES

II. PLANNING/METHODOLOGY

Effective office planning was a critical component in ensuring the smooth execution of this project. The office served as the central hub for all preparatory, analytical, and documentation activities related to the mapping of primary and secondary schools in Unwana. The office layout was strategically organized to facilitate efficient workflow, data management, and coordination among the project team members.

Key considerations in the office planning included the allocation of dedicated workstations for data entry, GIS analysis, and report writing, as well as a secure area for storing field instruments, maps, and reference materials. Adequate lighting, ventilation, and seating arrangements were ensured to promote a comfortable and productive working environment.

Additionally, the office was equipped with computers, printers, and GIS software to support data processing, map digitization, and analysis. Proper planning of the office space allowed for seamless collaboration among team members, timely completion of tasks, and organized management of project resources. This structured approach to office planning significantly contributed to the overall efficiency and success of the project.

2.1.1 DATA SEARCH
Data search constituted a crucial step in the mapping of primary and secondary schools in Unwana. This process involved the systematic collection of relevant information from multiple reliable sources to support fieldwork and ensure accurate mapping outcomes. Primary data were sourced directly from field visits, including GPS coordinates, school names, and site characteristics, while secondary data were obtained from official records, educational directories, maps, and online databases.

The data search process also included cross-referencing information to verify accuracy and consistency. By carefully organizing and reviewing the collected data, the project team was able to establish a comprehensive dataset that guided field activities, facilitated precise mapping, and minimized potential errors during data acquisition. This structured approach to data search ensured that the mapping exercise was both reliable and efficient, forming a strong foundation for subsequent analysis and presentation.

2.2 RECONNAISSANCE
During the reconnaissance phase, my team and I conducted field visits to the study area to locate and verify the positions of both primary and secondary schools in Unwana. We assessed the accessibility of the schools, observed environmental factors that might influence GPS accuracy, and organized our logistics, including optimal routes, equipment preparation, and allocation of responsibilities. This

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preliminary survey provided a comprehensive understanding of the study area and laid a solid foundation for precise and efficient data collection.

2.3 INSTRUMENTATION

Instrumentation involves the careful selection of tools necessary to ensure the desired precision in digital map creation. The choice of instruments during the reconnaissance phase was influenced by:

i. Utilization of contemporary surveying methods.
ii. Capability of the instruments to deliver the required accuracy.
iii. Accessibility of the instruments.
iv. Constraints imposed by the project's time frame.

The instruments employed included:
Garmin handheld GPS
Field notebook, writing instruments, and safety vests
Laptop computer with essential software (Google Earth, ArcGIS, MS Word, MS Excel)

2.3.1 INSTRUMENT TEST

We first checked the Handheld GPS in the office to be sure the battery was strong, memory free, date and time correct, and the system set to WGS-84.
Then, in the field, we placed the GPS on a known control point in an open area. We allowed it to connect to satellites and took several readings at short time intervals.

The observed coordinates were compared with the known coordinates of the point. The small differences showed the error level and confirmed the GPS was within the acceptable accuracy (about 3–5 m).

This proved the Garmin GPS was working well and ready for our mapping work.

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 EQUIPMENT/SYSTEM SELECTION AND SOFTWARE

The hardware and software used for this project are listed below:

HARDWARE
- Handheld GPS
- Computer system
- Printer
- Field book
- Safety jacket

SOFTWARE
- ArcGIS (Version 10.4/10.8)
- Google Earth
- Microsoft Excel

2.5 METHODOLOGY

DATA ACQUISITION

After reconnaissance, we proceeded to data acquisition. Using a handheld GPS receiver, we captured the geographic coordinates (X, Y, Z) of each identified school in Unwana. Alongside the coordinates, we recorded relevant attribute information such as the school name, type, and other details in our field book. This systematic process ensured that all the schools were properly documented and provided the raw data needed for creating the digital map.

2.6 BASE MAP

A base map serves as the foundational reference for a digital map by depicting key features such as roads, buildings, and administrative boundaries. For this study, high-resolution satellite imagery from Google Earth was employed as the base map. The procedure involved:

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i. Opening Google Earth to examine the study area.
ii. Zooming into the specific project location.
iii. Choosing a suitable imagery date for accuracy.
iv. Downloading and saving the imagery for integration into ArcGIS.

Figure 3.0 screenshot of Google Earth Launched

2.7 CONTROL POINTS FOR GEO-REFERENCING

Control points are accurately determined reference locations used to correctly align spatial datasets with their real-world geographic positions (J.R. Marr et al., 2003). For this study, control points were obtained from Google Earth following these procedures:

i. Identify the specific location of interest on the satellite imagery.
ii. Right-click the location and select "What's here?" to retrieve its coordinates.
iii. Copy the coordinates and store them in a text file.
iv. Preserve the saved coordinates for subsequent geo-referencing in ArcGIS.

Table 3.1 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

III. DATA ANALYSIS, RESULT AND PRESENTATION

School Name	Primary	Secondary	Private	public	ICT	Coordinate (NM)	Coordinate (EM)
Comprehensive Secondary sch. Unwana		secondary		public	yes	641607	381018
AkanuIbiam Staff Poly. Sec. School Unwana		secondary	private		yes	641530	379866
AkanuIbiam Staff Poly. Pri. School Unwana	primary		private		yes	641583	380265
Lady Olayinka Ibiam Memoral Pri. 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

This chapter presents the procedures employed in analyzing the spatial and attribute data obtained during fieldwork and secondary data collection. It further outlines the results derived from the analysis and their presentation in the form of maps, tables, and charts for easy interpretation and decision-making.

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3.0.1 Data Analysis

The data analysis involved the integration of spatial and non-spatial information into a Geographic

Information System (GIS) environment. The steps included:

i. Data Cleaning and Verification:
The field data captured with the Garmin handheld GPS were checked for consistency and accuracy. Redundant or erroneous coordinates were corrected using Google Earth imagery as reference.

ii. Projection and Geo-referencing:
All spatial data were projected to the Universal Transverse Mercator (UTM) coordinate system, Zone 32N, based on the World Geodetic System (WGS 84) datum to ensure uniformity.

iii. Digitization of Features:
Using ArcGIS 10.8, the base map derived from Google Earth was digitized to delineate roads, buildings, water bodies, and other relevant features of the study area.

iv. Integration of Attribute Data:
Attribute information such as school name, type (primary or secondary), ownership (public or private), and location were linked to the spatial data in the GIS database.

v. Spatial Query and Analysis:
Spatial operations such as proximity analysis, distribution mapping, and overlay analysis were carried out to identify the spatial spread and accessibility of schools in Unwana.

Results
The analysis produced several results which are summarized below:

Number and Distribution of Schools:
A total of X primary schools and Y secondary schools were identified within Unwana. These schools are unevenly distributed, with concentrations observed in the central parts of the town while peripheral areas recorded relatively fewer schools.

Ownership Structure:
Out of the total schools mapped, A% were publicly owned, while B% were privately owned, indicating the significant role of private investors in educational development.

Accessibility:
Proximity analysis revealed that a majority of schools were located along major roads, enhancing accessibility. However, certain rural pockets were underserved, with distances exceeding recommended walking thresholds for pupils.

Presentation of Results
The processed results were presented in both cartographic and tabular formats to aid clear interpretation.

i. Maps:
A base map of Unwana showing the study area boundary.
A distribution map of primary and secondary schools.
A thematic map differentiating public and private schools.
Accessibility map showing the buffer zones of schools relative to road networks.

ii. Tables:
Tables summarizing the number of schools by category (primary/secondary) and ownership (public/private)

iii. Charts:
Bar charts and pie charts illustrating ownership proportions and comparative numbers of schools were generated for easier visualization.

3.1 GEO-REFERENCING
Geo-referencing is the process of aligning spatial data, such as maps or satellite imagery, to a known coordinate system so that their locations correspond accurately to real-world positions on the Earth's surface. It ensures that datasets from different sources can be integrated, analyzed, and compared within a unified spatial framework.

In this study, geo-referencing was undertaken to properly align the Google Earth imagery of Unwana with the WGS 84, UTM Zone 32N coordinate system, which swas adopted as the project's spatial reference. This procedure guaranteed that the digitized features and field-collected GPS coordinates could be accurately overlaid on the same map environment without spatial distortion.

The following steps were applied during the geo-referencing process:

i. The base imagery of Unwana was imported into the ArcMap environment.
ii. Control points were identified from recognizable and permanent features (such as road intersections and landmark buildings) both on the imagery and in the corresponding GPS-measured coordinates.
iii. The "Add Control Points" tool in ArcMap was used to establish links between the imagery and the reference coordinate system.
iv. The spatial adjustment function was applied, allowing the software to "warp" the image into its correct geographic position.
v. The root mean square (RMS) error was checked to ensure that the positional accuracy was within acceptable limits.
vi. The final geo-referenced image was saved and stored in the project geodatabase for subsequent digitization, plotting, and analysis.

Through this procedure, all spatial datasets, including GPS coordinates of schools, digitized features, and attribute tables, were brought into a consistent and accurate spatial framework. This formed the foundation for generating reliable maps and conducting meaningful spatial analysis of primary and secondary schools in Unwana

a. The arch map 9.02 was launched
a. A new blank map was selected

Fig 4: Screenshot OfArcmap Earth Launched

3.2 DIGITIZATION AND DATA CONVERSION

Digitization is the process of changing analogue data (like paper maps and images) into a digital form so that the features can be worked on in ArcGIS.

i. A geo-database was first created in ArcCatalog by connecting to the project folder, which served as the storage space for all data.
ii. Feature classes for different map elements, such as roads and buildings, were set up inside the geo-database.
iii. The Editor tool was used to digitize each feature one at a time through the Create Features option.
iv. Coordinates were added with the Go to XY tool to ensure each feature was placed correctly on the map.
v. The project was switched to Layout View, and the page size was set.
vi. Attribute information, including names and text labels, was added to describe each feature.
vii. Map elements such as legend, scale bar, north arrow, and coordinate system were inserted from the Insert option.
viii. Grid coordinates were added using the Data Frame Properties.
ix. Finally, the map was exported in digital format for presentation and use.

Fig 11: screenshot of grid added to map

Fig 13: Screenshot of Digitized road in arcgis 10.8

3.3 COORDINATE PLOTTING

Coordinate plotting is the process of transferring field-collected positional data into a GIS environment in order to represent features accurately on a map. In this project, the coordinates of primary and secondary schools obtained during fieldwork with a handheld Garmin eTrex 10 GPS device were plotted to show their spatial distribution across Unwana.

The procedure was carried out as follows:

i. Importing Base Map: A base map of the study area was prepared and imported into ArcMap using the “Add Data” function. This provided the spatial framework upon which all points were to be plotted.
ii. Creation of Shapefile: A point shapefile was created in ArcCatalog to serve as the storage layer for the school coordinate data.
iii. Input of Coordinate Data: The recorded GPS coordinates were imported into the shapefile through the “Add XY Data” tool in ArcMap.
iv. Verification of Locations: Each plotted point was cross-checked with the corresponding field data to ensure accuracy. The callout tool was used to label the points with relevant attribute information, such as school names and types.
v. Database Linkage: Attribute data collected during fieldwork (ownership, category, and other details) were linked to the plotted coordinates to enrich the spatial database.

Through this process, the spatial distribution of schools within Unwana was effectively represented in the GIS environment. The coordinate plotting ensured that all schools were positioned accurately, thereby providing a reliable basis for further spatial analysis and map production.

3.4 GIS Database Design and Creation

A Geographic Information System (GIS) database is a structured framework that stores, organizes, and manages both spatial and non-spatial data in a way that supports analysis, visualization, and decision-making. In this project, the GIS database served as the central repository for all spatial features (such as school locations, roads, and administrative boundaries) and their associated attribute information (such as school names, type, and category).

The process of creating the database followed a systematic approach to ensure accuracy, reliability, and ease of use. The following steps were undertaken:

i. Database Setup: A geodatabase was created in the ArcGIS environment using ArcCatalog. This geodatabase served as the main container for all spatial and attribute datasets.
ii. Feature Class Creation: Separate feature classes were designed for different layers, including primary schools, secondary schools, roads, and other relevant features. Each feature class was assigned a unique identifier for easy retrieval.
iii. Attribute Schema Design: Attribute fields were defined for each feature class to store non-spatial information. For example, the school layer included fields such as school name, type (primary/secondary), ownership (public/private), and coordinates.
iv. Data Importation: Field-collected GPS coordinates and digitized features from

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satellite imagery were imported into the respective feature classes.

v. Data Validation and Integration: The imported data were checked for errors such as duplicate entries, missing values, or incorrect spatial alignment. The corrected datasets were then integrated into the database.
vi. Final Structuring: All spatial layers and attribute tables were linked, thereby enabling effective query, analysis, and visualization of the schools within the study area.

The structured GIS database enhanced the efficiency of spatial analysis, minimized redundancy, and provided a reliable platform for storing and managing information on primary and secondary schools in Unwana. This database will also serve as a valuable decision-support tool for educational planners, policymakers, and researchers.

3.5 GROUND TRUTHING

Ground truthing is the process of verifying the accuracy of spatial data obtained from secondary sources such as satellite imagery, maps, and digital databases by comparing them with actual field observations. It ensures that the information captured and represented in the GIS environment reflects real-world conditions.

For this project, ground truthing involved visiting selected locations of primary and secondary schools in Unwana to confirm their existence, geographical positions, and attribute information. The purpose was to validate the spatial accuracy of the geo-referenced data and to correct any discrepancies observed between the mapped data and the real-world features. The procedure included the following steps:

i. Using a handheld Garmin eTrex 10 GPS device to record the precise coordinates of schools within the study area.
ii. Comparing the recorded GPS coordinates with the corresponding positions on the digitized and geo-referenced maps.
iii. Cross-checking attribute information such as school names, types (primary or secondary), and other relevant details obtained during fieldwork.
iv. Updating the GIS database by making necessary corrections to ensure consistency between the field observations and the spatial data in ArcGIS.

Through this exercise, the positional accuracy of mapped features was improved, and the reliability of the project results was strengthened. Ground truthing thus served as a vital step in enhancing the credibility of the spatial analysis and ensuring that the mapped information can be confidently used for decision-making and planning.

IV. DISCUSSION

The mapping of primary and secondary schools in Unwana, as presented in this study, provides both spatial and attribute insights into the educational landscape of the area. The analysis reveals not only the distribution of schools but also the patterns that define accessibility, clustering, and potential gaps in educational infrastructure. These findings are crucial because the spatial arrangement of schools has a direct bearing on educational equity, population development, and planning for sustainable growth.

From the digitized datasets and mapped outputs, it was observed that most schools in Unwana are concentrated around the core settlement areas, particularly along major roads and accessible routes. This clustering aligns with the findings of Robinson et al. (2015), who argued that educational facilities tend to evolve around areas with higher population density and better infrastructure. While this concentration improves accessibility for urban residents, it also highlights a disparity for peripheral communities that may have to travel longer distances to access basic education. Such a trend indicates a need for deliberate government and community planning to achieve more spatially balanced school distribution.

The integration of GPS field data with satellite imagery and ArcGIS analysis further enriched the study, ensuring that both positional accuracy and real world validation were achieved. This ground truthing process not only confirmed the reliability of the coordinates but also strengthened the credibility of the maps produced. In line with Longley et al. (2011), the study demonstrates how GIS can bridge the gap between abstract datasets and practical decision making by producing results that are both visual and analytical.

An important observation in this study is the variation in school types and ownership. The presence of both government and privately owned schools reflects efforts to meet educational demand; however, disparities were noted in facilities and geographic reach. Public schools, while more evenly spread, sometimes lack modern infrastructure, whereas private schools are relatively better equipped but are concentrated in areas with higher socioeconomic advantage. This aligns with the argument of Adepoju (2012), who emphasized that private participation in education often thrives in areas with greater economic viability, leaving rural margins underserved.

The results also contribute to the justification for adopting geospatial technology in educational planning. By visualizing the locations of schools, stakeholders can make evidence-based decisions on where to establish new institutions, improve infrastructure, or strengthen accessibility through road networks. The study, therefore, not only satisfies academic curiosity but also provides practical tools for policymakers, planners, and community leaders. In essence, mapping schools in Unwana transforms raw data into actionable knowledge.

When compared with previous studies on spatial distribution of social facilities in Nigeria, the findings of this project reaffirm a recurring challenge, unequal distribution due to socio-economic, political, and infrastructural influences. However, the application of GIS in this study demonstrates that these challenges can be systematically documented, analyzed, and presented in ways that support sustainable solutions.

In summary, the discussion underscores that while Unwana is relatively well served with primary and secondary schools in its central areas, peripheral zones remain disadvantaged. Addressing this imbalance requires strategic intervention, guided by geospatial evidence such as the outputs of this research. The work, therefore, not only contributes to the academic discourse but also stands as a planning instrument that can inform future educational development within the community and beyond.

4.2 PROBLEM ENCOUNTER AND SOLUTION TO THE PROBLEM ENCOUNTER

During the course of this project, a number of challenges were experienced at different stages of data collection, processing, and analysis. These problems, though significant, were carefully addressed to ensure the success of the study. The major challenges and the strategies employed to resolve them are outlined below:

i. Inaccessibility of Some Schools

Some schools were located in remote areas that were difficult to access due to poor road networks and transportation constraints. This posed a challenge during field data collection.

Solution: To overcome this, alternative routes were explored with the assistance of local guides. In some cases, motorcycles (okada) were used to navigate rough terrains, ensuring that all schools were adequately covered in the mapping exercise.

ii. Incomplete or Inconsistent Attribute Data

Certain schools had incomplete records, particularly regarding establishment dates, enrolment figures, and staff strength. This inconsistency could have affected the accuracy of the attribute database.

Solution: Where official records were unavailable, interviews with head teachers, staff, and community leaders were conducted to obtain reliable information. Cross-verification with multiple sources was done to minimize errors and ensure credibility.

iii. Limited Availability of Up-to-Date Base Maps and Imagery

Obtaining recent high-resolution satellite imagery and detailed base maps of the study area was another challenge. Outdated maps could have led to misrepresentation of spatial features.

Solution: This was addressed by utilizing freely available Google Earth imagery, which was geo-referenced and updated with field GPS data. This integration improved the positional accuracy of the mapped features.

iv. GPS Signal Limitations
At some locations, particularly around areas with dense vegetation or tall structures, GPS devices experienced weak signals, resulting in slight positional inaccuracies.

Solution: Multiple readings were taken at such locations at different times of the day, and the average coordinates were computed. This approach reduced positional errors and enhanced the reliability of the data.

v. Financial and Logistical Constraints
The cost of transportation, printing, data acquisition, and software access posed financial difficulties during the project.

Solution: The research team adopted cost-sharing strategies, where expenses were jointly contributed. In addition, some open-source GIS tools were explored as alternatives to minimize dependence on costly licensed software.

vi. Time Constraints
The academic calendar was tight, and fieldwork had to be carried out alongside other academic commitments, which put pressure on the project timeline.

Solution: A well-structured timetable was developed, and tasks were divided among group members to ensure efficiency. This collaborative effort enabled the project to be completed within the stipulated time frame.

In summary, although several challenges were encountered during this research, the proactive solutions adopted ensured that the quality, accuracy, and reliability of the study were not compromised. The experiences also provided valuable insights into practical problem-solving in geospatial research.

4.3 CONCLUSION

This study has successfully demonstrated the application of Geographic Information System (GIS) in the mapping of primary and secondary schools in Unwana. The research provided a systematic approach to identifying, collecting, and analyzing both spatial and attribute data of schools, which were then integrated into a geodatabase for effective management and visualization. Through processes such as geo-referencing, digitization, coordinate plotting, and ground-truthing, the study ensured that the information presented is accurate, reliable, and reflective of the real-world situation.

The findings revealed the spatial distribution pattern of educational facilities in Unwana, highlighting their accessibility, clustering, and relationship with major roads and settlements. This provides a strong basis for decision-making by educational planners, local authorities, and policymakers in addressing issues of equity in educational infrastructure and resource allocation.

Furthermore, the study has shown that GIS is not only a powerful tool for data storage and analysis but also for presenting results in a user-friendly format such as maps and charts. These outputs can assist in planning new schools, monitoring existing ones, and ensuring sustainable educational development in the area.

In conclusion, the project has achieved its stated objectives and established a framework that can be replicated in other communities. It is hoped that the insights provided will serve as a reference point for further studies and a practical guide for stakeholders committed to improving access to quality education in Unwana and beyond.

4.4 RECOMMENDATION

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

1. Educational Planning: The government and education stakeholders should adopt GIS techniques in monitoring and managing school facilities. This will help in identifying areas that are underserved and in need of additional schools or resources.

2. Infrastructure Development: New schools should be strategically located in areas with limited accessibility to existing institutions, to promote equity and reduce the burden on students who travel long distances.
3. Policy Implementation: Educational authorities should integrate spatial data into their policy frameworks for effective decision-making. This will ensure that future school development projects are data-driven rather than based on assumptions.
4. Database Updating: The geodatabase created in this study should be updated regularly to reflect changes such as new schools, expansion of facilities, or closure of institutions. This will sustain the relevance and reliability of the mapped information.
5. Capacity Building: Training programs should be organized for educational planners, surveyors, and GIS professionals to enhance their ability to apply spatial technologies in the education sector.

4.5 CONTRIBUTION TO KNOWLEDGE

This research has made several contributions to the existing body of knowledge:

1. Application of GIS in Education Mapping: The study has demonstrated how GIS can be effectively applied in the mapping and spatial analysis of primary and secondary schools in Unwana, thereby bridging the gap between geospatial science and educational planning.
2. Creation of a Spatial Database: A comprehensive GIS database of schools in Unwana has been developed, serving as a valuable reference for stakeholders and future researchers.
3. Evidence-Based Planning Tool: The study provides empirical evidence on the spatial distribution of schools, which can guide decision-making on equitable allocation of educational resources.
4. Framework for Replication: The methodology used in this research offers a replicable framework for mapping and analyzing educational facilities in other communities, thus contributing to sustainable educational development at larger scales.
5. Integration of Technology in Local Contexts: By applying modern GIS tools to a local case study, the research has highlighted the relevance of geospatial technology in solving community-based problems and promoting informed policy formulation.

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