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# Application of GIS and Remote Sensing in Mapping of Infrastructural Facilites in Fed Polytechnic Nekede, Owerri Imo State

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**ABSTRACT** - The study applied GIS and Remote Sensing in mapping infrastructural facilities in Federal Polytechnic Nekede Owerri.This study has demonstrated the effectiveness of applying Remote Sensing and GIS in mapping and analysis of infrastructural facilities. Its objectives were achieved by identifying the types of infrastructure in Fed Polytechnic Nekede, Owerri Imo State, creating a multipurpose geospatial database for the integration of infrastructural data in Fed Polytechnic Nekede, Owerri Imo State and performing spatial queries in administration of facilities in Fed Polytechnic Nekede, Owerri Imo State. The methodology adopted included: the acquisition of primary and secondary data within the study area, data processing and analysis amongst others. The software used included: ArcGIS10.7 and Microsoft excel. The results revealed that about 5 out of 70 buildings in the school were faculty buildings, namely, School of Engineering Technology (SET), School of Industrial and Applied Science (SIAS), School of Business Management Technology (SBMT), School of Humanities and Social Science (SHSS) and School of Environmental Development Technology (SEDT), 1 out of 70 infrastructures was for sports. 9 out of 70 infrastructures within the school premises were dilapidated, 10 out of 70 infrastructures within the school were classroom blocks, 26 out of 70 infrastructures within the school premises were office blocks and 5 out of 70 infrastructures within the school premises are laboratories and workshops.It was therefore recommended amongst others that the results of this study should serve as a decision support system in management of infrastructural facilities in Fed poly Nekede Owerri Imo State.

**Keywords:** Federal Polytechnic Nekede, Geographic Information System (GIS), Imo State, Infrastructure, Mapping, Owerri, Remote Sensing.

## I. INTRODUCTION

Infrastructure is a basic human right and is indispensable for realizing other rights, providing social, cultural, political, and economic benefits. It is transformative and empowering, contributing to building more just societies. No society has ever achieved significant economic development without substantial and steady investment in infrastructure. Despite almost fifty years of self-rule, nation-building, and transition to democracy, as well as receiving technical and financial assistance from the World Bank, Nigeria continues to struggle to improve its infrastructure (Ojiako, 2012).

In Owerri, educational infrastructure significantly impacts development in various dimensions, including cognitive competence, literacy, numeracy, and problem-solving skills. More than ninety percent of the information required for community administrators to manage educational infrastructures contains a spatial component, such as school names and their distances from the nearest city (Lockhead and Verspoor, 1990). The severe decline of the oil market in the early 1980s, combined with the Structural Adjustment Programme (SAP), led to drastic reductions in spending on education. This resulted in unpaid teacher salaries, degradation of educational facilities, and strikes in universities and schools, ultimately leading to declining literacy rates in the country.

The success of education in any country depends on its ability to develop and manage educational facilities and activities effectively. Nigeria, a developing country in West Africa, possesses rich educational infrastructures spread across its 36 states, including Abia State. However, these facilities need to be properly managed. Accurate data for decision-making in managing these facilities is vital, as such data provides crucial information for individuals, private organizations, and governments to harness.

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Geographic Information System (GIS) is defined as an information system used to input, store, retrieve, manipulate, analyze, and output geographically referenced or geospatial data to support decision-making for planning and managing land use, natural resources, the environment, transportation, urban facilities, and other administrative records, including education (Ayeni et al., 2004; 2007; 2012). Education encompasses activities, facilities, services, and schools that deliver a growing experience through imparting knowledge, demonstration, teaching, learning, studying, recreation, historical and cultural experiences, and other services available to scholars. GIS and education share common characteristics that cross disciplinary boundaries and application areas. Given the significance of education in all areas of life, the potential for GIS application in education is substantial. With the advent of GIS technology, information can be acquired, stored, and retrieved quickly for dissemination. GIS is widely recognized as a valuable tool for managing, analyzing, and displaying large volumes of diverse data pertinent to many local, regional, and national activities. Its use in environmental planning is rapidly increasing, and education management, being highly dependent on environmental resources, can benefit greatly from GIS application.

Several studies have highlighted the poor state of education in Nigeria, not only due to acute shortages of infrastructure but also because of inadequate facilities. The poor state of infrastructure in Federal Polytechnic Nekede is largely due to the low level of school structure and the inability to combine various data sources meaningfully (Ejieh, 2009). There are no available maps showing educational facilities within the school or a comprehensive database listing the infrastructures that could be used for management. Despite the availability of spatial information, educational data in Federal Polytechnic Nekede still suffers from issues related to quality and completeness: erroneously recorded and reported data, inconsistent coding systems for information on schools and teachers, prolonged periods between data collection and data release, and poor school record keeping. These issues hamper efficient decision-making within the school system.

## II. MATERIALS AND METHOD

### 2.1 Study Area

The Federal Polytechnic, Nekede is a federal government-owned higher institution located in Nekede, Owerri West local government area in Imo State, South-Eastern Nigeria. It was established on a temporary site at the premise of Government Technical College by the Imo State government in 1978 as College of Technology, Owerri before it was moved to its present location in Nekede. On 7 April 1993, the polytechnic was changed to a federal government institution and was renamed "The Federal Polytechnic, Nekede". The Federal Polytechnic, Nekede offers National Diploma and Higher National Diploma courses at undergraduate levels, see figure 1.


Figure 1: Map of study area

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### 2.2 Methodology

The methodology for this research was divided into several stages: Planning, Data Requirements/Acquisition, Digitization/Data Conversion and Coordinate Plotting, GIS Database Design and Creation, GIS Analysis, and Result Presentation.

In the Planning Stage, a user requirement analysis was conducted to determine current information usage, users, and data management processes, along with the selection of appropriate hardware and software. Data Requirements/Acquisition involved collecting primary data from GPS coordinates and non-spatial descriptive information, and secondary data from maps of Owerri L.G.A and Fed Poly Nekede, as well as general information from various sources.

Digitization/Data Conversion entailed converting analogue maps into digital format using an AO Scanner, followed by geo-referencing and creating shapefile layers for geographic features using ArcGIS 10.7. In GIS Database Design and Creation, real-world entities and their relationships were modeled through conceptual, logical, and physical designs. Conceptual Design involved simplifying human conceptualization of reality, using a vector scheme to represent facilities, roads, and boundaries. Logical Design translated the conceptual model into data structures compatible with database management software to avoid information loss and duplication. Physical Design converted real-world entities into relational structures for easy implementation and management, structuring geospatial and non-spatial data into a database format compatible with ArcGIS 10.7.

Linking of Data was done using the attribute table feature in ArcGIS, ensuring accessibility, retrieval, and updating of data. GIS Analysis included techniques such as classification, spatial search, buffering, overlay operations, and spatial queries. Spatial Queries provided solutions to questions about specific entities based on set criteria, utilizing both single and multiple query approaches with the ArcGIS query builder module.

## III. RESULTS

Results of database queries were presented in form of digital maps and tables. These maps could be thematic in nature. The results include the following:

**Query 1: Faculty Buildings in Fed Polytechnic Nekede**

A query to determine the faculty buildings in Fed Polytechnic Nekede was formulated using the Query module: ("Type" = ‘Faculty’) as shown in Figure 2.

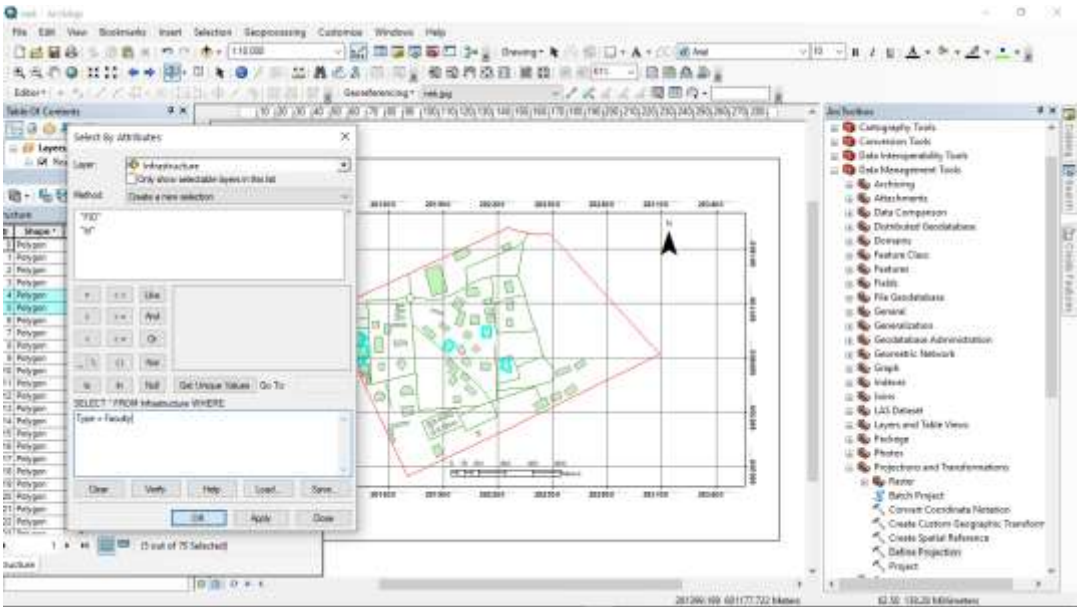

Figure 2: Query command showing faculty buildings in Fed Polytechnic Nekede

From the query result shown in Fig 4.2, it shows that about 5 out of 70 buildings in the school were faculty buildings, namely, School of Engineering Technology (SET), School of Industrial and Applied Science (SIAS), School of Business Management Technology (SBMT),

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School of Humanities and Social Science (SHSS) and School of Environmental Development Technology (SEDT). This query result is also presented in a digital map (see figure 3)

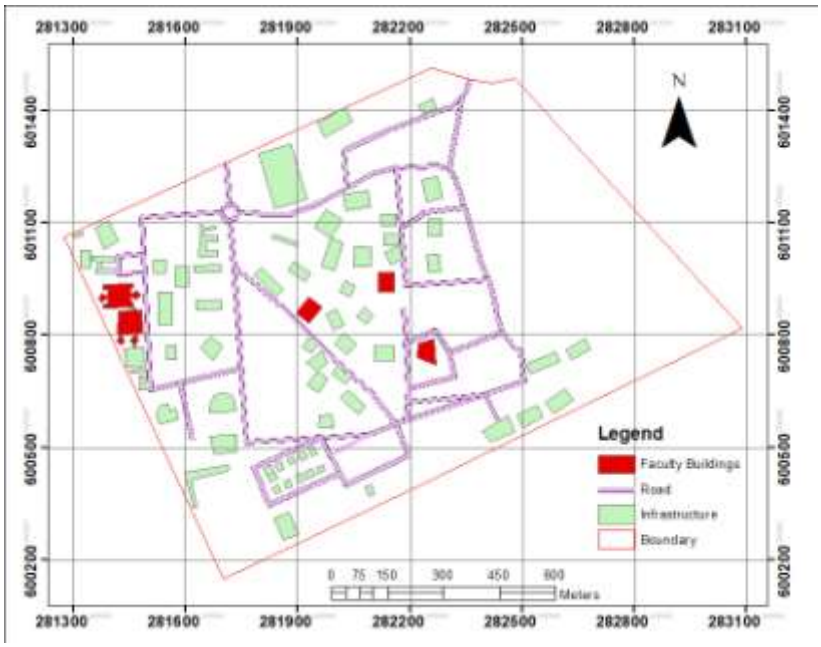


Figure 3: Digital Map showing distribution of faculty buildings within the school premises

**Query 2: Sports Infrastructure within Fed Polytechnic Nekede**

A query to determine the sports infrastructure in Fed Polytechnic Nekede was formulated using the command ("type' = "sports") as shown in Figure 4.

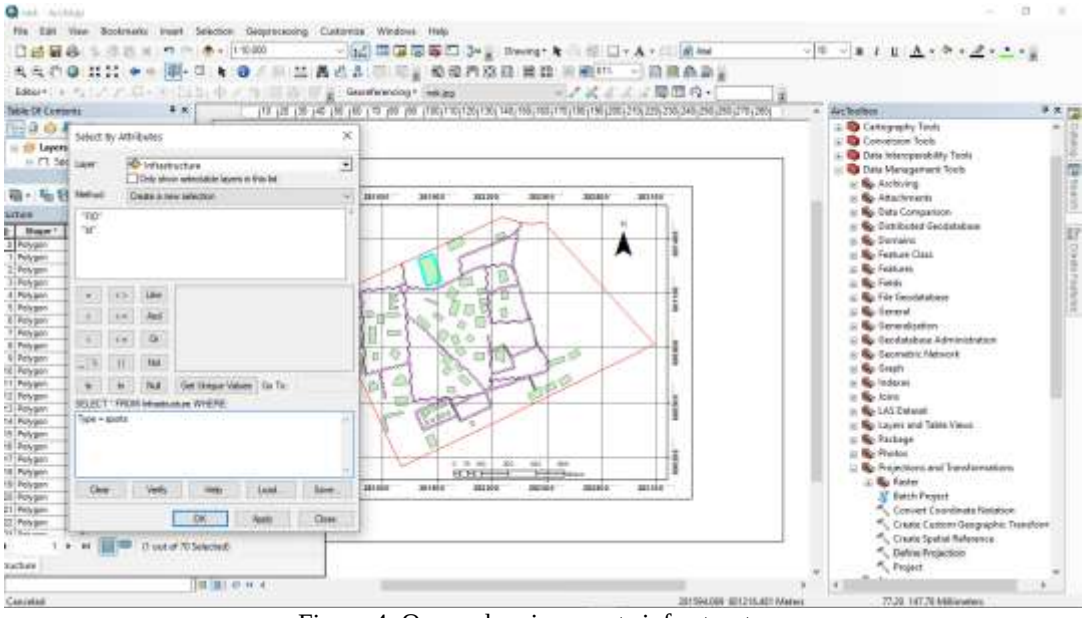

Figure 4: Query showing sports infrastructure

From the query result shown in Figure.4, 1 out of 70 infrastructure was for sports. The result is also presented in a map form below in figure 5.

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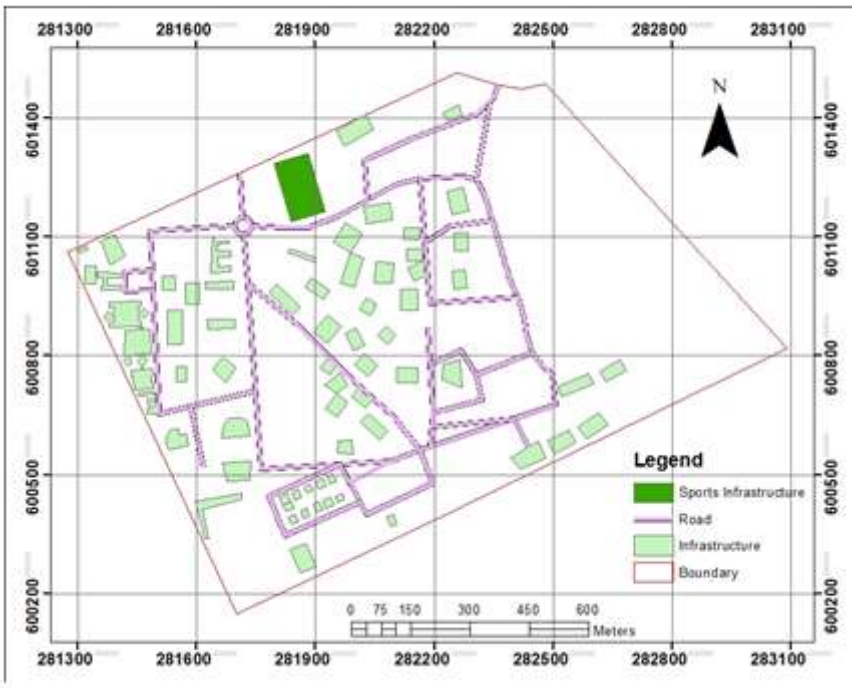


Figure 5: Digital Map Showing sports Facility Locations

**Query 3:Dilapidated Infrastructure**

A query to show dilapidated infrastructure in the school premises was formulated using the command ("condition" = ‘’Dilapidated’’) as shown in Figure 6.

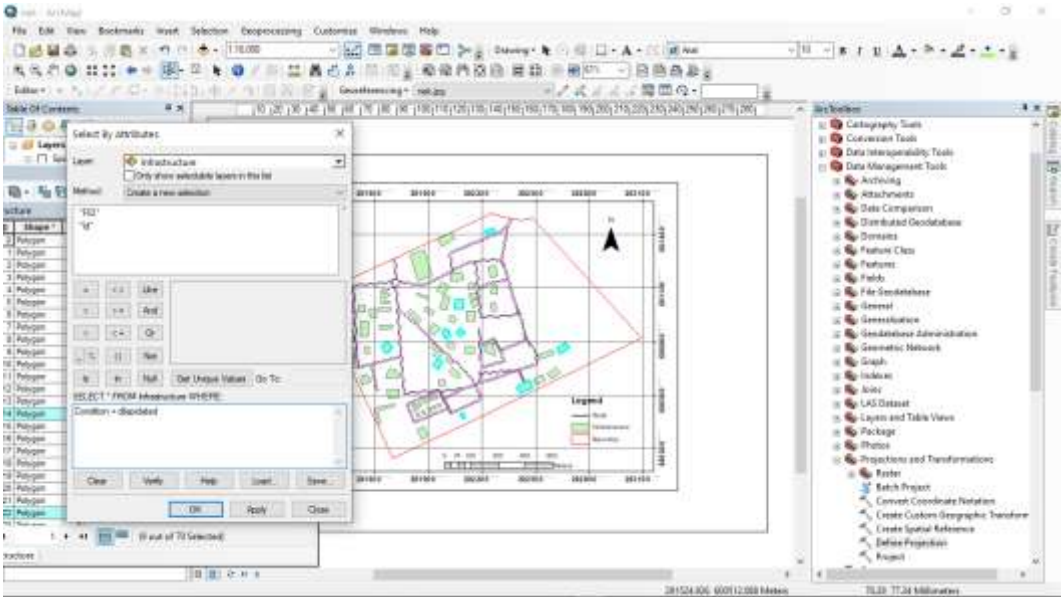

Figure 6: Query Showing dilapidated infrastructure within the school premises

From the query result shown in Figure 6 it shows that about 9 out of 70 infrastructures within the school premises were dilapidated. This query result is also presented in a map form below in figure 7.

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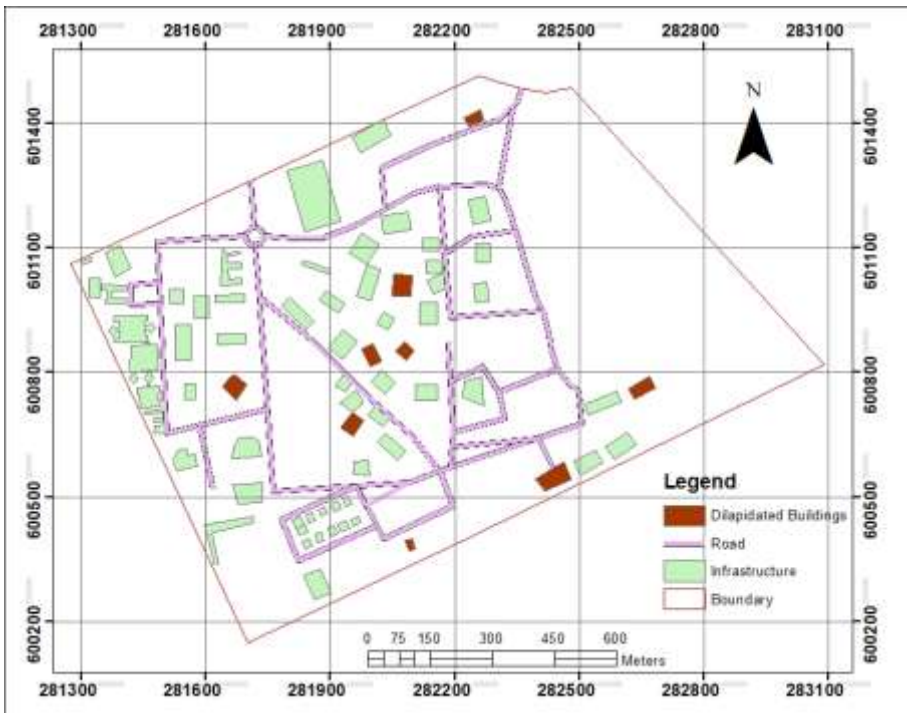


Figure 7: Map Showing dilapidated infrastructure

**Query 4: Number of classroom blocks in Fed Polytechnic Nekede**

A query to determine the number of classroom blocks within the school premises was formulated using the command ("Type " = "Classroom") as shown in Figure 8.

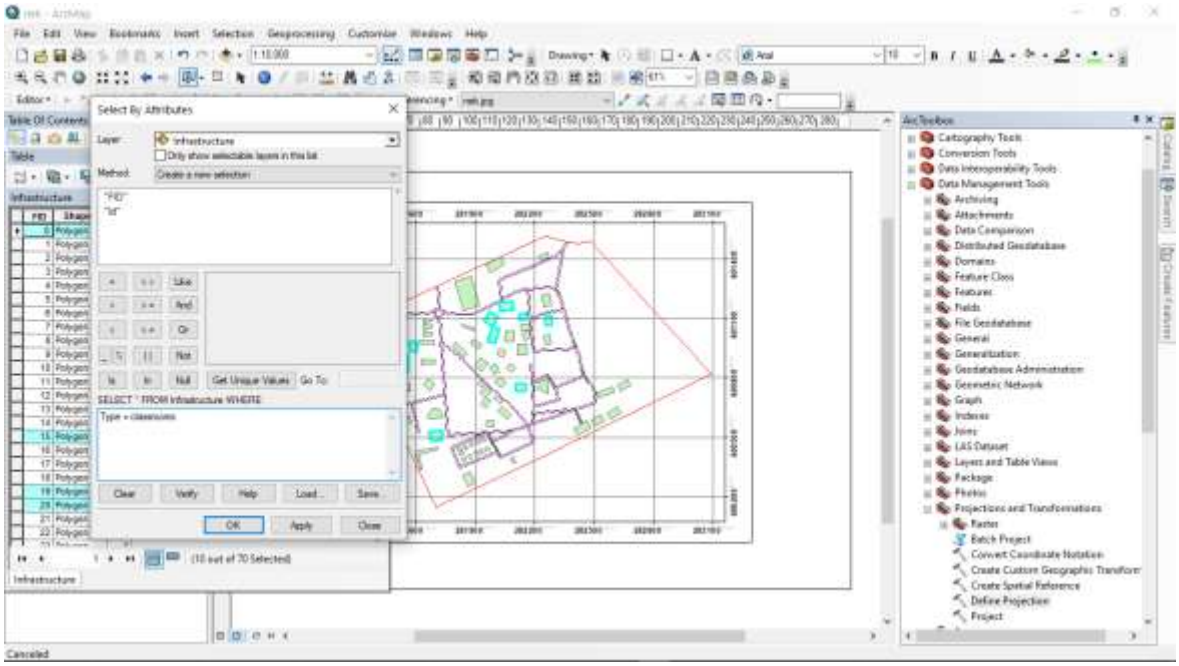

**Figure 8:** Query Result Showing number of classroom blocks

From the query result shown in Figure 8 it shows that about 10 out of 70 infrastructures within the school were classroom blocks. This query result is also presented in a map form below in figure 9.

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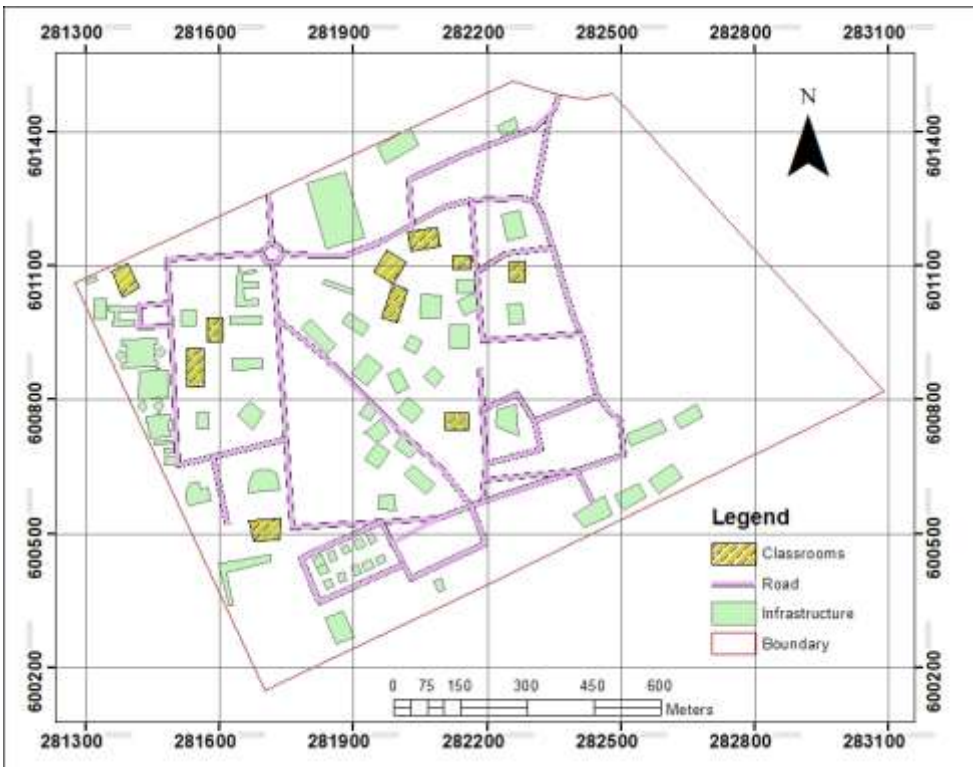


Figure 9: Digital map showing classroom blocks within the school premises

**Query 5: Office Blocks within Fed Polytechnic Nekede**

A query to determine the number of office blocks within the school premiseswas formulated using the command ("type " = “offices”) as shown in Figure 10.

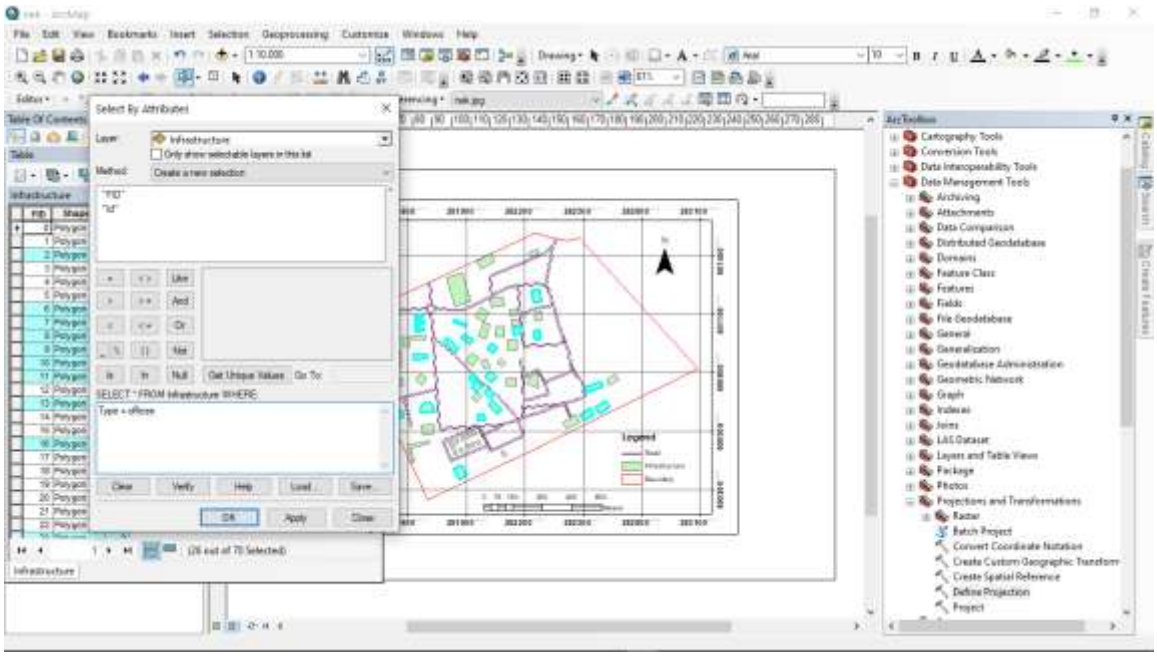

**Figure 10:** Query Result Showing locations offices

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From the query result shown in Figure 10 it shows that about 26 out of 70 infrastructures within the school premises were office blocks. This query result is also presented in a map form below in figure 11.

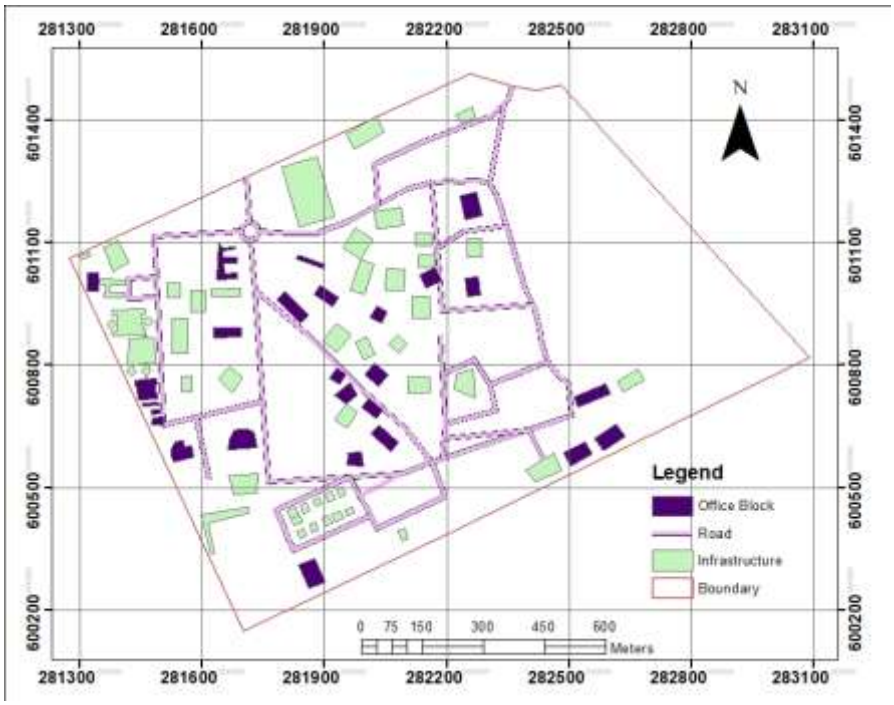


Figure 11: Digital map showing location of office blocks within the school premises

**Query 6: Laboratories and Workshops within Fed Polytechnic Nekede**

A query to determine the locations of laboratories and workshops within the school premises was formulated using the command ("Type " = "Laboratory" and "Type " = "Workshops") as shown in Figure 12

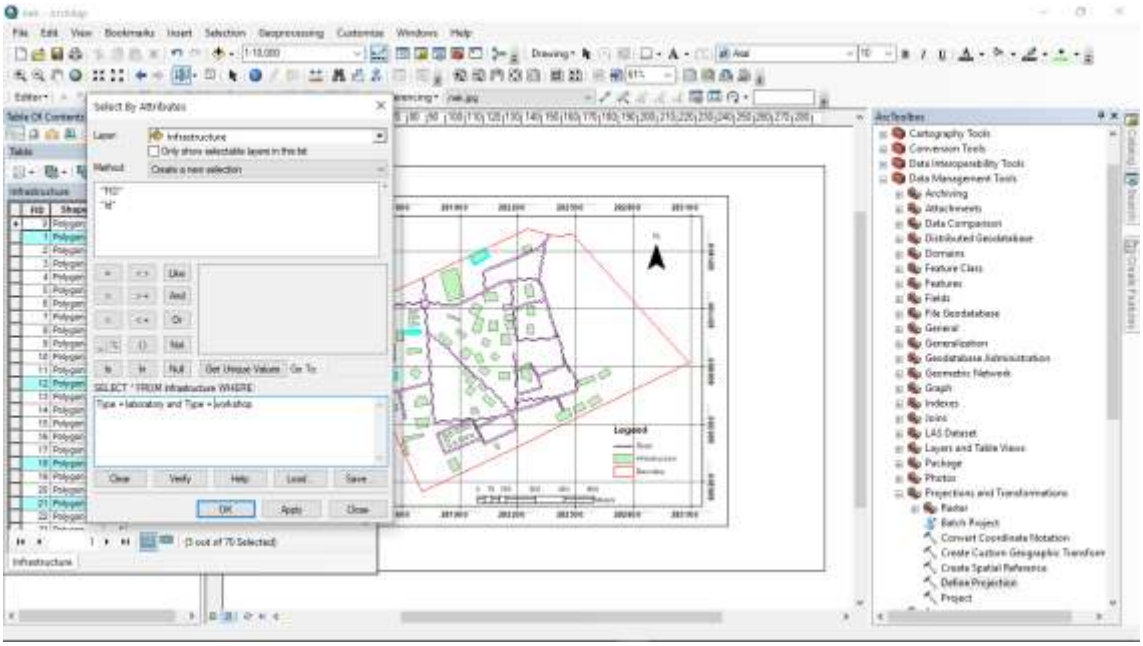

Figure 12: Query Result Showing locations of laboratories and workshops

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From the query result shown in Figure 12 it shows that about 5 out of 70 infrastructures within the school premises are laboratories and workshops. This query result is also presented in a map form below in figure 13.

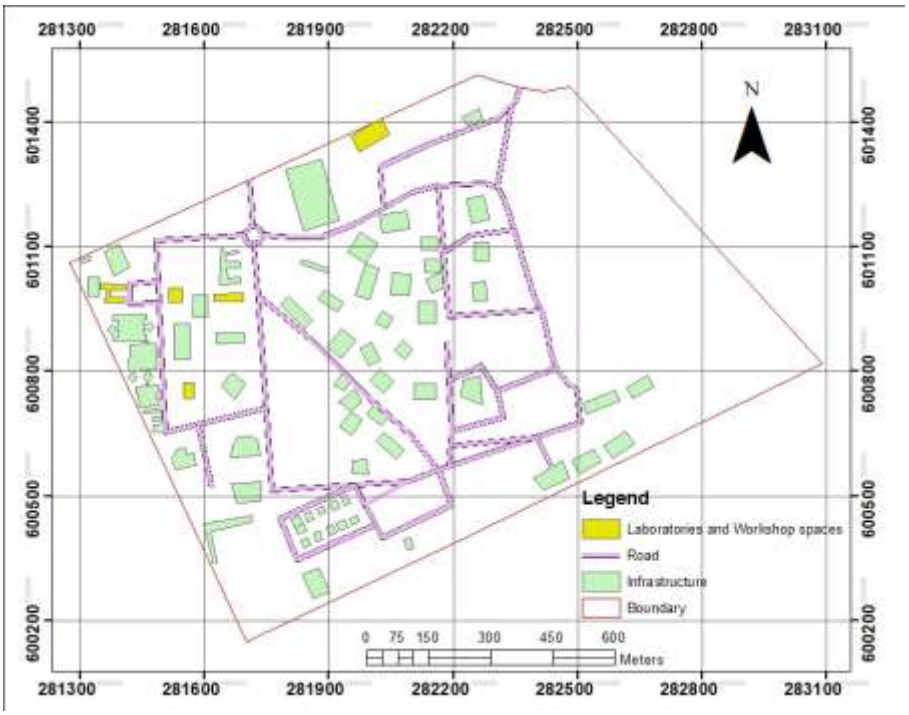


Figure 13: Digital map showing location of laboratories and workshops in the study area

## IV. DISCUSSION OF FINDINGS

The analysis of the spatial data collected from the school revealed several key findings regarding the distribution and condition of the campus infrastructure. Out of a total of 70 buildings, five were identified as faculty buildings housing the School of Engineering Technology (SET), the School of Industrial and Applied Science (SIAS), the School of Business Management Technology (SBMT), the School of Humanities and Social Science (SHSS), and the School of Environmental Development Technology (SEDT). Only one building was dedicated to sports facilities. The school had 10 classroom blocks, 26 office blocks, and five buildings designated for laboratories and workshops. Additionally, nine buildings were found to be in a state of disrepair.

These findings highlight the importance of understanding the distribution and condition of the school's infrastructure. Knowing the exact distribution of buildings allows for better resource allocation, ensuring that essential areas such as faculties, classrooms, and laboratories are adequately funded and maintained. Identifying dilapidated buildings is crucial for prioritizing repair and renovation efforts, which in turn improves overall campus safety and aesthetics. This detailed knowledge aids in strategic planning for future development, ensuring balanced growth across different departments and facilities.

The implications of these findings are significant for several reasons. First, the quality of education and research is directly impacted by adequate and well-maintained infrastructure, which provides a conducive environment for learning and innovation. Second, efficient management of office spaces and facilities enhances administrative operations, contributing to smoother day-to-day functioning of the school. Third, a well-maintained campus with diverse facilities enhances the student experience, leading to higher satisfaction and retention rates.

This research contributes to the scientific body of knowledge by demonstrating the application of GIS technology in educational infrastructure analysis, providing a model for similar studies in other institutions. It emphasizes the importance of data-driven decision making in educational management, highlighting how spatial data can inform policies and development strategies. Additionally, it adds to the methodologies for assessing and categorizing building conditions within academic settings, which can be referenced in future research.

The research provides significant contributions to the school. By identifying the

current state and distribution of buildings, the school can implement more effective infrastructure management practices. The detailed analysis supports more informed planning and development strategies, ensuring resources are allocated where they are most needed. Ultimately, the research supports the school's mission by enhancing both academic and operational aspects, contributing to a better environment for students, faculty, and staff. It also establishes a benchmark for future studies and assessments, enabling ongoing monitoring and improvement of the campus infrastructure.

This research not only sheds light on the current state of the school's infrastructure but also provides actionable insights and strategic direction for future improvements. The integration of GIS technology in this analysis underscores its value in educational management and planning, paving the way for more efficient and effective use of resources within the institution.

## V. CONCLUSION

The analysis of the school's infrastructure revealed a disproportionate distribution of facilities, with a limited number of buildings allocated for sports and faculty purposes compared to the higher number of office blocks. The presence of nine dilapidated buildings indicates an urgent need for repair and maintenance to ensure safety and functionality. The findings underscore the necessity for strategic planning and resource allocation to enhance the academic environment and operational efficiency of the school. The use of GIS technology in this research highlights its effectiveness in infrastructure management, providing a valuable tool for future development and planning. This research contributes to the scientific understanding of educational infrastructure management and offers practical insights for improving the school's facilities, ultimately supporting the institution's mission and enhancing the student experience.

## REFERENCES

[1]. Ayeni, O. O. (2004). Application of multimedia GIS to tourism in Abuja and environs. In P. C. Nwilo et al. (Eds.), Application of geo-information to the development and management of Nigeria's resources (pp. 103-122). Proceedings of the conference of geo-information society of Nigeria.

[2]. Ayeni, O. O., & Abiodun, O. E. (2007). Multimedia GIS for the management of educational facilities in Lagos Mainland, Nigeria. FIG Working Week, Hong Kong.

[3]. Ayeni, O. O., Igbokwe, J. I., Onojeghno, A. O., Onujeghno, R. A., &Okiako, J. C. (2012). Geographic information system to the tourism industry in Abia State, Nigeria. Paper presented at the Geoinformation Society of Nigeria, pp. 12-24.

[4]. Ejieh, U. C. M. (2009). The universal basic education as an effective strategy for meeting the millennium development goals in Nigeria. Retrieved from http://www.nobleworld.biz/images/Ejieh.pdf (Accessed on September 27, 2011).

[5]. Lockheed, M., &Verspoor, A. (1990). Improving primary education in developing countries: A review of policy options. World Bank, Washington, D.C.

[6]. Ojiako, J. C., & Igbokwe, J. I. (2011). Application of geographic information system (GIS) and remote sensing (R.S) technology to school mapping in Nnewi Local Government Area of Anambra State. An Environment Review. A Multi-Disciplinary Journal for the Environmental Sciences, 4(2).