for educational planning and policy. The study calls for a more strategic approach to improving access to educational opportunities.

Keywords: Accessibility, Educational Facilities, GIS, Yola South, Spatial Analysis

Introduction

Education serves as the foundation for societal development, acting as a regulated medium for transferring socially significant experiences across generations (Dagar, 2017). It is a comprehensive process encompassing the acquisition of knowledge, skills, and character development, enabling individuals to make informed decisions in various circumstances (Idris, 2012). The term "education" is derived from the Latin word educare, meaning "to bring up" or "nourish," underscoring its fundamental role in fostering human conduct and societal advancement. In Nigeria, education is pivotal to the nation's aspiration to rank among the world's largest economies. However, the current educational landscape in the country is fraught with challenges that necessitate urgent reforms to position education as a robust tool for national development.

The equitable distribution and accessibility of educational facilities are critical to achieving sustainable development goals (SDGs). Despite the acknowledged importance of education, disparities persist in the allocation and accessibility of educational resources, particularly in underserved regions such as Yola South Local Government Area in Adamawa State. Geographic Information Systems (GIS), a powerful tool for spatial analysis, present innovative solutions for evaluating and optimizing the distribution of educational resources (Parveen I & Awan, R.2019). GIS integrates spatial data with relevant attributes, facilitating evidence-based decision-making to enhance educational planning and management.

Previous studies have demonstrated the spatial inequities in educational resource allocation. For example, Haruna and Banki (2012) analyzed the distribution of primary and secondary schools in Bida City, Nigeria, revealing that the distribution often failed to align with population density, resulting in inequitable access. Similarly, Deniz (2023) investigated the spatial distribution of secondary schools in Salihli city, Turkey, identifying significant disparities, including

shortages in northern regions and overcrowding in primary schools. These studies highlight a global challenge: unequal spatial distribution of educational facilities that limits accessibility and efficiency. However, there is limited research addressing how factors such as proximity, population density, and infrastructure quality influence access and utilization of educational facilities in specific Nigerian contexts like Yola South Local Government Area.

The Federal Government of Nigeria recognizes the shortage of qualified teachers as a significant impediment to improving educational standards. Approximately 23% of the over 400,000 primary school teachers lack the Teachers' Grade Two Certificate, even though the National Certificate of Education (NCE) is the minimum required qualification for teaching at this level (Africa Union Analysis, 2019). In remote areas, however, holders of the Teachers' Grade Two Certificate are still employed due to a lack of alternatives (Better Future Foundation Amodu [BFFA], 2014). Global standards for teacher-pupil ratios also vary, with UNESCO (2019) recommending a ratio of 1:25 for primary schools, whereas Nigeria's Universal Basic Education Plan (2010–2019) adopted a more relaxed ratio of 1:35 to accommodate resource constraints.

In terms of accessibility, the Federal Ministry of Education (FMoE, 2009) recommends that primary schools should be within a 3–4 km walking distance for children. Similarly, the Revised Yola Metropolitan Plan (RAMP, 1980) established a service radius of 5 km for public primary schools, with a maximum class size of 50 pupils and a teacher-pupil ratio of 1:25 pre- primary, primary 1:35, for secondary school 1:40. (Ogunode 2020). These benchmarks are critical for guiding equitable resource distribution, but effective implementation requires robust tools such as school mapping (SM). School mapping, as described by Mercy (2024), integrates technical data like population density and settlement patterns into the planning of school locations, enhancing resource allocation.

The use of GIS in education planning offers numerous advantages. Studies have demonstrated its efficacy in identifying disparities and optimizing resource distribution. For example, Ahmed et al. (2013) used thematic maps and buffer zone analyses to evaluate the distribution of police stations in Yola Metropolis, while Kibon and Ahmed (2013) applied similar methods to healthcare facilities, uncovering clustered distributions. In the educational sector, Sule, Abdullahi, and Bungwon (2012) and Aliyu (2013) employed GIS to assess school distribution in Kaduna and Yola North Local Government Areas, respectively. Their findings

revealed uneven resource distribution, with some areas underserved while others experienced facility clustering.

GIS further enhances educational planning by integrating spatial data with educational statistics, such as teacher-pupil ratios and infrastructure quality (Eray, 2012). This integration supports evidence-based decision-making, as demonstrated by Olubadewo, Abdulkarim, and Ahmed (2013) in Fagge Local Government Area, where thematic mapping and buffer zone analyses were used to improve resource allocation. However, several barriers to effective education delivery remain, including inadequate infrastructure, insufficient funding, and unqualified teaching staff is a barrier to education access (Johnson & Wasiu 2016). Addressing these challenges requires innovative strategies, such as leveraging GIS technology to ensure equitable access and improved resource management.

Modern GIS applications offer advanced features such as attractive data visualization, precise spatial analysis, and scenario planning. These capabilities allow for the projection of tabular data onto thematic maps, uncovering patterns that facilitate more effective planning, Ibrahim (2019). By integrating GIS into educational micro-planning, stakeholders can optimize resource distribution, improve infrastructure management, and ultimately enhance student outcomes.

This study evaluates the accessibility and spatial distribution of educational facilities in Yola South Local Government Area, Adamawa State, using GIS. The findings aim to provide actionable insights into the alignment of educational infrastructure with population needs, identify gaps, and offer recommendations for more effective planning and resource allocation.

Materials and Methods

Study Area

Yola South, situated in Adamawa State, Nigeria, forms part of the state's administrative capital. It shares boundaries with Jimeta, a major commercial hub, and is located at latitude 9°14'N and longitude 12°28'E. The area exhibits diverse land uses, including administrative, residential, institutional, industrial, and commercial. Among these, residential land use predominates and is further categorized into low, medium, and high-density zones. High-density areas are particularly notable for their intense commercial activities (Ilensanmi, 1999). The major ethnic groups include the Fulani, Verre, Laka, and Hausa, with Fulfulde and Hausa serving as the primary languages (Fakuade, 1999).

The population of Yola South was recorded as 196,197 in the 2006 census, with an estimated annual growth rate of 2.8% (Federal Republic of Nigeria, 2009). This study focused on the 11 wards of Yola South, employing stratified random sampling to select 145 participants, comprising teachers, principals, and head teachers from primary and secondary schools.

Reconnaissance Survey

A reconnaissance survey was conducted to evaluate the study area and locate key facilities in primary and secondary schools. A descriptive survey design was adopted, and data collection was carried out using a structured questionnaire titled "School Facility Inventory." This inventory documented information on available facilities such as classrooms, libraries, staffrooms, playgrounds, and utilities.

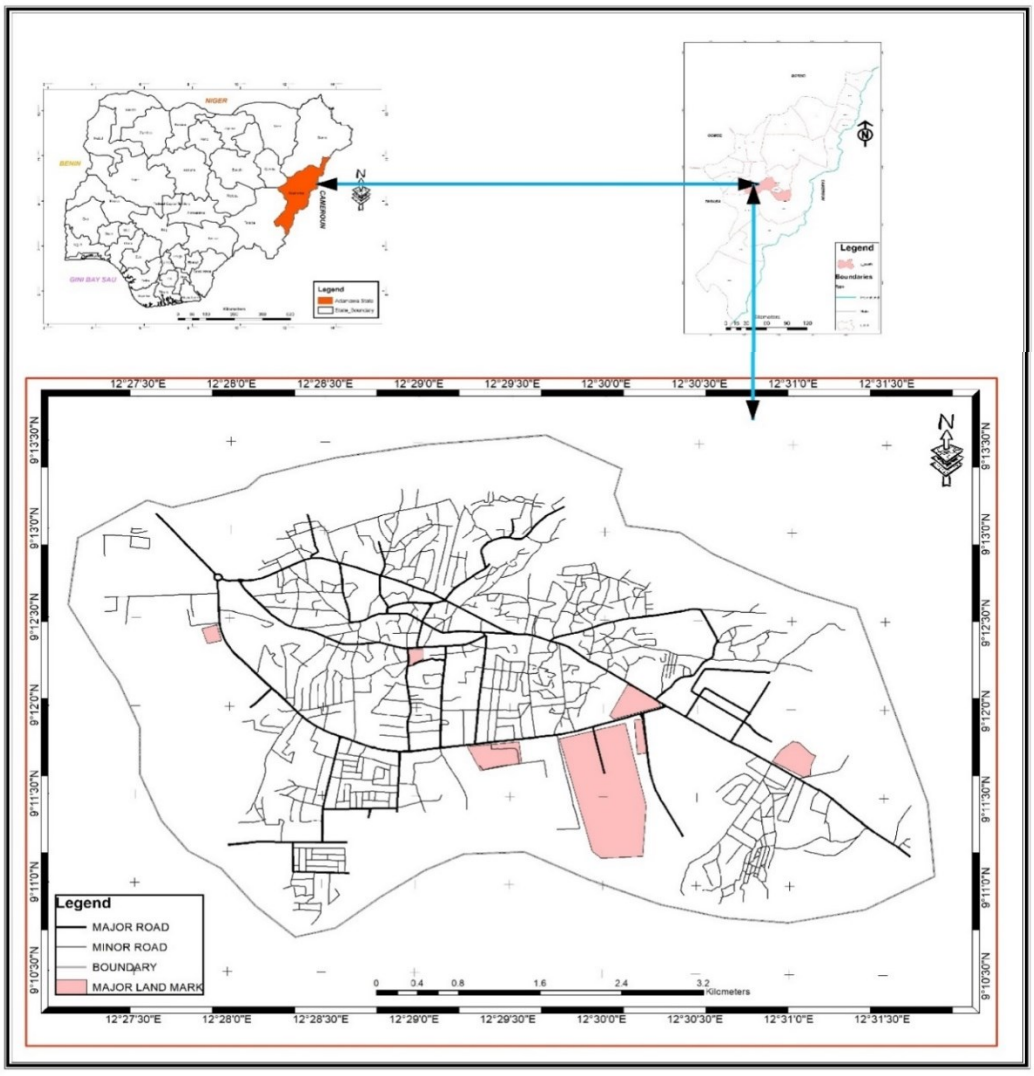


Fig: 1, Map of the study Area:

Types and Sources of Data

The study utilized both primary and secondary data to evaluate the accessibility of educational facilities in Yola South. Primary data were collected through field observations, GPS coordinates, and satellite imagery. Tools such as Google Earth Pro 7.4 were employed for spatial data acquisition, while an Etrex 10 Garmin GPS receiver was used to collect precise geospatial data. Additionally, a 5-point Likert scale questionnaire was administered to gather respondents' perceptions of access to educational facilities. Secondary data were sourced from textbooks, journals, government publications, and various datasets, including WorldView-2 high-resolution satellite imagery and digital administrative maps of Nigeria. Other key secondary data included educational enrollment records and teacher qualification data obtained from the Yola South Local Education Authority. Specifically, school enrollment data from 2020 and records of teacher qualifications and school facilities from 2021 were digitized and analyzed using Excel to create a database table, enhancing the comprehensiveness of the analysis.

Methods of Data Analysis

The methods of data analysis and presentation employed a combination of spatial and statistical techniques, with ArcGIS 10.8 serving as the primary analytical tool. The methodology was organized into three phases.

In the first phase, data input, satellite images were georeferenced using the Universal Traverse Mercator (UTM) Zone 33N coordinate system. Spatial features, including roads, schools, and public facilities, were digitized to construct a comprehensive geospatial database. In the second phase, digitization, shapefiles were created to classify and analyze spatial features, with attributes assigned to datasets for road networks, buildings, and other significant landmarks.

The third phase involved analysis and results, encompassing spatial and statistical analyses. GIS tools, such as buffering and hotspot analysis, were employed to examine the distribution patterns of educational facilities. Descriptive statistics, including mean and frequency analyses, were applied to field data to complement the spatial analysis. The findings were visualized through maps and charts, providing insights into the accessibility of educational facilities and their compliance with standards set by UNESCO (2015) . Buffering analysis played a critical role by creating buffer zones around educational facilities, which helped

evaluate their accessibility within specific distance thresholds. This analysis also identified areas in need of improved infrastructure and service delivery.

Statistical Analysis

The data were analyzed using a Likert scale, measuring levels of agreement across the following categories: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). A threshold mean of 2.50 indicated agreement.

The integration of spatial and statistical methods provided a robust framework for assessing the distribution and accessibility of educational facilities in Yola South.

Results and Discussion

The results from the survey on the accessibility of educational facilities in Yola South present a mixed picture. Both primary and secondary schools face significant challenges in terms of infrastructure, which affects their accessibility and, consequently, the quality of education provided.

Primary Schools

Table 1 highlights the results for primary schools, where several critical issues were identified. For instance, the survey indicated that a majority of respondents disagreed with statements regarding the adequacy of classroom blocks, libraries, staff rooms, playgrounds, and utilities ($M \leq 2.0$). The results showed that facilities like toilets for both male and female students, staff rooms, and organized playgrounds were inadequate, with most responses falling under the "Disagree" category. These findings align with studies that report the poor state of school infrastructure in many developing regions (Ihebon &Uko, 2020). The lack of these basic amenities could lead to an environment that is not conducive to learning, negatively impacting students' academic performance and overall well-being.

However, it was noted that headteachers' offices were deemed adequate, with an average agreement score of 3.1, suggesting that administrative facilities may be slightly better maintained compared to other educational amenities. This could be attributed to the prioritization of administrative needs over student-focused infrastructure in some schools (Jokodole, 2021).

Table 1: School facilities inventory (primary schools)

S/N	Items	SA	A	D	SD	M	REMAKS
1.	Does the school have enough class room blocks?	2	10	28	45	1.6	Disagree
2.	Does the school have the following facilities?						
	Library	4	10	21	50	1.6	Disagree
	Staff room	7	11	20	47	1.9	Disagree
	Head teachers office	49	21	9	6	3.1	Agree
3.	Does the school have toilets for?						
	Male	5	17	23	40	1.6	Disagree
	Female	3	20	23	39	1.9	Disagree
	Male teachers	5	12	27	41	1.8	Disagree
	Female teachers	12	15	21	37	2.0	Disagree
4.	Does the school have organized playing fields?	10	16	12	42	1.8	Disagree
5.	Does the school have electricity supply?	11	9	14	51	1.8	Disagree
6.	Do you have male teachers in this school?	20	53	10	2	3.1	Agree
7.	Do you have female teachers in this school?	4	10	21	50	1.5	Disagree
8.	Does the school have enough furniture's?	5	6	19	56	1.6	Disagree

M= Mean; N= 85

Secondary Schools

Similarly, the secondary school data presented in Table 2 revealed that the accessibility of educational facilities in these schools was also suboptimal. Items such as classroom blocks, playing fields, electricity supply, and furniture all received negative assessments, with agreement scores consistently falling below 2.5 ($M \leq 2.1$), signaling a significant gap in these facilities. The absence of adequate infrastructure in secondary schools is consistent with previous findings that indicate infrastructural deficits as a key challenge in Nigerian education (Tsohon Kanifani 2018). The inadequacies in these schools could have profound

effects on students' ability to perform academically, as the lack of proper learning environments is known to correlate with reduced student performance (Osher, 2020).

However, some aspects, such as the availability of libraries, staff rooms, and male teachers' toilets, were rated more positively, reflecting some areas where progress has been made. These positive responses could suggest targeted efforts to improve administrative and basic welfare facilities in these schools, potentially due to the allocation of resources towards maintaining these services (LEAP Africa, 2023).

School facilities inventory (Secondary Schools)

S/N	Questions (items)	SA	A	D	SD	X	REMAKS
1.	Does the school have enough class room blocks?	12	5	18	25	1.4	Disagree
2.	Does the school have the following facilities?						
	Library	26	4	4	16	2.9	Agree
	Staff room	21	10	8	21	2.9	Agree
	Principal office	49	5	__	6	3.6	Agree
3.	Does the school have toilets for?						
	Male		17	23	40	2.1	Disagree
	Female	3	20	23	39	2.3	Disagree
	Male teachers	21	13	5	21	2.6	Agree
	Female teachers	26	15	2	17	2.8	Agree
4.	Does the school have organized playing fields?	9	13	11	27	2.1	Disagree
5.	Does the school have electricity supply?	11	9	30	2	2.2	Disagree
6.	Do you have male teachers in this school?	40	8	2	10	3.3	Agree
7.	Do you have female teachers in this school?	5	4	42	8	2.1	Disagree
8.	Does the school have enough furniture's?	5	2	10	43	1.5	Disagree

M= Mean; N= 60

Accessibility and Spatial Distribution

The accessibility of educational facilities was further analyzed using GIS-based methods, including Euclidean distance and weighted overlay analysis. The Euclidean distance analysis revealed that the most suitable sites for future secondary schools were located within 200-400 meters of existing settlements, suggesting that proximity to residential areas is a critical factor in ensuring educational accessibility. The weighted overlay analysis considered factors such as proximity to roads, schools, and built-up areas, with settlements given the highest weight, indicating that new schools should be located near densely populated areas to ensure maximum accessibility. The resulting suitability map (Figure 2) suggests that areas within 200-400 meters of built-up areas and road networks are the most suitable for new school locations.

These findings are consistent with previous studies that highlight the importance of school location in determining educational accessibility. Proximity to schools significantly influences student enrollment and attendance, especially in rural and underserved areas (Limaye,S. 2016). Furthermore, it is essential to consider factors such as the avoidance of water bodies and terrain challenges when selecting suitable locations for new schools, as this will ensure that the infrastructure remains sustainable and accessible to all students.

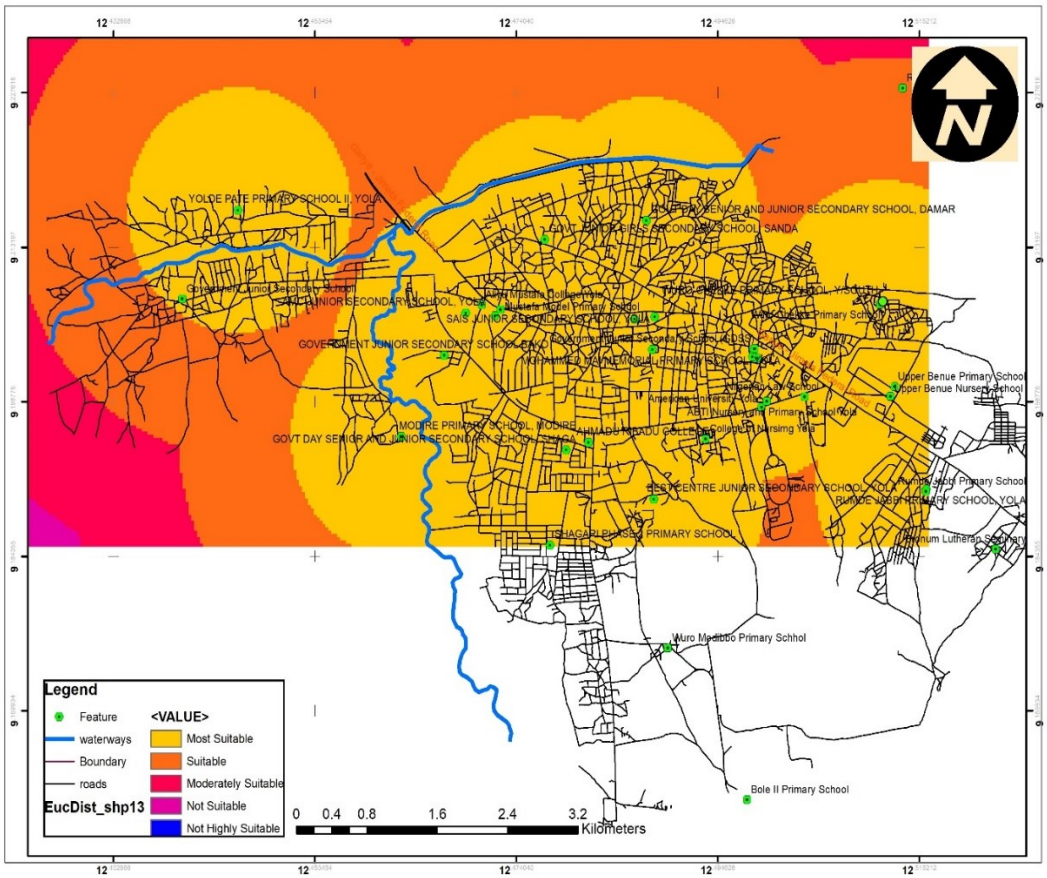


Fig 2 The range for the weighted overlay Map

Conclusion

The study reveals significant challenges in the accessibility of educational facilities in Yola South, both in primary and secondary schools. The lack of essential infrastructure such as adequate classrooms, toilets, electricity, and furniture poses serious barriers to quality education. These issues are compounded by spatial distribution challenges, as evidenced by the GIS analysis, which suggests that many areas lack sufficient proximity to educational facilities. However, targeted improvements in specific areas, such as administrative facilities, offer hope for incremental progress. To improve educational outcomes, there is a need for a comprehensive approach that prioritizes the development of critical educational infrastructure while also ensuring that new schools are located in accessible areas to cater to the growing population. The following recommendations were:

- Government should integrate Geographic Information System (GIS) into educational micro planning.
- Government should improve infrastructural management
- Government should improve on effective resource allocation
- Government should observed standard on walking distance to school when approving school plan
- Teachers should be trained on modern skills and technological innovation.
- Government should provide facilities, utilities and services (FUS) for the smooth running of schools in Yola South Local government Area (LGA).

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