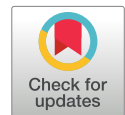


International Journal of Environment and Geoinformatics**Research Article** **Open Access****Geospatial Analysis of Distribution and Accessibility of Microfinance and Commercial Banks in Akure South LGA, Ondo State Nigeria**Onyemaechi John Nnamani¹  & Arigbede Israel Olaoluwa¹ ¹ Federal University of Technology Akure, Department of Surveying and Geoinformatics, Akure, Nigeria**Abstract**

This study employs Geographic Information Systems (GIS) technique to analyze the spatial distribution of commercial and microfinance banks in Akure South Local Government Area (LGA). A total of 25 financial institutions, comprising 14 commercial banks and 11 microfinance banks, were identified within the study area, with 48 bank branches in total, including 33 commercial bank branches and 15 microfinance bank branches. The study also observes a spatial normal distribution pattern, with higher bank branch density near the city center and decreasing density towards the periphery, following major road networks. This spatial analysis provides valuable insights into the geographic distribution of bank branches in Akure South LGA, aiding in strategic decision-making for future bank branch placements and financial accessibility across the region. The findings suggest a need for targeted banking expansion to optimize coverage and accessibility, especially in underrepresented areas, while leveraging existing corridors of bank concentration for enhanced service provision. To enhance financial inclusion in the Akure South Local Government Area, the study suggests implementing specific initiatives like the provision of mobile banking units, increasing the number of agent banking networks, and launching community-oriented digital literacy programs in underserved areas. Additionally, these efforts should be bolstered by spatial strategies such as upgrades to road networks, improved service area planning utilizing GIS, and collaborations between the public and private sectors to strengthen infrastructure and service provision.

Keywords

Geographic Information System (GIS) · spatial distribution · commercial bank · microfinance bank



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Introduction

The location of banks is a critical consideration for customers conducting physical transactions. In Nigeria, the efficiency of facilities has been a topic of discussion for years, with many planners advocating for services to be located based on need and equity rather than solely on population (Okafor, 2008). With the recent increase in the number of banks and their daily efforts to efficiently serve customers in a highly competitive banking environment, it becomes crucial to measure banking institutions' efficiency in terms of the spatial spread of their branches (Ogundele et al., 2013). The spatial distribution of commercial and microfinance banks plays a vital role in citizens' lives, affecting the accessibility of banking services in terms of distance, mode of travel, and time taken to reach the bank in relation to residents' locations. When people must travel long distances to reach a bank, it impacts their arrival time and daily activities, potentially hindering their economic performance.

In recent years, spatial inequality in the distribution of banks and their facilities has become a significant issue in many developing countries, including Nigeria. This uneven distribution not only affects monetary access but also hampers economic quality. Therefore, ensuring an appropriate spatial distribution of banks is crucial for achieving higher economic performance and fostering even development across communities.

GIS, or Geographic Information System, is a set of tools used to collect, store, analyze, and display spatial-related data. Advancements in technology have greatly influenced the use of GIS tools, enabling interactive map presentations and analytical capabilities that aid in understanding spatial relationships. Several studies have highlighted the effectiveness of GIS in mapping the locations and distributions of financial institutions. For instance, Adeboboye et al. (2012) emphasized the importance of spatial modeling using GIS for accurately representing the business landscape of an area, while Balogun et al. (2020) explored the use of geospatial technology in assessing banking activities in Benin City. Olagoke et al. (2022) utilized GIS to map existing banks and analyze their spatial distribution patterns.

Despite these contributions, there remains a significant gap in research concerning the updated geospatial distribution of commercial and microfinance banks in Akure South Local Government Area. There is currently no comprehensive map illustrating the spatial arrangement of banking institutions in the area, nor is there a buffer analysis depicting their service reach. Additionally, the absence of a network analysis assessing accessibility to these banks further limits

understanding of financial service distribution. Identifying underserved areas can help policymakers and financial institutions implement strategies to improve banking access and enhance financial inclusion (Olagoke et al., 2022). This paper provides insights into potential gaps in financial inclusion and informs policymakers and banks about areas that require targeted interventions. By assessing the geospatial distribution of bank branches, the study sheds light on potential disparities in access to financial services based on socioeconomic factors within areas in Akure South Metropolis.

As it is known that banks facilitate capital flow (Monguno et al., 2015), lend to businesses, and support investment in the community, this information can be used to advocate for a more equitable distribution of banking resources. Understanding the geographical distribution of banks can help identify areas with a higher potential for economic growth and areas that might require additional financial resources (Yazdani et al., 2018) to spur development in some parts of Ondo State, Akure.

The emergence of the "learning spillover effect" in the research by Zhou *et al* (2020) provides a new dimension to the role of physical bank branches. Initial branch openings in a region encourage customer engagement with complex financial transactions. Over time, this leads to learning that enables customers to perform similar transactions via digital channels. Thus, instead of physical branches becoming outdated in the digital era, they act as pivotal hubs for enhancing customers' digital abilities, especially in regions where digital adoption has been historically low. While digital banking is reshaping the financial landscape, recent studies emphasize that the relevance of physical bank branches persists particularly in developing contexts. According to song et al (2022), optimal branching strategies must now blend spatial accessibility with digital service delivery to ensure inclusive coverage. In Akure South LGA, where internet connectivity and digital literacy vary widely, the strategic siting of physical branches remains essential for financial inclusion, especially in underserved southern zones.

Therefore this study advocates for a hybrid banking model that leverages digital innovation while maintaining physical presence in key demand nodes, as identified through geospatial analysis of the distribution and accessibility of commercial and microfinance banks in Akure South LGA. Specifically, it aims to map existing bank locations, evaluate their spatial distribution, and assess their accessibility and proximity to residential areas. By identifying gaps in financial service coverage, this research seeks to provide valuable insights for policymakers and financial institutions, fostering a

more equitable banking landscape and supporting economic development in Akure South Metropolis.

Materials and Methods

This section outlines the methods, procedures used in executing this study. It covers the planning, reconnaissance survey (office and field), data acquisition, data processing, data quality, and analysis used to achieve the objectives of the study.

Study Area

The area under consideration is a Local Government Area within Akure City, which is located in southwestern Nigeria. It lies in the southern part of the forested Yoruba Hills and at the intersection of roads from Ondo, Ilesha, Ado-Ekiti, and Owo. Akure is an agricultural trade center for cassava, corn (maize), bananas, rice, palm oil and kernels, okra, rubber, coffee, and pumpkins. Although cocoa is the most important local commercial crop, cotton, teak, and palm produce are also cultivated for export (Olawuyi, 2022). The town's industries include electronics manufacturing, soft drink bottling, weaving, and pottery making. Akure is the site of the Federal University of Technology, Akure (founded in 1981), and the Federal College of Agriculture (1957). Akure is made

up of three local government areas: Akure South, Akure North, and Ifedore. For the purpose of our study, Akure South is the area of study.

Akure South Local Government in Ondo State, Nigeria, is located between latitude $7^{\circ} 5'23.62''\text{N}$ to $7^{\circ}21'12.972''\text{N}$ and longitude $5^{\circ}20'46.975\text{E}$ to $5^{\circ} 10'$ with an altitude of 353 meters above sea level. It has an area of 331 sq km and a population of 353,211 at the 2006 census, which is projected to be 618,570 at the 2016 census.

Data collection

Data relating to commercial and microfinance bank branch locations, including coordinates (latitude and longitude) and addresses, was gathered. Administrative boundary data for Akure South LGA was acquired from a secondary source (openstreetmap); this also includes road network data. Primary data in the form of geographic coordinates of financial institutions located within Akure South LGA was obtained using handheld GPS. Secondary data comprises the study area shapefiles, road network data, population data, and details obtained from the financial institutions. The software that was employed includes ArcMap, MS Excel, Google Earth, USGS, OpenStreetMap, and QGIS. The boundary data of all the local government areas in Akure were obtained

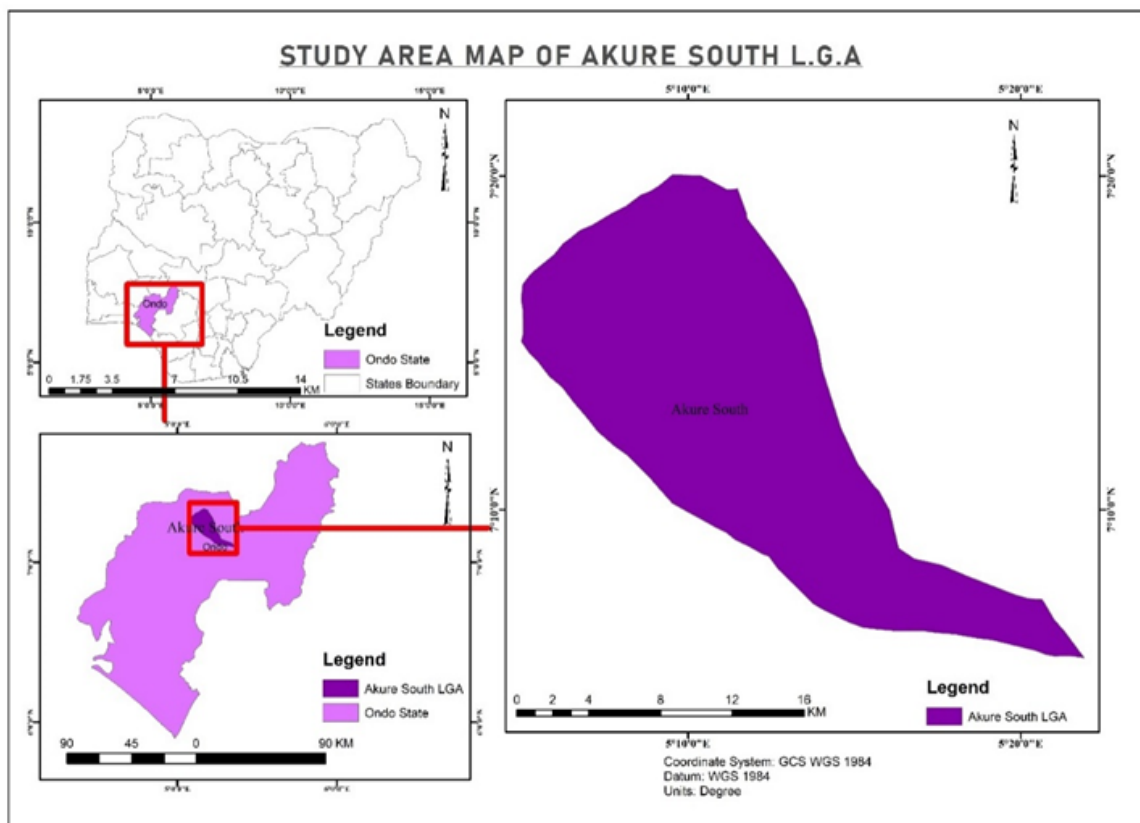


Figure 1. Map of the study area.

in the form of a shape file, which defines the geographical extent of the area under consideration. For this study, only four kinds of roads are of interest, which include primary, secondary, tertiary, and unclassified roads.

Data Processing

The field data collected through handheld GPS was corrected and converted to CSV format. The CSV data format was imported into the ArcMap and then projected to display the X and Y locations of the microfinance and commercial bank branches. Also, the raw data obtained from an online source (www.openstreetmap.com) contains the overall data of the Nigerian administrative boundaries, road networks, towns, buildings, railways, drainages, water bodies, etc. The data for the study area was extracted using the “Clip” tool embedded in ArcGIS 10.7.1 software. Excel data was imported into the software, including shape files of the study area, which were geo-referenced. Network analysis was then carried out, making use of road data, population data, and bank spatial locations. A correlation coefficient on the relationship between the number of banks in various areas of Akure South and the percentage of housing considered absolute beneficiaries was performed.

The administrative map of Nigeria was used as baseline data for the analysis, retrieved from an online geospatial database called "openstreetmap. The map was reprocessed to generate a map of Akure South LGA from the geo-processing-merge operation of ArcGIS 10.7.1. The ArcGIS method of database creation and analysis was also used. This was performed in the attribute table to create the database, using the add fields and records operation. The generated maps were subjected to Symbology Layer Properties using two operations: dot density and quantities (gradually colored). For the later operation (quantities and graduated colors), the seven classification methods under “natural breaks” were used to produce maps for the following: the spatial distribution of banks, percentage of total banks per bank type, total population, ratio of banks to population, and percent of underserved areas.

Results

The results of findings from field operations and the use of GIS in the management of financial institutions in Akure South Local Government Area (LGA) are presented in this section. The names, category, and number of branches of each financial institution are presented in Table 1.

This table provides a clear overview of the different types of financial institutions and the number of branch/ locations in Akure South LGA.

Table 1. List of Commercial and Microfinance banks in Akure South LGA.

S/N	Financial Institution	Category	Number of Branch/ Locations
1.	Access Bank Plc Akure	Commercial bank	3
2.	First Bank Plc, Akure.	Commercial bank	4
3.	Guaranty Trust Bank	Commercial bank	3
4.	Heritage Bank	Commercial bank	2
5.	Jaiz Bank Plc	Commercial bank	1
6.	Polaris Bank Limited	Commercial bank	1
7.	Stanbic IBTC Bank	Commercial bank	1
8.	Union Bank	Commercial bank	2
9.	United Bank for Africa	Commercial bank	3
10.	Unity Bank	Commercial bank	3
11.	Wema Bank	Commercial bank	2
12.	Zenith Bank Akure	Commercial bank	2
13.	First City Monument Bank	Commercial bank	3
14.	Bank Of Industry	Commercial bank	1
15.	AB Microfinance bank	Microfinance bank	1
16.	Accion microfinance Bank	Microfinance bank	2
17.	CPEEP Microfinance Institution	Microfinance bank	1
18.	LAPO Microfinance Bank Branch	Microfinance bank	5
19.	Memphis Microfinance Bank Limited	Microfinance bank	1
20.	Oredegebe Microfinance Bank	Microfinance bank	1
21.	Advans La Fayette Microfinance Bank Ltd.	Microfinance bank	1
22.	Nigeria Police Microfinance Bank	Microfinance bank	1
23.	NIRSAL microfinance Bank	Microfinance bank	1
24.	Fidelity Bank Plc	Commercial bank	1
25.	Ecobank	Commercial bank	2
Total			48

From Table 1, it can be observed that the total number of financial institutions listed is 25, comprising of 14 commercial banks and 11 microfinance banks.

The highest number of branches among commercial banks is 4, which is held by First Bank Plc. LAPO Microfinance Bank has the highest number of branches among microfinance banks, with 5 branches.

The table reflects a diverse financial landscape in Akure, with a mix of commercial banks and microfinance banks catering to the financial needs of the population.

Commercial banks tend to have fewer branches compared to microfinance banks, with First Bank Plc having the highest number of branches among all listed banks.

Figure 2 shows the spatial distribution of Microfinance and commercial banks in Akure South LGA, including the roads and settlements.

Buffer Coverage Analysis

To illustrate the operational reach of bank branches and the degree of concentration, the map underwent a buffer analysis using multiple ring buffers at distances of 500 meters and 1 kilometer (1KM). The 500-meter buffer is represented in light green, while the 1-kilometer buffer is depicted in Medium Coral Light color, as shown in Figure 3.

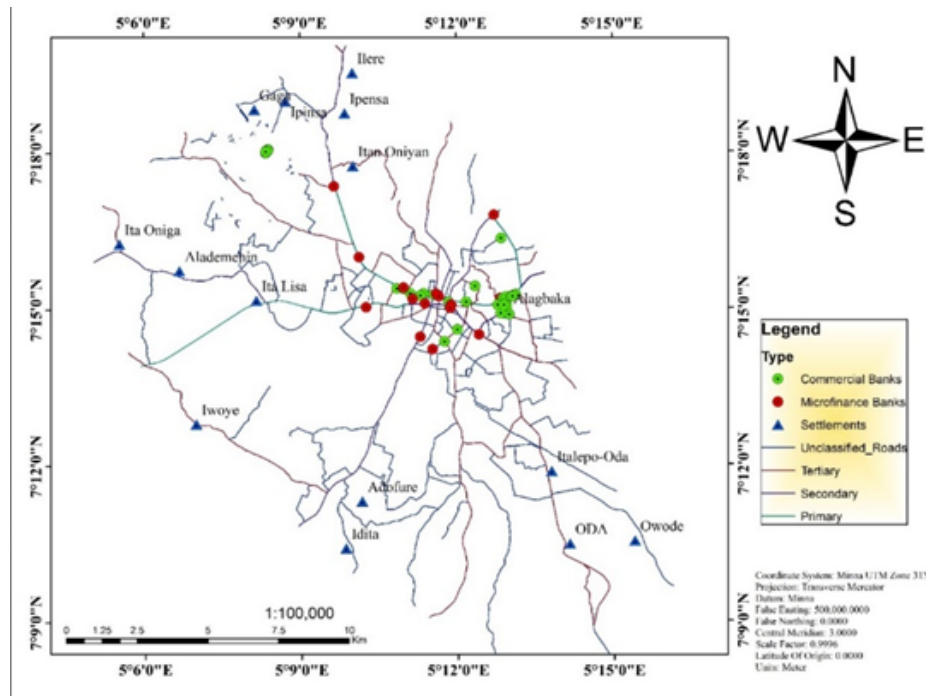


Figure 2. Spatial Distribution of financial institutions in Akure South.

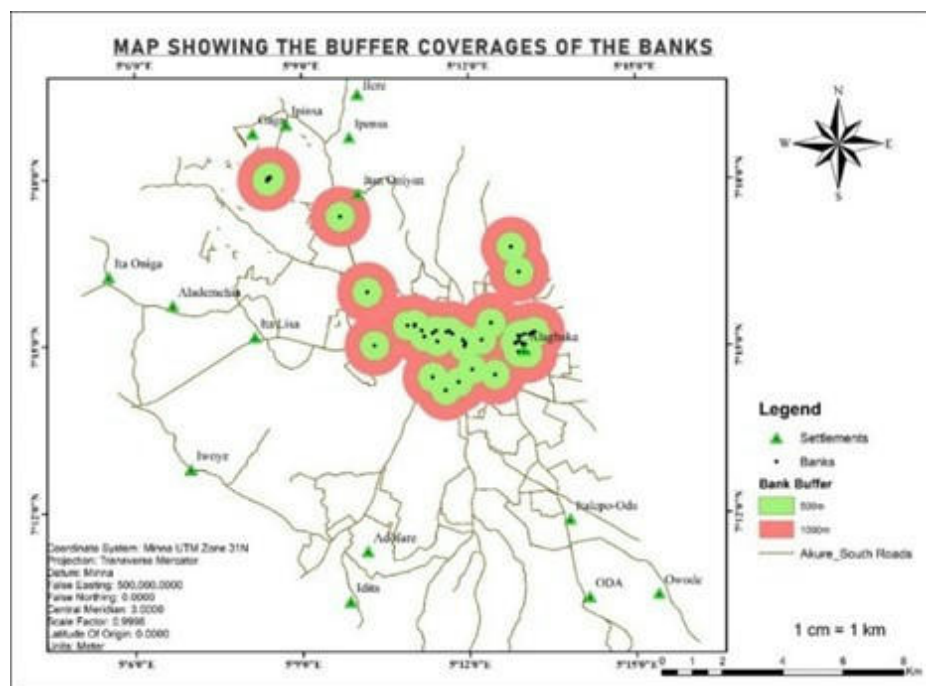


Figure 3. Multiple Ring Buffer coverage of banks

Building Coverage of Banks

Figure 4 illustrates the households encompassed by the 1-kilometer buffer zone of banks in Akure South LGA. Banks are denoted by black dots on the map, while red polygons represent the households included.

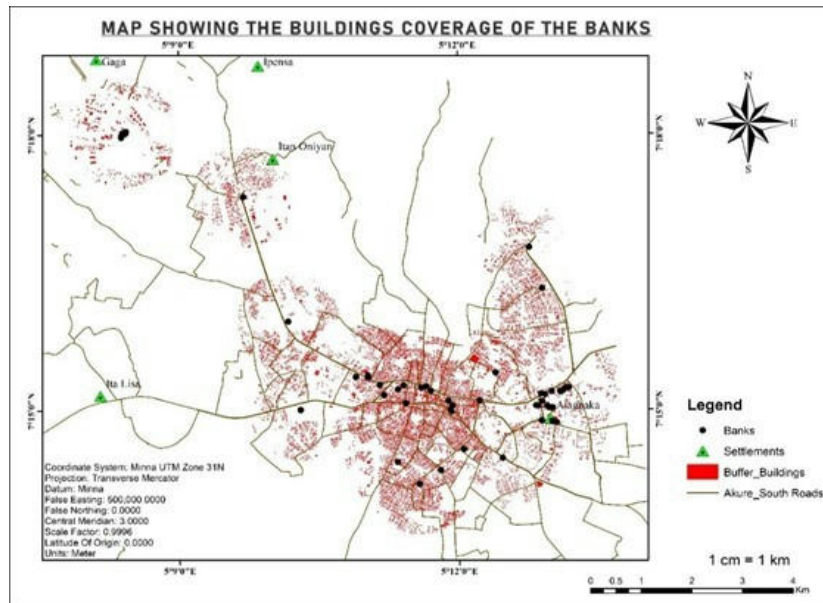


Figure 4. Households covered by the 1KM buffer coverage of banks

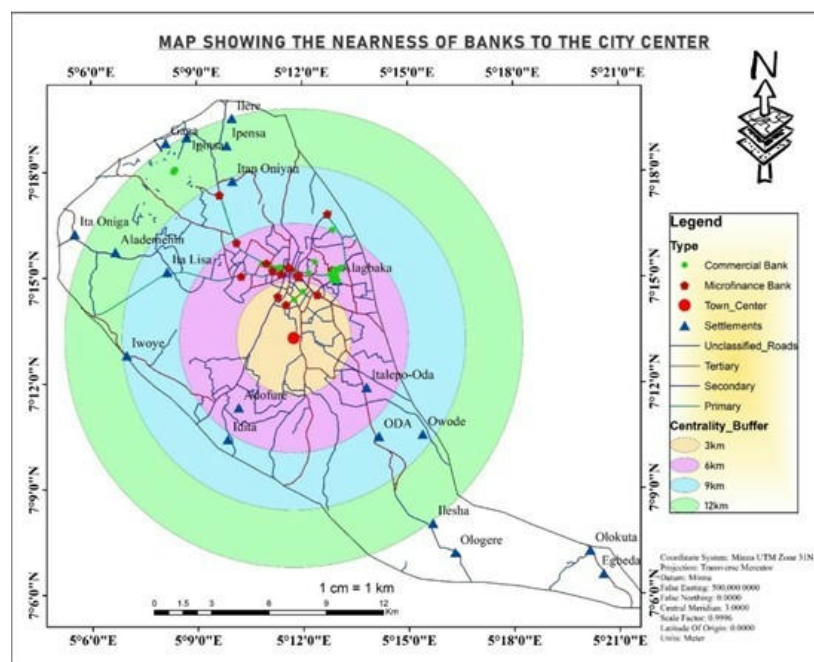


Figure 5. Proximity of Banks to the City Center

Proximity of Banks to the City Center

To evaluate the proximity of banks to the central area of the study, concentric rings were drawn at intervals of a 3-kilometer radius, extending from the city center to an outer ring of 12 kilometers. The banks distribution shapefile overlaid on these concentric rings illustrates the proximity of banks distribution to the central area, as shown in Figure 5. Table 2 presents the number and percentage of banks in relation to centrality.

Table 2. Banks with respect to the centrality

BUFFER	NO. OF BANKS	% OF BANKS
3KM	5	10%
6KM	35	73%
9KM	3	6%
12KM	5	10%
TOTAL	48	100%

Within a 3-kilometer buffer from the city center, there are 5 banks, accounting for 10% of the total banks. In the 6-kilometer buffer zone, there are 35 banks, constituting 73% of the total banks. Banks located 9 kilometers away from the city center amount to 3 banks, representing 6% of the total. Similarly, within a 12-kilometer buffer, there are 5 banks, also making up 10% of the total. Overall, the table shows that a significant majority of banks (73%) are located within a 6-kilometer radius from the city center, with smaller percentages at farther distances.

Bank Accessibility via Road Networks

The accessibility of banks to roads was evaluated by considering the road networks and the placement of banks along various grades of roads. The roads were categorized as primary, tertiary, secondary, and unclassified roads. A composite map was created using road network data, banks distribution, and ward boundary shape files to illustrate the correlation between bank locations and the road network, as depicted in Figure 6. Table 3 shows the types of roads and the number of banks with proximity to roads.

Table 3. Distribution of Banks along Roads

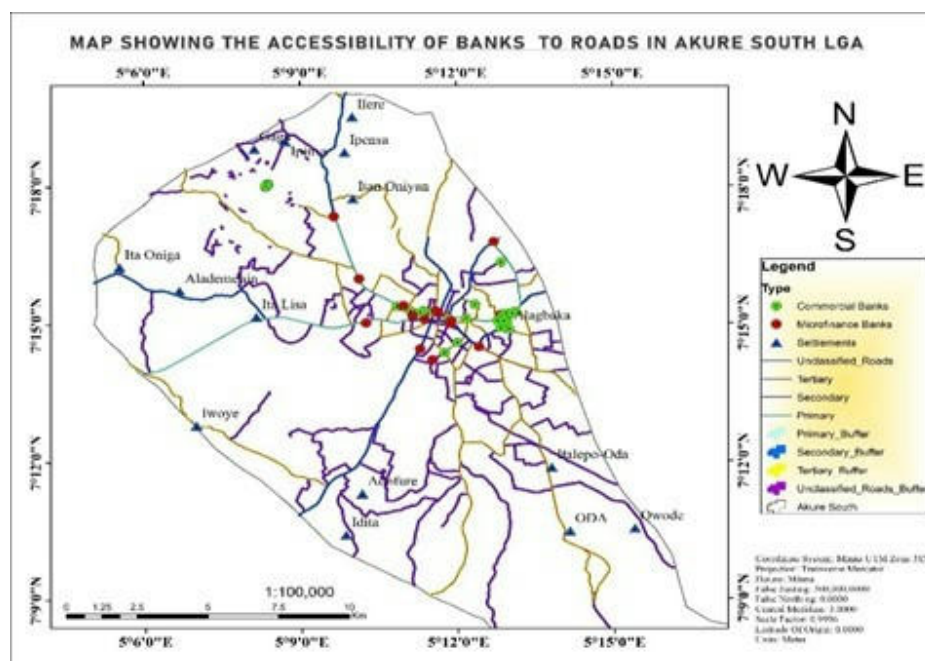
ROADS	No. of Banks	% of Banks
Primary Roads	11	34%
Secondary Roads	6	19%
Tertiary Roads	12	38%
Unclassified Roads	3	9%
TOTAL	32	100%

Analysis of Operational Service Areas of Banks

Settlements types within the study area were categorized into two types (served and underserved) based on their level of service as seen in Figure 7. The Served Settlements are areas where bank facilities are adequately provided, while the underserved settlements lack sufficient services or infrastructure compared to the needs of the residents. The well served areas include Itan Oniyan, Ipinsa, Gaga, Alagbaka, and Ita Lisa. While the underserved areas include Ipinsa, Ilere, Italepo-Oda, Oda, Owode, Ilesha, Ologere, Idita, Adofure, Iwoye, Ita Oniga, Alademehin, Olokuta, and Egbeda. Table 4 provides information about the distribution of settlements based on their level of service provision by banks.

Table 4. The number of served and underserved areas.

Settlements	No. of Settlements	% Settlements
Served Settlements	5	26%
Underserved Settlements	14	74%
Total	19	100%

**Figure 6.** Accessibility of Banks along Road Networks

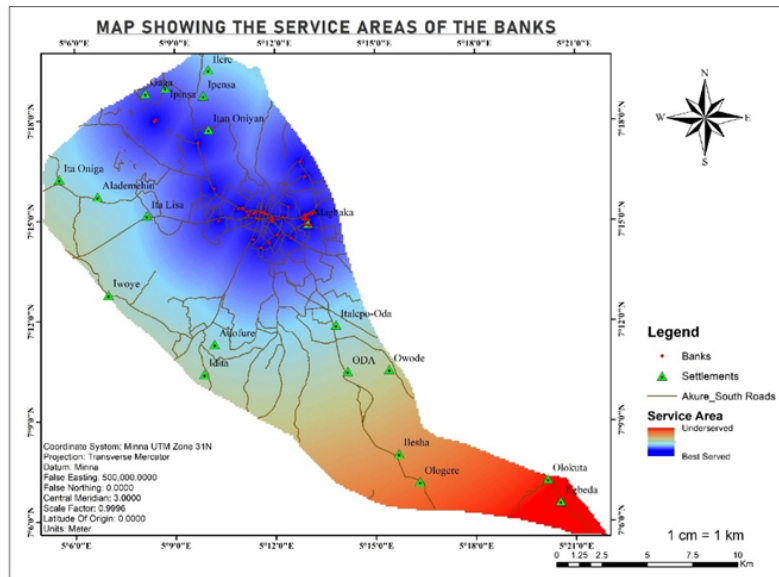


Figure 7. The Representation of the served and underserved areas.

In relation to Table 4, there are 5 settlements classified as Served, which represents about 26% of the total number of settlements considered (19 in total). 14 settlements categorized as Underserved, making up approximately 74% of the total settlements. From this interpretation, it's evident that majority of settlements (74%) are underserved, indicating a potential need for improved services or infrastructure in those areas. This breakdown is essential for identifying areas that may require additional attention or investment to improve service delivery and enhance the quality of life for residents. Spatial Distribution Analysis of Banks in the Standard Cluster Zone of Akure South LGA

In the Standard Cluster Zone, depicted in Figure 8, the spatial distribution of banks around the geometric mean center is illustrated. The circle in Figure 8 signifies that bank branches are concentrated within a confined area relative to the entire area of Akure South Local Government Area.

Spatial Statistics

The analysis conducted using ArcGIS spatial statistics tools, specifically the Average Nearest Neighbor Analysis (ANNA) (as shown in Figure 9), provided insights into the spatial pattern distribution of banks in Akure South. The results indicate that the distribution pattern is not distinct from being clustered.

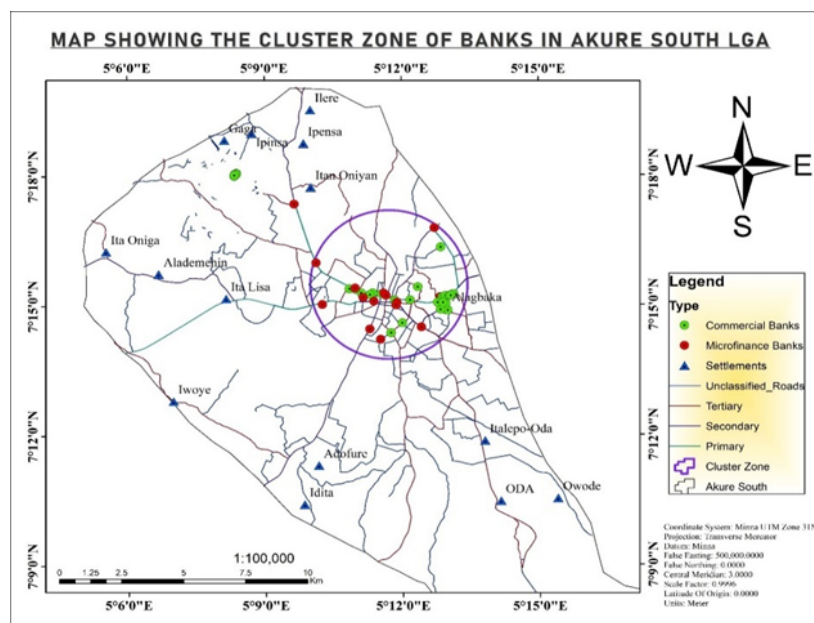


Figure 8. The standard Distance variation of the banks cluster

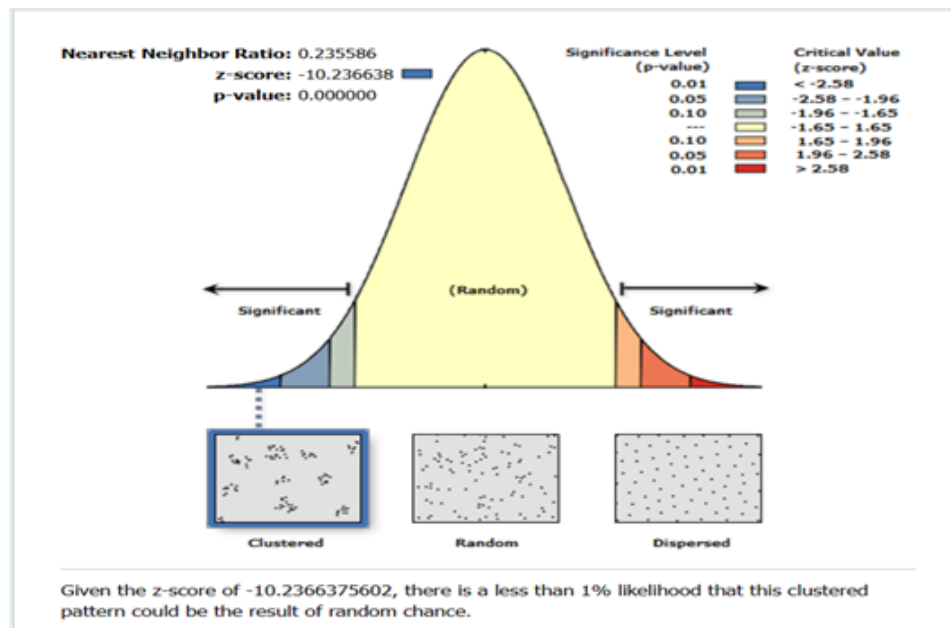


Figure 9. Average Nearest Neighbor Summary of spatial distribution of banks in Akure South

The Z-score of -10.236638 is significantly less than the critical value of -1.96 (which corresponds to a 95% confidence level). This indicates that the distribution pattern is highly unlikely to occur by random chance alone. This indicates a strong clustering pattern among the financial institutions. Furthermore, the Nearest Neighbor Ratio of 0.235586 is less than 1. This less than 1 suggests clustering, where points (in this case, banks) are closer to each other than would be expected in a random distribution. Combining these results, it's clear that banks in Akure South exhibit a clustered distribution pattern.

Discussion and Conclusion

The analysis of the Spatial Distribution of Banks revealed that majority of bank branches, totaling 38, were concentrated around the Oba Ile-Alagbaka axis, which houses the largest market centers in Akure South. Additionally, the Federal University of Technology Akure campus hosted five bank branches. Bank facilities were found to be more concentrated in areas with a high density of business outlets and large corporate organizations. However, there was less concentration of bank branches around market centers with decreasing market size or importance. The presence of multiple bank branches in the Oba Ile-Alagbaka axis likely fosters not only physical access but also supports customer migration to online platforms, as predicted by the learning spillover effect (Zhou *et al.*, 2020). This could explain why digital banking may be thriving in these zones while lagging in underserved southern areas where initial learning opportunities via branches are minimal. The corridor of bank

branch locations spans from Oba Adesida to Arakale Road along the Alagbaka axis and from Ondo Road to Oke-Ijebu Road. Further analysis estimated that these bank branches collectively cover approximately 20,500 households out of nearly 45,000 households in Akure South LGA, representing about 46% of the total household population, according to data from www.openstreetmap.com.

With regards to the nearness of Banks to the City Center, the distribution of bank branches in Akure South LGA follows a pattern where the first concentric zone, within a 3 km radius from the city center, contains only 10% of the total bank branches. In contrast, the second concentric zone contains a significantly higher proportion of 73% of the bank branches, followed by 6% in the third zone and 10% in the fourth zone. This distribution pattern aligns with the concept of spatial normal distribution, as described by Borregaard *et al.* (2009) and Paradi *et al.*'s (2011), where features are densest in the center and gradually become less dense towards the periphery. In this case, the centrality of the city center influences the choice of bank branch locations, with a higher concentration closer to the center and a decrease in density as the distance from the center increases.

The accessibility of banks to roads in Akure South LGA shows that more than 65% of the banks are strategically located along different types of roads, including primary, secondary, tertiary, and unclassified roads. Specifically, 34% of these banks are positioned near primary roads, 19% near secondary roads, and 38% close to tertiary roads. This distribution pattern indicates a preference for placing banks along major roadways, especially those leading to significant destinations

like Ondo, Benin, and Abuja. However, it was observed that areas such as Ipinsa, Ilere, Italepo-Oda, Oda, Owode, Ilesha, Ologere, Idita, Adofure, Iwoye, Ita-Oniga, Alademehin, Ita Lisa, Olokuta, and Egbeda have lower concentrations of bank branches. This is likely due to the major roads traversing these areas leading to other locations within the study area, resulting in fewer banks being established directly in these settlements.

The results of the study highlight the importance of demographic factors in the geographic profiling of potential customers and the expansion of bank branches. The concentration of bank branches is likely influenced by factors such as population size, literacy levels, the proportion of the workforce, and the urbanization of communities. The study reveals a skewed distribution of bank branches across areas, showcasing two distinct extremes. Interestingly, the distribution of the working population does not significantly influence the location of bank branches in Akure South LGA; rather, business patterns appear to dictate placement. For instance, areas like Ipinsa and Ipinsa, despite having sizable populations, exhibit limited bank presence aside from a cluster of banks such as First Bank, UBA, GTBank, and Wema Bank located within the Federal University of Technology, Akure campus. This underscores the need to promote neighborhood banking, particularly in the southern part of the city, where dense populations face limited access to formal banking services.

Similar to patterns observed in marginalized communities in the United States (Larivière and van den Poel, (2007), areas within Akure South such as Ipinsa, Ilere, and Adofure where formal banks are scarce often depend on informal credit systems or digital financial agents. Although these alternatives provide convenience, they frequently involve higher costs and reduced consumer protection, potentially deepening financial vulnerability in these underserved communities.

To support inclusive digital banking adoption in Akure South LGA, initial branch siting in underserved areas should be prioritized not as a permanent dependency, but as a strategic learning phase that empowers customers to later migrate to digital platforms. This approach can ensure long-term cost efficiency for banks while enhancing financial inclusion. Additionally, improving road accessibility in these areas can stimulate business activities beyond the primary concentric zone and attract more banks.

Recommendations

Based on the spatial analysis of the distribution and accessibility of commercial and microfinance banks in

Akure South Local Government Area, several areas including Ipinsa, Ilere, Oda, and Adofure have been identified as underserved. To promote inclusive financial access and support economic development in these areas, the following targeted interventions are recommended:

- i. In areas such as Ipinsa and Ilere, where permanent banking infrastructure is lacking, it is suggested that mobile banking units be introduced. These mobile branches, managed by commercial banks, can deliver vital financial services on designated market days and during busy economic periods. The use of GIS-based route optimization should be implemented to create efficient travel paths for these mobile units. Furthermore, enhancing road conditions, particularly on unpaved or poorly maintained routes, will guarantee all-season accessibility.
- ii. In Oda and Adofure, expanding the agent banking model represents a viable and cost-efficient approach. Agent banking, which utilizes local Point of Service (POS) agents, can provide savings, withdrawals, and micro-loan services to community members without requiring traditional bank branches. A buffer and proximity analysis can help pinpoint ideal agent locations within 300–500 meters of densely populated residential areas. Public-Private Partnerships (PPPs) can facilitate the establishment of secure kiosks equipped with power and connectivity infrastructure.
- iii. Digital educational initiatives are crucial for advancing financial inclusion, especially among women and young people. Workshops focused on digital financial literacy can be organized in all underserved areas to teach residents about utilizing mobile banking applications, USSD codes, and ATM cards. Public venues like schools, churches, and community centers should be identified and used as temporary training sites. A geospatial monitoring system could be established to monitor adoption rates and enhance the targeting of programs.
- iv. To encourage banks to set up permanent branches in areas like Oda and Adofure, it is suggested that they receive infrastructural incentives. These could consist of improvements to access roads, as well as land grants or tax exemptions for financial institutions willing to expand into underserved areas. The enhancement of road networks that connect these underserved communities to current financial centers should be given priority. Investment should be directed to areas with the greatest potential impact, guided by spatial analysis.



v. For effective long-term planning, establishment of a GIS-based financial access dashboard is advisable. This resource will enable policymakers and financial organizations to visualize regions that lack access, evaluate infrastructure needs, and organize equitable service provision. The dashboard should integrate layers such as population density, road networks, existing bank locations, and land use types. Periodic updates using satellite imagery and field data will ensure accuracy and responsiveness to population growth and urban sprawl.

This multi-faceted strategy, which integrates innovative financial services with spatial infrastructure development, will greatly improve financial inclusion in Akure South LGA. Implementing these recommendations through coordinated efforts between government, private sector stakeholders, and community groups can lead to sustainable economic empowerment.



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