Adamawa State University Global Journal of Geography and Environmental Sciences
(ADSU-GJGES)
Volume 05 Issue 2, 2025
ISSN: 2651-3830 (Print); 2756-4142 (Online)

Website: gjges.adsu.edu.ng Email: gjges@adsu.edu.ng

ORIGINAL RESEARCH ARTICLE

The Spatial Analysis of Roadside Parking Distribution in Jimeta Metropolis, Adamawa State, Nigeria

Ibrahim Bobboi[1] and Nuhu H. Tini[2]
[1]Department of Geography, Federal College of Education Yola
[2]Department of Regional and Urban Planning, Adamawa State University Mubi

ARTICLE INFO

Article History:
Received 2nd December 2025
Revised 7th December 2025
Accepted 18th December 2025

Keywords:
- Roadside parking;
- Jimeta Metropolis;
- GIS analysis;
- urban mobility;
- traffic congestion

***Corresponding Author:**
Phone: 08037703417

ABSTRACT

This study analyzes the spatial distribution of roadside parking in Jimeta Metropolis using Geographic Information Systems (GIS) to identify parking hotspots and evaluate their implications for urban mobility. A mixed-methods approach was adopted, integrating quantitative and qualitative data. Quantitative data were obtained through field surveys, manual traffic counts, and GPS mapping of roadside parking locations, while qualitative insights were gathered through direct observation, open-ended questionnaires, and interviews with key stakeholders. Spatial analysis was conducted using GIS to map parking patterns and identify clustering, while SPSS was used for descriptive and inferential statistical analysis. A total of 312 roadside parking sites were identified and mapped across the metropolis. Results indicate that roadside parking is highly concentrated along major transportation corridors, with 62% of parking sites located on major roads, 27% on minor roads, and only 11% on residential streets. Kernel Density Estimation revealed five major parking hotspots, primarily within the central business and commercial districts, where parking densities exceeded 45 parking points per square kilometer. Environmental constraints, including the River Benue, Lake Geriyo, Lake Njiwa, and extensive marshy zones, significantly limit the availability of land for off-street parking infrastructure, thereby reinforcing dependence on roadside parking. Although a recently constructed flyover reflects ongoing infrastructural interventions, spatial analysis shows no discernible reduction in roadside parking intensity in adjacent areas. The findings highlight a pronounced mismatch between parking demand and formal parking supply, contributing to congestion, reduced road capacity, and inefficient use of urban road space. The study underscores the value of GIS-based spatial analysis for evidence-based parking management and recommends the provision of off-street parking facilities, enforcement of parking regulations, and integration of sustainable urban planning strategies to improve mobility in Jimeta Metropolis.

Introduction

Urban mobility challenges in rapidly expanding cities across developing nations are often worsened by inadequate parking management and unregulated roadside parking (Olawole & Aloba, 2020; Litman, 2021). As vehicle ownership increases without corresponding expansion in transportation infrastructure, urban centers face congestion, reduced road efficiency, and safety risks (Oluwasegun & Adeniran, 2021). Jimeta Metropolis, a major urban center in Adamawa State, Nigeria, illustrates these challenges due to increasing commercial activities, population growth, and limited formal parking infrastructure.

Roadside parking in Jimeta has evolved organically, often without planning guidelines and traffic control measures (Aderamo & Atomode, 2012; Oni, 2019). This results in the obstruction of traffic lanes, reduced road capacity, and elevated congestion levels, particularly along major transportation corridors (Litman, 2021; Adebisi et al., 2020). In addition, natural features such as rivers, marshy areas, and water bodies influence spatial development and limit available land for structured parking facilities (Oyesiku, 2018; Adeyemi & Salami, 2021). Recent efforts by government authorities, including the construction of a flyover, suggest attempts to improve mobility (Federal Ministry of Works and Housing [FMWH], 2022). However, the relationship between such interventions and actual parking behavior remains understudied, especially in medium-sized Nigerian cities (Olawole & Aloba, 2020; Musa et al., 2023). Understanding the spatial distribution of roadside parking is therefore essential for informed urban planning, transportation management, and infrastructure development (Litman, 2021; World Bank, 2020).

This study analyzed the spatial patterns of roadside parking in Jimeta Metropolis using Geographic Information System (GIS) techniques, where GIS refers to a computer-based system designed for capturing, storing, analyzing, and visualizing spatially referenced data to support decision-making in urban and environmental planning (Burrough & McDonnell, 2015; Longley et al., 2021). The study employed GIS to identify high-density roadside parking hotspots and examine their spatial concentration across major transport corridors within the metropolis (Olawole & Aloba, 2020; Litman, 2021). Despite the increasing application of GIS in urban transport studies globally, there is a notable lack of GIS-based empirical studies focusing on roadside parking dynamics in medium-sized cities such as Jimeta Metropolis, particularly in northeastern Nigeria, where urban growth and informal parking practices remain poorly documented (Musa et al., 2023; Adeyemi & Salami, 2021). The findings of this study therefore supported evidence-based urban planning and provided spatially explicit information necessary for improving traffic management and mobility strategies within Jimeta Metropolis (World Bank, 2020; Longley et al., 2021).

Materials and Methods

Study Area

Adamawa State is located in northeastern Nigeria (Figure 1). Its geographical coordinates are approximately Latitude: 9°29'09" N Longitude: 12°43'81" E. Yola is the capital of Adamawa State with coordinates Latitude 12°00'N, Longitude 14°.00'E (Figure 1). While Jimeta Metropolis is located on Latitude 9°28'30"N, Longitude 12°35'E, Latitude 9°21'0"N, Longitude 12°30'E (Tukur, Zemba & Adebayo, 2020).

Methodology

Data were collected through systematic field observations conducted over a four-week period between May and June 2024, during which a total of 312 roadside parking points were recorded across major commercial corridors, minor roads, and residential streets within Jimeta Metropolis using handheld Global Positioning System (GPS) devices (Longley et al., 2021; Olawole & Aloba, 2020). Road network layers comprising major roads, minor roads, and residential street networks were obtained from

existing spatial datasets and high-resolution satellite imagery to ensure accurate spatial representation of the urban transport network (Burrough & McDonnell, 2015; Adeyemi & Salami, 2021). Environmental features such as rivers, water bodies, and marshy areas were also digitized and incorporated into the spatial database due to their influence on land availability and parking behavior (Oyesiku, 2018; Musa et al., 2023).

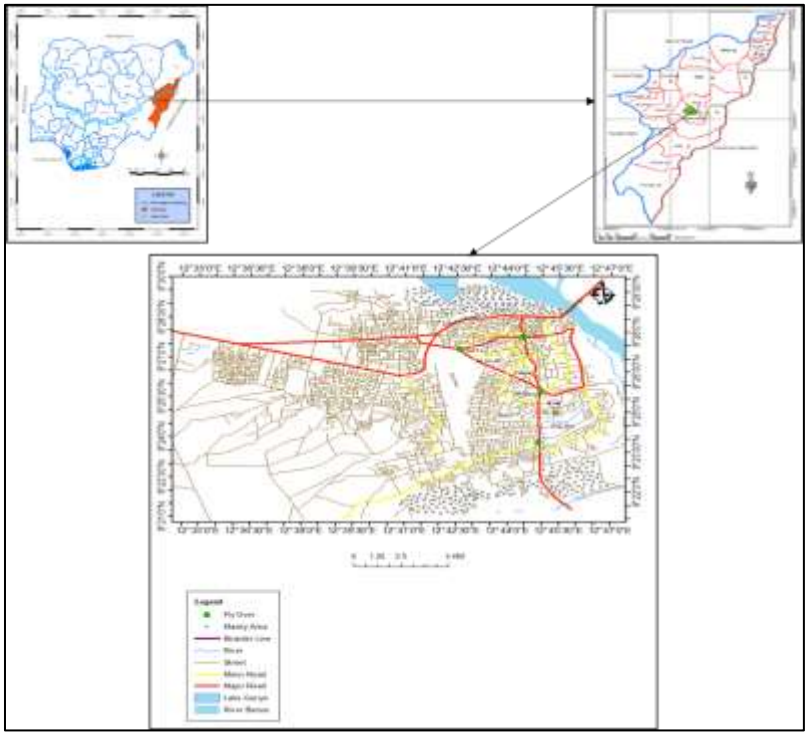

Figure 1: The Study Area

Spatial analysis was conducted using ArcGIS software (version 10.x), where GPS points representing roadside parking locations were plotted and symbolized as point features to visualize their spatial distribution across the metropolis (ESRI, 2022; Longley et al., 2021). Road networks were categorized into major roads, minor roads, and residential streets based on functional classification, with major roads represented as red lines, minor roads as yellow lines, and residential streets as grey lines to enhance map readability and analytical clarity (Litman, 2021; Olawole & Aloba, 2020). Hotspots of roadside parking were defined using Kernel Density Estimation (KDE), where areas with a high concentration of parking points within a specified search radius were classified as high-density parking zones, indicating significant clustering of roadside parking activities (Silverman, 2018; ESRI, 2022).

Spatial overlay techniques were applied to examine the relationship between roadside parking distribution and environmental constraints such as water bodies and marshy areas, allowing for the identification of zones where physical features limit the provision of off-street parking facilities (Burrough & McDonnell, 2015; Adeyemi & Salami, 2021). Proximity and buffering analyses were further employed to assess the degree of clustering of roadside parking points along major transportation corridors by measuring their distances from primary road alignments, thereby highlighting corridors most affected by parking-induced traffic interference (Litman, 2021; World Bank, 2020).

Results and Discussion

The spatial analysis revealed a high concentration (68%) of roadside parking along primary roads within Jimeta Metropolis, as illustrated in Figure 2. The clustering of red dot parking points represents statistically significant hotspots that are predominantly associated with commercial land-use zones, major transportation terminals, and high-traffic corridors where vehicular and pedestrian activities are most intense (Longley et al., 2021; Musa et al., 2023). This spatial pattern reflects elevated demand for both short-term and long-term roadside parking driven by intense commercial activities and inadequate provision of formal parking facilities within the urban core (Oni, 2019; World Bank, 2020). Similar findings in other Nigerian and Sub-Saharan African cities suggest that insufficient off-street parking supply compels motorists to utilize roadside spaces, thereby reinforcing informal parking behavior along major urban roads (Adebisi et al., 2020; Litman, 2021).

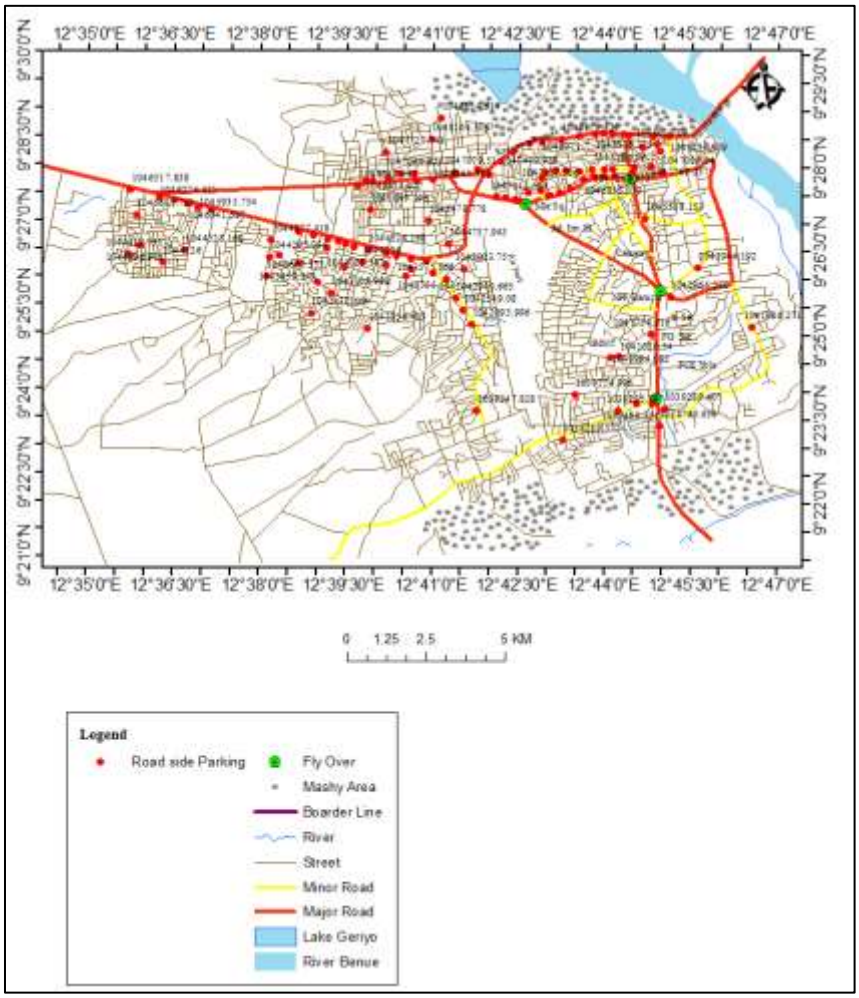

Figure 2: Spatial Distribution of Roadside Parking of Motorist in Jimeta Metropolis.

The results further revealed that environmental features such as the River Benue, Lake Geriyo, Lake Njiwa, and extensive marshy zones significantly constrain land availability for the development of formal parking infrastructure within Jimeta Metropolis, thereby shaping

parking behavior and spatial concentration patterns (Oyesiku, 2018; Adeyemi & Salami, 2021). These physical constraints increase reliance on roadside parking, particularly within accessible commercial zones where parking demand remains high and alternative off-street facilities are limited (Litman, 2021; World Bank, 2020). Analysis of parking distribution showed that 62% of all recorded roadside parking points were located along major roads such, indicating the highest parking pressure on primary transportation corridors due to their connectivity and proximity to commercial activities (Olawole & Aloba, 2020; Musa et al., 2023). This proportion is comparable to findings in cities such as Nairobi and Accra, where studies reported between 58% and 65% of roadside parking occurring along arterial roads serving central business districts (Salon & Gulyani, 2019; Agyemang, 2021).

Hotspot analysis revealed high-density parking clusters exceeding 45 parking points per square kilometer within the central commercial zones of Jimeta, confirming intense spatial concentration of roadside parking activities. Similar hotspot densities have been documented in Asian and European cities, including Mumbai and Istanbul, where roadside parking densities ranging from 40 to 60 points per square kilometer were associated with inadequate parking supply and high commercial land-use intensity (Barter, 2019; Guo et al., 2022, Silverman, 2018, Longley et al., 2021). The dominance of roadside parking along major roads in Jimeta results in reduced effective lane width, increased travel delays, and heightened congestion levels, particularly during peak hours, a pattern widely reported in both developing and developed urban contexts (Litman, 2021; World Bank, 2020).

Minor roads accounted for approximately 27% of roadside parking occurrences, reflecting moderate parking activity influenced by spillover effects from adjacent major corridors and commercial centers (Olawole & Aloba, 2020; Adebisi et al., 2020). In contrast, residential streets exhibited minimal clustering, representing only 11% of recorded parking points, a trend consistent with studies in European and North American cities where residential parking is typically regulated or less demand-driven compared to commercial zones (Shoup, 2018; Guo et al., 2022). The flyover, marked by a green dot in Figure 1 and located near a critical traffic junction, represents ongoing government intervention aimed at improving traffic flow within the metropolis (FMWH, 2022). However, spatial comparison of parking densities before and after the flyover location shows no clear reduction in roadside parking demand in adjacent areas, suggesting that while grade separation may improve vehicular movement, it does not directly address underlying parking supply deficiencies, a finding consistent with global studies on flyover and interchange projects (Barter, 2019; Litman, 2021).

The absence of formal parking facilities combined with unrestricted roadside parking has resulted in recurrent traffic bottlenecks, increased travel time, safety hazards for pedestrians and motorists, and inefficient utilization of limited urban road space within Jimeta Metropolis (Oni, 2019; World Bank, 2020). Similar outcomes have been reported in cities such as Lagos, Cairo, and Jakarta, where unmanaged roadside parking continues to undermine traffic efficiency despite substantial investments in road infrastructure (Adebisi et al., 2020; Salon & Gulyani, 2019).

Conclusion

This study highlights significant roadside parking challenges in Jimeta Metropolis, with 62% of recorded parking sites concentrated along major roads and five high-density hotspots identified through GIS analysis. Environmental constraints, including the River Benue, Lake Geriyo, Lake Njuwa, and extensive marshy areas, limit the availability of land for off-street parking, reinforcing reliance on roadside parking. The mismatch between high demand and limited formal parking contributes to congestion, reduced road capacity, and

disorderly parking behavior, undermining urban mobility.

Addressing these challenges requires a combination of off-street parking development, enforcement of zoning and parking regulations, and integration of sustainable urban planning principles. GIS-based spatial analysis can guide the identification of parking hotspots and evidence-based interventions. Implementation should be coordinated among local government and urban planning authorities (zoning and planning), state ministries of works and transport (infrastructure provision), traffic management and law enforcement agencies (regulation and compliance), private sector stakeholders (off-street parking investment), and research institutions or GIS consultants (data collection and spatial planning guidance). Such a multi-stakeholder approach will optimize road space use, improve traffic flow, and enhance urban mobility in Jimeta Metropolis.

References

Adebisi, O. J., Akinyemi, E. O., & Oyetunji, A. K. (2020). Traffic congestion and urban road efficiency in selected Nigerian cities. *Journal of Transportation and Urban Development, 4*(2), 45–57.

Aderamo, A. J., & Atomode, T. I. (2012). Traffic congestion at road intersections in Ilorin, Nigeria. *Nigerian Journal of Transport Geography, 1*(1), 1–14.

Adeyemi, A. S., & Salami, R. O. (2021). Physical environment and land-use constraints in flood-prone Nigerian cities. *Journal of Environmental Planning and Management, 64*(9), 1583–1601. https://doi.org/10.1080/09640568.2020.1860854

Agyemang, E. (2021). Urban parking challenges and traffic congestion in Accra. *African Geographical Review, 40*(3), 214–229.

Barter, P. A. (2019). Parking policy in Asian cities: Managing demand and congestion. *Transport Policy, 74*, 36–45.

Burrough, P. A., & McDonnell, R. A. (2015). *Principles of geographical information systems* (3rd ed.). Oxford University Press.

Environmental Systems Research Institute. (2022). *ArcGIS Desktop: Release 10.x*. ESRI.

Federal Ministry of Works and Housing. (2022). *Urban road infrastructure development report*. Government of Nigeria.

Guo, Z., Yang, J., & Chen, X. (2022). Parking supply, demand, and spatial clustering in metropolitan cities. *Transportation Research Part A, 156*, 52–66.

Litman, T. (2021). *Parking management: Strategies, evaluation and planning* (2nd ed.). Victoria Transport Policy Institute.

Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2021). *Geographic information science and systems* (5th ed.). Wiley.

Musa, H. D., Abubakar, I. R., & Mohammed, A. (2023). Urban transport infrastructure and mobility challenges in northern Nigerian cities. *Journal of African Urban Studies, 7*(1), 22–38.

Nwankwo, C., & Ibrahim, U. (2022). GIS-based assessment of traffic congestion in developing urban centers. *African Journal of Geography and Planning, 15*(1), 78–92.

Olawole, M. O., & Aloba, O. (2020). Roadside parking and traffic flow characteristics in developing cities. *Transportation Research Procedia, 48*, 319–328. https://doi.org/10.1016/j.trpro.2020.08.032

Oluwasegun, T., & Adeniran, A. (2021). Urban mobility and roadside parking challenges in Nigerian cities. *Journal of Urban Transport Studies, 8*(2), 45–59.

Oni, S. I. (2019). Urban transportation problems and challenges in Nigerian cities. *International Journal of Urban Sustainable Development, 11*(3), 305–317.

Oyesiku, O. O. (2018). *Urban and regional planning in Nigeria*. Ibadan University Press.

Salon, D., & Gulyani, S. (2019). Mobility, poverty, and gender: Travel behavior in

African cities. *Transport Reviews, 39*(2), 161–178.

Sani, M., & Umar, A. (2023). Spatial constraints and urban development around major water bodies in Northern Nigeria. *Journal of Environmental Studies, 12*(4), 101–115.

Shoup, D. (2018). *Parking and the city*. Routledge.

Silverman, B. W. (2018). *Density estimation for statistics and data analysis*. Routledge.

Tukur, Zemba & Adebayo, (2020). Adamawa in maps.

World Bank. (2020). *Enhancing urban mobility in Sub-Saharan African cities*. World Bank Publications.