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GIS-Based Accessibility and Service Area Analysis for Integrated Land-Use and Transport Planning: Evidence from Ilorin Metropolis, Nigeria

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Abstract— *Service Area accessibility is a vital component of a successful transportation system. This study addresses this challenge by conducting a GIS-based accessibility and service area analysis to support integrated land-use and transport planning in Ilorin Metropolis, Nigeria. The aim was to diagnostically measure the effectiveness of the urban structure in providing access to opportunities and essential services and to identify spatial mismatches that affect mobility, service delivery, and urban sustainability. Utilizing Geographic Information System (GIS)-based techniques for network analysis, service area mapping, origin-destination matrices, and multi-ring buffer analyses on data from satellite imagery, road networks, and field surveys, the research quantified accessibility disparities. Key findings reveal a monocentric urban structure skewed towards residential use (37.6% of total land area), forcing intense radial commutes. This is evidenced by an origin-destination matrix showing over 4,026 vehicle trips per hour converging at the Murtala/Amilegbe junction being a congestion hotspot, with 922 daily trips recorded between Murtala/Amilegbe and Sawmill intersections, indicating intense pressure along central corridors. Service area analyses exposed critical deficits: peripheral zones like Asa Dam and Alapa lay outside the 15-minute travel threshold for commercial and health facilities, and despite a theoretical 5,000m buffer, public transport coverage in these areas remains ineffective due to fragmented connectivity. The study concludes that Ilorin's urban expansion has occurred without corresponding transport integration, perpetuating spatial inequalities. The study recommends a strategic shift to polycentric development by creating sub-centers in Adewole, Tanke, and Eiyenkorin, alongside investment in the implementation of high-capacity transit corridors, and the institutionalization of GIS-based planning tools to achieve equitable and sustainable urban mobility.*

Keywords— *Accessibility, GIS, Service Area, Transport Planning.*

I. Introduction

The relationship between land-use and transportation has long been recognized as central to sustainable urban development. Transportation provides the essential link between spatially separated activities, while land-use generates mobility demand through the distribution of residences, workplaces, industries, and commercial hubs (Wegener & Fürst, 2004). In cities across the Global South, rapid urbanization continues to strain infrastructure, amplifying the disconnect between land-use planning and transportation systems. Nigerian cities, including Ilorin, the capital of Kwara State illustrate this challenge through uncontrolled expansion, inefficient land allocation, and severe traffic congestion (Aderamo, 2010; Olawepo et al., 2020). These conditions foster unsustainable mobility patterns, manifested in overdependence on private vehicles, elongated commutes, and diminished accessibility to essential services, with adverse impacts on productivity and quality of life (Ahmed, 2018; UN-Habitat, 2023).

Urban planning literature affirms the interdependence between land-use and transportation: while land-use patterns dictate trip generation and distribution, transport networks shape urban form and accessibility (Cervero & Kockelman, 2019; Litman & Steele, 2020). Integrated land-use and transport planning is thus indispensable for achieving sustainable urban mobility. Central to this integration is the concept of accessibility, defined as the ease with which people can reach opportunities such as education, health, employment, and recreation (Hansen, 1959). Recent advances in Geographic Information Systems (GIS) provide powerful tools for diagnosing accessibility, enabling spatially precise analyses such as service area modeling, origin–destination (O–D) matrices, and network-based assessments (Rodrigue, 2019; Guzman & Oviedo, 2018). These techniques not only measure the efficiency of transport systems but also reveal underserved areas and support data-driven planning (Curtis & Scheurer, 2010).

Despite their potential, GIS-based approaches remain underutilized in Nigerian cities, where mismatches between land development and mobility persist. Ilorin metropolis offers a compelling case, characterized by rapid suburban expansion, clustered industrial zones at the periphery, and increasing pressure on road infrastructure. Although concepts like Transit-Oriented Development (TOD) are widely discussed, empirical applications that integrate spatial data and transport systems are limited (Adedeji & Afolayan, 2021; Ibrahim & Lawal, 2021). This limits the ability of planners to identify accessibility disparities and implement targeted interventions.

Against this backdrop, this study employs GIS-based techniques to provide empirical insights into accessibility in Ilorin metropolis. Specifically, the objectives are: (i) to map the spatial pattern of land-use areas; (ii) to analyze accessibility patterns using GIS-based service area analysis; and (iii) to establish the origin–destination matrix for travel time and distance across the metropolis. The findings will highlight accessibility disparities, guide the prioritization of interventions, and inform integrated land-use and transport planning strategies for sustainable urban mobility in mid-sized African cities.

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II. Literature Review

The concept of accessibility has evolved from a theoretical ideal to a central, measurable metric in evaluating the efficiency and equity of urban systems. Accessibility is defined as the ease with which people can reach desired goods, services, activities, and destinations, and it is fundamentally shaped by the intricate interplay between land-use patterns and transportation networks (Handy & Niemeier, 1997). The shift from mobility-based planning, which focuses on increasing vehicle speeds and road capacity to accessibility-based planning signifies a paradigm change. This new approach prioritizes the proximity of opportunities over the sheer ability to move, making it a critical tool for achieving sustainable urban development (Litman, 2020).

The application of accessibility measures has been revolutionized by Geographic Information Systems (GIS). GIS enables planners to move beyond abstract notions and quantitatively analyze spatial relationships. Techniques such as service area analysis and network-based cost matrices allow for the calculation of travel times from origin points (e.g., residential centroids) to destinations (e.g., jobs, healthcare, markets) across an actual road network, not just straight-line distances (Rodrigue, 2019). This methodological advancement is crucial for diagnostic planning. Studies by Guzman and Oviedo (2018) in Bogotá utilized such gravity-based and cumulative opportunity models to evaluate the impact of Bus Rapid Transit (BRT) systems on pro-poor accessibility, demonstrating that while subsidies improved affordability, spatial inequities in access persisted due to land-use patterns.

Empirical evidence consistently shows that integrated land-use and transport planning (LUTP) that prioritizes accessibility yields significant benefits. A seminal meta-analysis by Ewing and Cervero (2010) of over 50 studies found that land-use variables like Density, Diversity, and Design (the "3Ds") have a measurable, though sometimes modest, impact on reducing Vehicle Miles Traveled (VMT). However, they conclude that the combination of these land-use factors with transportation options is key. This is supported by the work of Cervero and Kockelman (2019), who argued that the "3Ds" are fundamental determinants of travel patterns, encouraging sustainable mobility by bringing destinations closer together.

The service area, a core GIS tool, operationalizes these concepts. It defines the geographic region that can be reached from a point within a specific travel time or cost threshold. Delamater et al. (2012) used buffer distances of 250m and 500m to assess walkability to schools, while Langford et al. (2008) employed 1000m and 5000m buffers to analyze access to public transport. These studies highlight that the choice of threshold is context-dependent and must reflect the mode of transport and the type of service being accessed. The critical finding from this body of work is the stark contrast between proximity (straight-line distance) and accessibility (network-based travel time). As your own analysis of Ilorin likely reveals, a school may be 2km away in a straight line, but congested, poorly connected roads can make the actual travel time prohibitively long, a disparity that simple land-use maps fail to capture.

In the context of rapidly urbanizing African cities, the application of these tools is particularly urgent but also challenging. Studies on Nigerian cities, such as Foda & Osman's (2010) research on transit stop accessibility, calculated accessibility using GIS to calculate the actual stop coverage, and this helped determine how accessible bus stops are and how each bus stop can be compared to know the most and least accessible ones. Usman et al. (2020) in Kano and Agunbiade et al. (2018) in Lagos, have used spatial autocorrelation and remote sensing to demonstrate that rapid, unplanned urban expansion has drastically outpaced transport infrastructure, leading to severe accessibility deficits. The research concludes that improved accessibility and the integration of land-use and transportation planning are crucial for promoting sustainable mobility. However, a common limitation identified, which this research directly addresses, is the lack of detailed network-based accessibility modeling to calculate service area coverage.

This study employs network-based service area analysis, therefore, empirically sets this study apart. By calculating service areas for healthcare, education, and commerce, one can empirically identify not just that problems exist, but precisely where "accessibility deserts" are located and how many people are affected. This provides the missing quantitative evidence needed to move from general policy recommendations like "decentralize services" to targeted, evidence-based interventions.

III. Study Area

Ilorin metropolis is the capital city, administrative and economic hub of Kwara State in Nigeria which covers about 100 km^2. The metropolis comprises Ilorin West, Ilorin East and Ilorin South Local Government areas with about 35 political wards collectively (Kwara State Diary, 2022), as seen in Figure 1. It is located between Latitude 80 30' and 80 50' N of the equator and Longitude 40 20' and 40 35' E of the Greenwich meridian. The city stands as the strategic gateway city between the densely populated south-western and the middle belt part of northern Nigeria (Adediji *et al*., 2019). The city is a rapidly urbanizing medium-sized metropolis characterized by mixed land-use patterns, a road-dominated transport system.

Ilorin is a nodal town with roads, railway and an airport that connects it to other parts of the country. Ilorin metropolis has a heterogeneous population, diverse socio-economic activities, and high travel demand concentrated around residential, commercial, industrial, and institutional zones. The road transport system has many routes with express roads (Ilorin to Ogbomoso and Ilorin to Kabba, among others) linking the city with other States. Within the metropolis, the major roads within the Ilorin metropolis include; Eiyenkorin road, Murtala Mohammed way, Taiwo road, Unity Road, Ahmadu Bello way, Tanke-University roads and Offa-Garage Road to which all other roads connect. Figure 2 shows the road network within the Ilorin metropolis (Kwara State Geographic Information Service, 2023).

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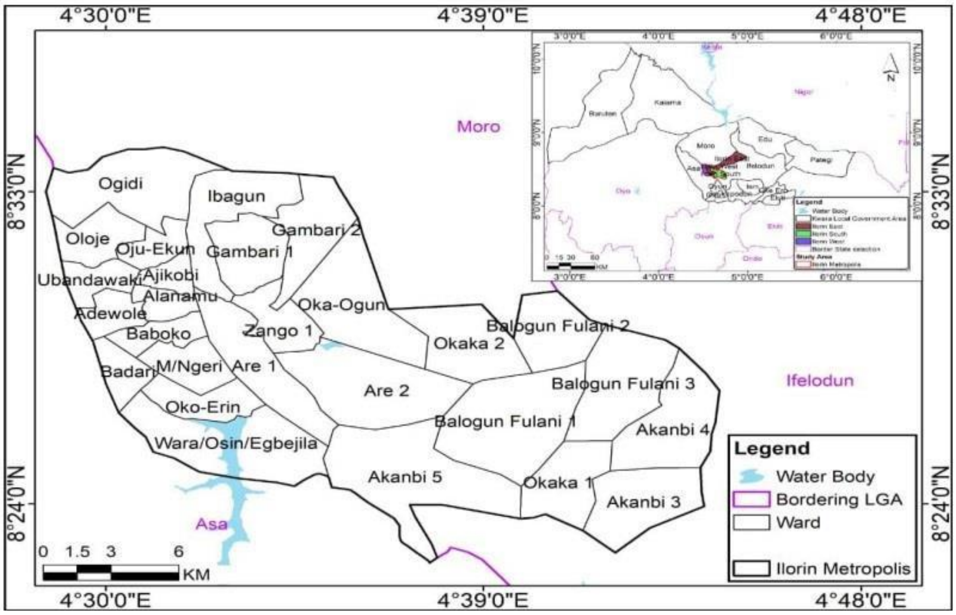

Fig. 1. Administrative Map of Ilorin Metropolis

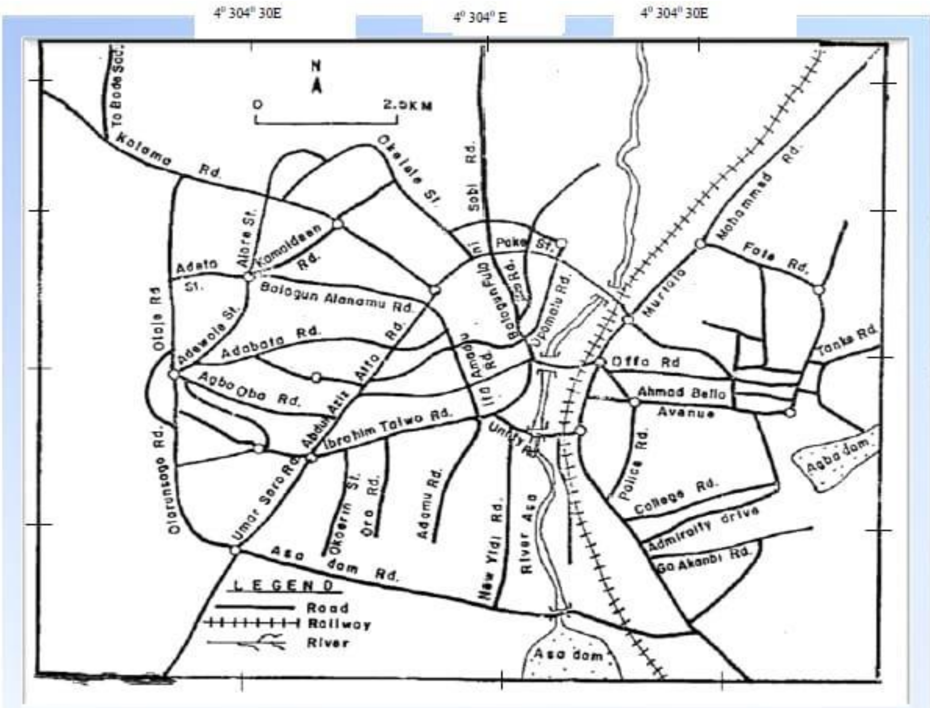

Fig. 2. Major Road Networks in Ilorin metropolis

IV. Materials And Methods

A mixed-method design was employed, integrating spatial analysis and traffic survey. The design enabled both quantitative and qualitative assessment of the relationship between land-use patterns, accessibility, and mobility. A multi-sourced data collection strategy was employed to ensure a comprehensive analysis. Data was categorized into spatial and attribute data. The spatial Data included High-Resolution Satellite Imagery: Downloaded from Google Earth Pro for recent land-use identification and digitization, detailed Land-Use/Land-Cover (LULC) Map acquired from the Kwara State Geographic Information Service (KWAGIS). A comprehensive and topologically correct road network data, including road hierarchy (Dual Carriageway, Single Carriageway, Local Streets) was obtained from the Kwara State Ministry of Works and Transport. The precise geographic coordinates (using WGS 1984 UTM Zone 31N) of key facilities (administrative offices, commercial centers, hospitals, schools, etc.) were collected using a handheld Garmin GPSmap 65s device during field surveys. Attribute Data used includes trip patterns, mode choice, travel time, trip purpose, and socio-economic

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characteristics of commuters, collected through a structured questionnaire administered to 400 residents. Data was analyzed using both spatial and statistical techniques. All GIS analyses (service areas, buffers, Origin-D matrix) were performed in ArcGIS 10.8. A network-based approach was applied to evaluate accessibility to key urban facilities (central markets, schools, administrative offices, health centers, and other commercial hubs) and to determine the precise geographic extent that could be reached within 5, 10, and 15-minute drive times. This identified zones of adequate and poor access. The origin-destination (OD) cost matrix tool in ArcGIS Network Analyst was used to compute travel time and distance across selected nodes i.e. major residential zones (Origins) and key activity centers (Destinations). Buffer and service area tools in ArcGIS were used to create multiple ring buffers (e.g., 500m, 1000m, 5000m) around facilities to delineate catchment areas of public transport nodes within 10-, and 15-minutes' travel thresholds, highlighting underserved zones. The results were synthesized to create maps visualizing accessibility patterns and identifying priority intervention zones.

V. Result and Discussion

A. Proportions and spatial pattern of Land-use Areas

The land-use distribution of Ilorin metropolis reveals that residential development dominates the urban landscape, covering 15,552.5 hectares (37.6%), reflecting the city's rapid demographic expansion and rising housing demand. This is followed by circulation networks (8,855.2 ha; 21.4%), which highlight the importance of road infrastructure in linking different functional zones. Institutional uses (8.4%) and commercial activities (7.8%) occupy significant portions of the urban fabric, largely concentrated along major corridors such as Muritala/Amilegbe, Challenge, and Offa Garage, serving as focal points of mobility and economic exchange.

By contrast, industrial land (5.5%) remains underdeveloped and spatially dispersed, limiting the city's capacity to balance residential and commercial pressures with productive economic zones. Similarly, recreational (3.7%), agricultural/vegetation (6.7%), open spaces (5.3%), and water bodies (3.6%) account for a relatively small share, indicating the encroachment of built-up areas on natural and leisure spaces. The dominance of residential areas underscores the city's demographic growth and demand for housing, while the concentration of commercial activities along arterial routes highlights the economic pull of trading and markets as key urban drivers. Spatially, this distribution reveals a critical disconnect from formal zoning principles as it underscores a planning challenge: Ilorin's urban growth is heavily skewed toward residential and transport functions, while non-residential and ecological land-uses are marginalized. The imbalance suggests weak zoning enforcement and uncoordinated expansion, calling for integrated land-use and transport planning to steer the city's expansion toward greater efficiency and sustainability. The spatial spread of the land-uses was mapped out and depicted in Figure 3.

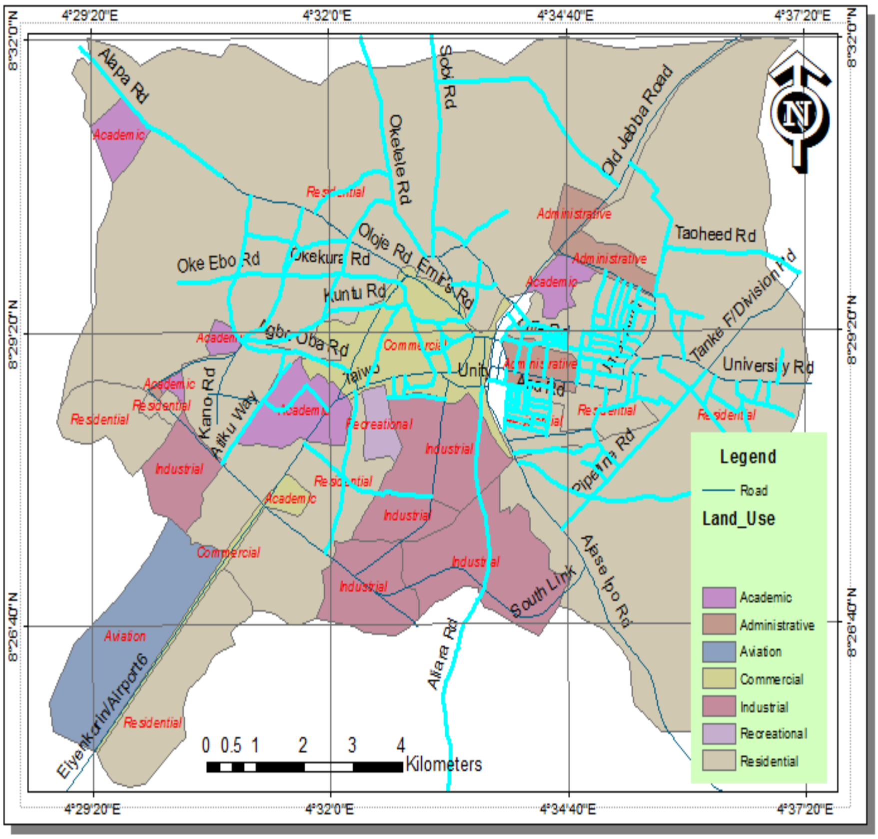

Fig. 3. Spatial Spread of Land-uses and Road Network (Circulation) in Ilorin Metropolis

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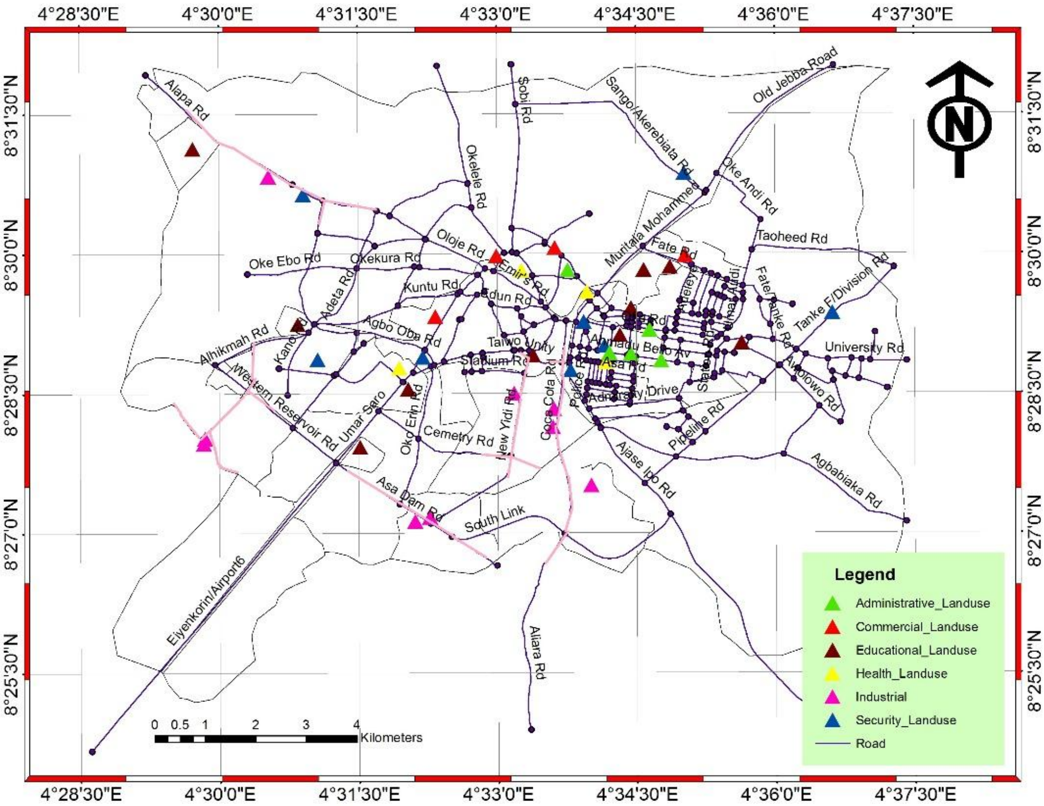

Fig. 4. Map of Land-use Facilities in Ilorin Metropolis

B. Pattern of Clustering of Key Land-use Facilities for Trip Generation

The spatial map on Figure 4 reveals a Ilorin metropolis exhibits a mono-nuclear urban structure, characterized by a pronounced clustering of major employment centers; commercial, security and administrative facilities along the city's primary road corridors most notably within the central and northern parts of the city, such as Taiwo Road, Muritala Mohammed Way, Ahmadu Bello way, and Unity Road exhibit the highest concentration of commercial and administrative land uses while health facilities are not clustered such as UITH being the major health facilities situated along Zaongo- Oke-oyi Road. These corridors serve as the economic backbone of Ilorin, accommodating markets, banks, government offices, and retail centers. Similarly, Ipata Market and the adjoining Oja-Oba area emerge as dominant commercial hubs, attracting large volumes of daily trips for trading and service-related activities. In terms of institutions, clusters of educational facilities are observed along University Road, Tanke, Kwara State Polytechnic (Sango) and Gaa Akanbi axis, reinforcing the role of institutional corridors as major trip generators, particularly for students and staff commuting on a daily basis.

Healthcare facilities are strategically dispersed but tend to follow arterial routes such as Fate Road and Sawmill–Geri-Alimi corridor, ensuring accessibility while simultaneously contributing to traffic buildup during peak hours. Security and administrative land-uses also cluster in the central districts, emphasizing the monocentric structure of Ilorin's urban core.

The implications of the facility clustering for trip generation are significant. The concentration of diverse employment opportunities within central and corridor-based clusters intensifies radial commuting patterns, where residents from peripheral zones travel toward the core for work, education, healthcare, and trade. This monocentric clustering fosters peak-hour congestion at critical intersections such as Challenge, Muritala/Amilegbe, and Offa Garage. Furthermore, the lack of decentralization in the spatial distribution of employment centers places immense pressure on arterial roads, limiting network efficiency and resilience. Overall, the clustering pattern signals the need for polycentric development strategies in Ilorin, including the promotion of sub-centers in peripheral areas involving strategic decentralization of key facilities (e.g., creating secondary commercial hubs in Adewole or Eiyenkorin) and enhancing high-capacity public transport along these identified corridors to manage the inevitable flow of people towards these clusters. Such restructuring could redistribute trips, reduce traffic congestion along central corridors, and foster more balanced and sustainable urban mobility.

VI. Network-Based Impedance And Service Area Analysis For Essential Services

A. Service Area Coverage for Security Facilities (Police Station) based on 10-minute travel times

The security service area analysis of Ilorin's police divisions, based on a 10-minute response threshold on figure 5, reveals both well-covered and underserved zones. A-Division secures the central core (Taiwo, Post Office, Unity Road),

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benefiting dense commercial and residential districts. B-Division covers Adewole, Surulere, Baboko, and transport hubs, ensuring safety for traders and commuters. C-Division serves Okelele, Gambari, and Oja-Oba, safeguarding traditional institutions and bustling markets. D-Division extends to Fate, GRA, and Asa Dam Road, providing protection for upscale residences, offices, and markets. E-Division secures Sango, Old Jebba Road, and Murtala corridors, vital for transport safety. F-Division focuses on Tanke and University Road, addressing student-related security needs, while G-Division covers Oko Olowo and Alagbado, where rapid urban expansion demands stronger policing. Outliers such as Asa Dam, Airport Road, and Alapa remain underserved, facing delayed response times. Bridging these gaps requires new outposts, improved patrols, surveillance technologies, and stronger community-police collaboration.

B. Service Area Coverage for Commercial Facilities within 15-minute travel time

Based on a 15-minute travel time threshold as depicted on Figure 6, Ilorin's commercial accessibility is highly concentrated in the central business district along major roads like Surulere-Baboko, Taiwo, and Murtala Mohammed, fostering thriving economic activity. However, significant peripheral areas including Alapa Road, Asa Dam Road, and parts of Airport Road fall outside this zone, creating commercial deserts. Residents and businesses in these underserved locations face increased transportation costs, delayed access to goods, and reduced economic opportunities. To rectify this disparity, the analysis recommends establishing satellite commercial hubs in peripheral zones and enhancing transport infrastructure to integrate these areas into the city's commercial ecosystem.

C. Service Area Coverage for Health Facilities within 15-minute travel time

The analysis of health service areas in Ilorin metropolis highlights disparities in accessibility, coverage, and spatial distribution of hospitals. Key facilities considered include KWASU Teaching Hospital, Unilorin Teaching Hospital, Maternity Wing, General Hospital, and Paediatric Hospital. GIS-based mapping (Figure 7) shows that areas within 0–5 km buffers of KWASU and Unilorin Teaching Hospitals enjoy high accessibility due to their proximity to arterial roads, while coverage sharply declines beyond 5 km, particularly where poor road infrastructure and weak public transport systems prevail. The Maternity Wing and Paediatric Hospital provide moderate accessibility, but traffic congestion near major intersections delays emergency response. Absence of dedicated ambulance lanes further worsens peak-hour travel times.

Origin–Destination (O–D) analysis indicates that Unilorin Teaching Hospital, as a tertiary referral center, attracts patients from peri-urban and rural areas, raising transport costs for low-income groups. General and Paediatric Hospitals mainly serve local populations within 2–5 km, but fragmented transit routes increase travel time. KWASU Teaching Hospital covers a wider regional area, emphasizing the need for stronger inter-city transport links. Outliers in northern and southern Ilorin lack direct access, exposing service gaps. Improving accessibility requires new satellite health centers, better road connectivity, subsidized medical transport, and integrated bus services to ensure equitable healthcare access.

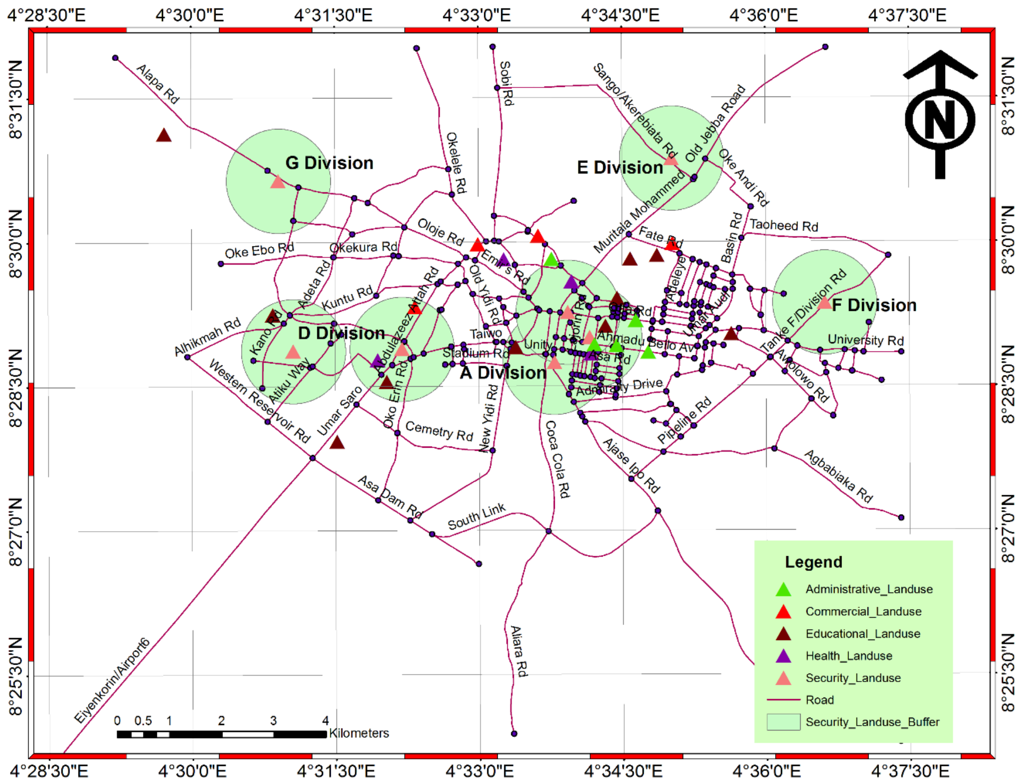

Fig. 5. Security Service Area Access Coverage in Ilorin Metropolis

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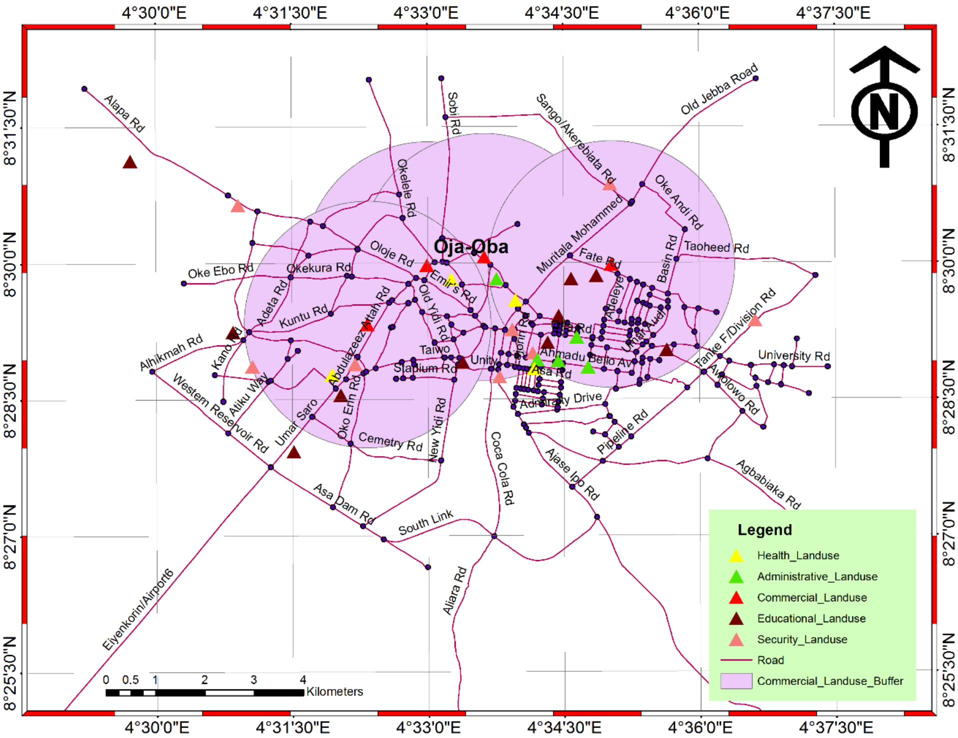

Fig. 6. Commercial Area Access Coverage in Ilorin Metropolis

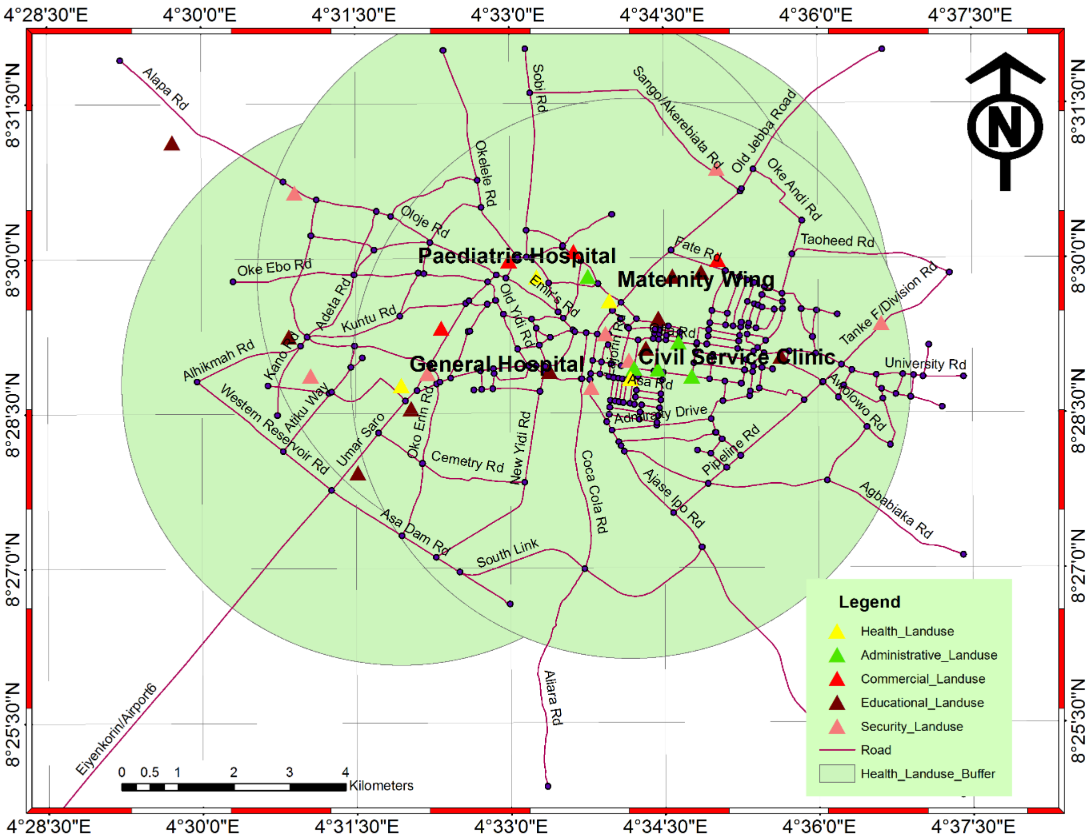

Fig. 7. Health Service Area Access Coverage in Ilorin Metropolis

D. GIS-Based Multiple Buffer Accessibility to Essential Services

The service area analysis of bus stops and minibus parks in Ilorin metropolis reveals sharp variations in accessibility across different neighborhoods. Within the 1,000m buffer, only core

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urban districts such as Taiwo, Post Office, Ipata, Challenge, and Muritala/Amilegbe corridors fall within reasonable travelling distance to bus stops. Residents and businesses in these areas benefit from high-frequency services and reduced travel costs, making public transport their primary mobility option (Table 1)

The 2,500m buffer extends coverage to intermediate neighborhoods such as Tanke, Basin, Adewole, Surulere, and Agbo-Oba. While accessibility here is relatively fair, many commuters still travel longer distances on foot or depend on motorcycles (okada) and tricycles (keke) to connect to bus terminals. This reliance on informal feeders increases overall transport costs and creates additional congestion at key loading points.

Figure 8 shows that by the 5,000m buffer, coverage expands into the peri-urban fringe, including Gaa Akanbi, Oke-Ogun, Egbejila, Alagbado, and parts of Airport Road. However, in these zones, bus stop accessibility is largely theoretical. Although they fall within the 5 km radius, the absence of continuous road connectivity, poor feeder services, and fragmented settlement patterns mean that effective coverage is minimal. Residents often face multiple transfer points, higher fares, and prolonged travel times to reach major transport hubs.

Critically, several neighborhoods remain excluded from the public transport network despite being within the city boundary. These include parts of Asa Dam, Eiyenkorin, Odota, and stretches along Alapa and Airport Road. Populations in these areas are underserved due to distance from formal bus corridors, inadequate road infrastructure, and dependence on informal paratransit. The findings highlight a spatial mismatch between bus stop locations and residential growth patterns in Ilorin. While central corridors are overserved, peripheral areas face exclusion, reinforcing socio-spatial inequalities in urban mobility. Addressing these gaps requires a strategy of decentralizing bus parks, creating feeder bus services, and extending formal transit infrastructure to underserved communities.

TABLE 1: Accessibility of Neighborhoods to Major Bus Stops/Minibus Parks in Ilorin Metropolis

Buffer Distance	Neighborhoods / Areas Covered	Level of Accessibility	Excluded / Underserved Areas	Key Implications
0–1,000 m (High accessibility)	Taiwo, Post Office, Ipata, Challenge, Muritala/Amilegbe corridors	Excellent – within walking distance, frequent services	None within this range	Core areas benefit from reliable and low-cost mobility.
1,001–2,500 m (Moderate accessibility)	Tanke, Basin, Adewole, Surulere, Agbo-Oba	Fair – require short feeder trips (okada, keke) to reach bus stops	Fringe of Adewole Extension, parts of Baboko	Added cost/time due to dependence on paratransit feeders.
2,501–5,000 m (Low accessibility)	Gaa Akanbi, Oke-Ogun, Egbejila, Alagbado, parts of Airport Road	Theoretical – within 5 km radius but poor connectivity limits real access	Asa Dam outskirts, Odota, Eiyenkorin, Alapa Road axis	Long travel times, multiple transfers, weak integration with city core.

Source: Researcher's Survey, 2025

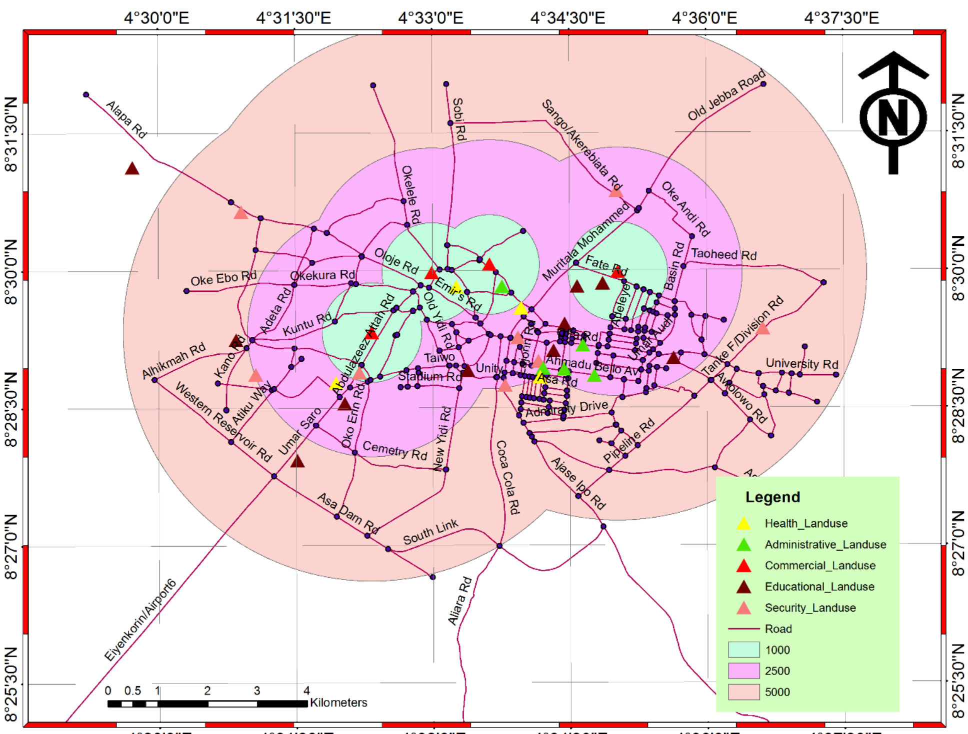

Fig. 8. Multiple Concentric Zone Accessibility to Essential Services

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E. Origin – Destination Matrix for Travel Time and Distance Across Ilorin Metropolis

This Origin-Destination (O-D) matrix, constructed using the value 1 to represent internal trips within each intersection as computed. After the unit matrix was added, the O-D matrix was updated by using the Panning tool to select the Estimation O – D Matrix command on Table 2, reveals critical traffic patterns in Ilorin. The high trip volumes along the matrix diagonal (e.g., Murtala/Amilegbe to Sawmill: 922 trips) indicate these major intersections function as powerful attractors and generators, creating significant through-traffic. This is compounded by the high interchange between key nodes like Tipper/Tanke and Murtala/Amilegbe (810 trips), demonstrating strong connectivity but also identifying primary congestion corridors.

The high volumes are a direct function of low impedance (short travel times/distances) along these major arterial corridors. Conversely, the lower values on the matrix periphery (e.g., Surulere/Agbo-Oba to Offa Garage: 496 trips) reflect higher impedance, likely due to longer distances or poorer route connectivity. The matrix confirms that traffic flow is heavily channeled through a network of high-capacity, low-impedance roads, leading to intense pressure at central hubs (Figure 9). This analysis directly links land-use concentration to traffic volume via network impedance, highlighting an urgent need for demand management and infrastructure upgrades at these critical junctions to reduce effective travel time and congestion.

TABLE 2: Origin-Destination Matrix

Origin/Destination	Offa Garage	Tipper/Tanke	Challenge	Murtala/Amilegbe	Sawmill/Geri-Alimi	Surulere/Agbo-Oba	Total
Offa Garage	1	556	553	647	619	491	**2867**
Tipper/Tanke	577	1	693	810	776	615	**3472**
Challenge	573	692	1	804	770	611	**3451**
Murtala/Amilegbe	691	836	831	1	930	737	**4026**
Sawmill/Geri-Alimi	657	794	789	922	1	700	**3863**
Surulere/Agbo-Oba	496	600	596	697	667	1	**3057**
Total	**2995**	**3479**	**3463**	**3881**	**3763**	**3155**	**20736**

Source: Researcher's Survey, 2025

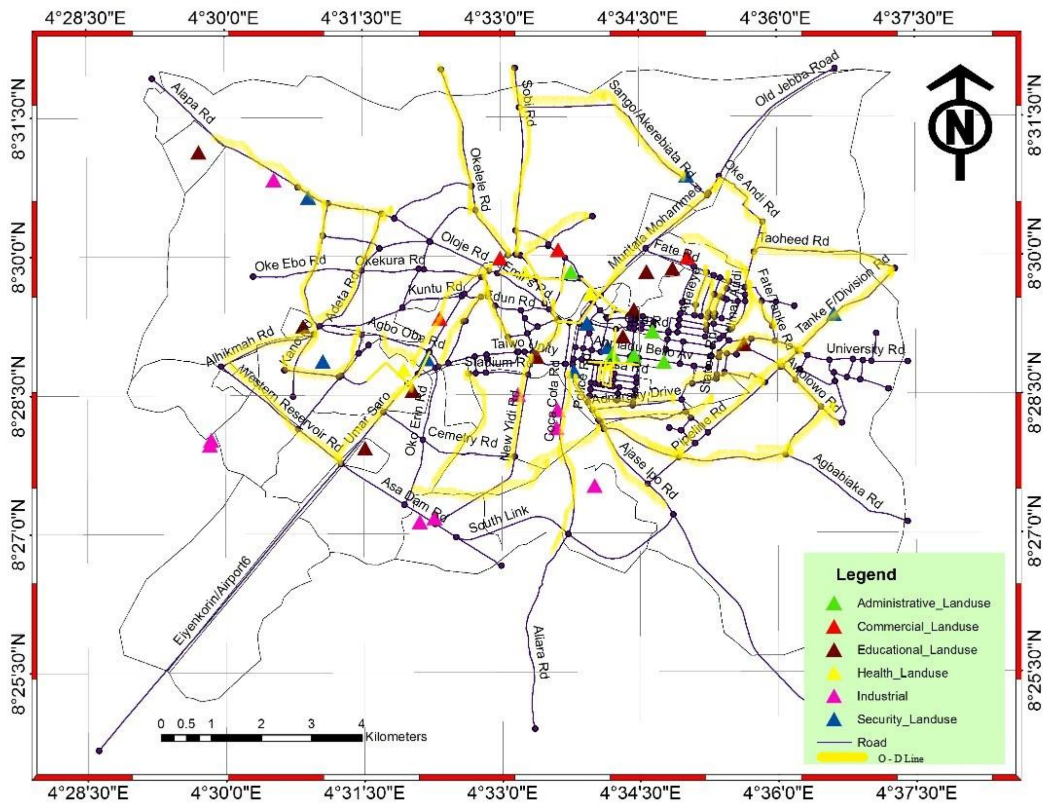

Fig. 9. Origin-Destination Matrices

VII. Conclusion and Recommendation

This study conclusively demonstrates that Ilorin Metropolis is characterized by a profound spatial mismatch between land-use patterns and transportation infrastructure, resulting in severe accessibility deficits and inefficient mobility. The dominance of residential land-use (37.6%), coupled with the concentration of commercial and institutional activities along central corridors, fosters a monocentric urban structure that generates intense radial travel demand. Network-based service

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area analyses reveal significant disparities: essential services such as healthcare, security, and commerce are accessible within 10–15 minutes only in the core urban areas, while peripheral neighborhoods including Asa Dam, Eiyenkorin, and Alapa remain underserved due to inadequate road connectivity and sparse public transport coverage. The Origin-Destination matrix further highlights that high traffic volumes between major intersections like Murtala/Amilegbe and Sawmill/Geri-Alimi are a direct function of land-use clustering and low network impedance along arterial routes, leading to chronic congestion. The reliance on informal paratransit services in outer areas exacerbates travel costs and limits equitable access to opportunities. These findings underscore that Ilorin's urban expansion has occurred without corresponding transport integration, perpetuating spatial inequalities and constraining sustainable development. Based on the findings from this study, it was recommended that to decentralize economic activities and reduce radial travel demand, urban policy should promote the development of strategically located sub-centers in rapidly growing peripheral areas such as Adewole, Tanke, and Eiyenkorin, as relocating key government offices, establishing new markets, and incentivizing commercial investments in these zones will create balanced trip distribution and shorten travel distances.

Policymakers are enjoined to implement a structured hierarchy of transit services, including high-capacity bus corridors along high-demand routes (e.g., University-Tanke-CBD and Offa Garage-Post Office-Oke-Oyi axes) and integrated feeder services using minibuses to serve peripheral communities. Additionally, designated bus lanes, traffic signal prioritization, and improved waiting facilities should be introduced to increase service speed, reliability, and coverage.

Finally, planners should use network-based service area models as demonstrated in this study as routine tools for evaluating proposed land-use changes, locating new facilities, and prioritizing transport investments. This evidence-based approach will ensure that future developments are oriented toward achieving equitable accessibility, reducing impedance, and fostering resilient urban mobility.

Conflicts Of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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