

## Public Green Spaces and Roads as Public Spaces: Morphology, Accessibility and Spatial Justice in the Peripheries of Greater Lomé and Yaoundé

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### ABSTRACT

Against the backdrop of rapid peri-urbanisation reshaping major cities in sub-Saharan Africa, this study examines equity of access to public spaces through an integrated analysis of public green spaces (PGS) and road public space in the periphery's areas of Greater Lomé and Yaoundé. It adopts a comparative, multi-scalar approach, combining the metropolitan scale with four contrasted peripheral sectors. The methodology relies on quantitative spatial analyses of PGS using OpenRouteService within QGIS 3.44.2, the calculation of equity indicators (Equity Gap and Relative Accessibility Index), a morphological assessment of road networks, and field observations of travel conditions. The results reveal structural spatial divides common to both cities, albeit expressed differently. At the metropolitan scale, PGS provision is critically low, 0.55 m<sup>2</sup> per capita in Yaoundé and 0.25 m<sup>2</sup> per capita in Greater Lomé, well below the World Health Organisation recommendation. These deficits are exacerbated in peripheral areas, where access distances exceed 20-minute travel-time thresholds by factors ranging from 13 to 47. Despite slightly better external accessibility in Yaoundé, high equity indicator values (above 1) in both metropolises indicate deeply unequal access, particularly disadvantaging emerging peripheral sectors. Analysis of road public space further shows that contrasting network morphologies, monocentric in Greater Lomé and polycentric in Yaoundé, do not mechanically translate into more equitable accessibility. While peripheral areas in Greater Lomé display satisfactory and stronger road connectivity, the environmental and functional quality of streets remains deficient in both metropolises, with more pronounced shortcomings in Yaoundé. By integrating urban morphology, spatial performance and mobility experiences, this research underscores the need for urban policies refocused on spatial justice and environmental equity.

**Keywords:** Public green spaces; Road public space morphology; Spatial accessibility; Spatial justice; Environmental equity; Yaoundé; Greater Lomé.

### INTRODUCTION

Public spaces occupy a central position in contemporary debates on urban production. They are open and accessible places that enable co-presence, social interaction, and encounters between individuals and social groups

[1]. Historically, the concept of public space has been theorised within European thought, notably by Jürgen Habermas [2], for whom it constitutes a sphere of collective expression and public deliberation. This conceptualisation has since been refined and enriched through perspectives developed in other cultural and territorial contexts. In Africa, courtyard practices and spaces of palaver reflect a relational and community-based understanding of public space, closely embedded in local social, political, and customary structures [3–5]. Although the overarching purpose of public space may appear broadly shared, its material forms, everyday uses and modes of institutional recognition vary markedly according to territorial, cultural and political dynamics. This diversity echoes Lefebvre's perspective [6], which conceives space as a social product shaped by practices, representations, and power relations. From this standpoint, public spaces can be understood as socio-political dispositifs through which territorial and social inequalities are revealed.

According to UN-Habitat [7], public spaces encompass streets, open areas, and infrastructures managed by public authorities, freely accessible and intended for non-profit purposes. Within this category, public green spaces (PGS) occupy a distinctive position in contemporary cities. Mensah [8] describes them as urban amenities contributing to urban aesthetics, while a growing body of literature highlights their role in improving urban health, strengthening social cohesion, and supporting governance processes [9–11]. Road infrastructure also constitutes a fundamental component of public space. Long approached primarily from a functional transport perspective, it is now increasingly recognised as a structuring space for mobility, accessibility, sociability, and urban inclusion [12, 13]. In African cities, the organisation of urban road networks reflects tensions generated by rapid demographic growth, weak urban planning frameworks, and intense land pressure [14]. The urban peripheries of Greater Lomé and Yaoundé illustrate two contrasting urban configurations: the former, coastal and sprawling, structured by extensive subdivision development [15]; the latter, landlocked and topographically constrained, characterised by limited functional integration of the road network [16, 17].

Research on the right to the city and spatial justice indicates equitable access to urban amenities as a core dimension of urban experience [18, 19], while environmental justice approaches emphasise fair access to key urban resources such as vegetation, mobility, and air quality [20]. These perspectives are increasingly mobilised in African scholarship [21–23], in contexts where urban planning remains unevenly implemented [24] and where urban development is shaped by customary logics, ambiguous land tenure regimes and everyday modes of co-presence that influence the recognition and structuring of public spaces, particularly PGS [3, 5, 4]. These dynamics have direct implications for urban equity and accessibility. Reports by the Centre for Affordable Housing Finance in Africa (CAHF) indicate that informal settlements account for over 65% of urban areas in Cameroon and over half of the urban population in Togo [25, 26]. In both contexts, road public space and public green spaces display pronounced structural deficiencies, with documented economic and social impacts on accessibility, informal practices and local commercial vitality [27, 28].

Despite the growing body of research on public spaces, African scholarship remains constrained by two main limitations. First, public green spaces and road public space are most often examined separately, even though they frequently intersect within urban fabrics, notably through linear vegetated layouts. Second, studies that jointly mobilise spatial equity indicators, urban morphology, and graph theory remain scarce in African contexts [3, 8, 4], despite calls to extend research on ecosystem services and urban accessibility to cities of the Global South [29]. This lack of integrated analysis hampers a nuanced understanding of the spatial mechanisms underpinning inequalities in access to public spaces. Against this backdrop, this study jointly examines public green spaces and road public space in order to assess their contribution to accessibility and spatial equity in urban peripheries of Greater Lomé and Yaoundé. Drawing on spatial equity indicators [30, 31], urban morphology [32], and graph theory [33], the analysis shows that the morphological configurations of these public spaces structure urban connectivity and produce differentiated patterns of access. The paper is organised as follows: it first presents the methodology, then the analytical results, and finally discusses these findings in relation to spatial and environmental justice.

## MATERIALS AND METHODS

### Spatial Delineation of the Study Areas

This study is based on a comparative analysis conducted in two African capitals with contrasting urban trajectories: Greater Lomé and Yaoundé (Figure 1).

Greater Lomé, the political and economic capital of Togo in West Africa, is a coastal agglomeration located in the extreme south-west of the country, around latitude 6°08'14" N and longitude 1°12'45" E. Its physical setting is characterised by a hot and humid tropical climate, classified as tropical savanna (Aw) under the Köppen-Geiger system [34], and a generally flat topography. In 2022, the population of Greater Lomé was estimated at 2,188,376

inhabitants [35]. The urbanisation process exhibits a strong spatial structuring, extending primarily along the Atlantic coastline bordering the Gulf of Guinea and following the main arterial road corridors [15].

Yaoundé, the capital of Cameroon in Central Africa, is a landlocked continental metropolis located in the southern part of the country, around latitude 3°52' N and longitude 11°40' E. The city evolves within a humid tropical climate of the Guinean equatorial type (Af/Am), according to the Köppen-Geiger classification [34], and is constrained by a markedly rugged topography, shaped by seven major hills and deeply incised valleys. Its population was estimated at 3,452,165 inhabitants in 2022 [36]. Urban expansion in Yaoundé is characterised by limited spatial control, spreading horizontally across hillsides, hilltops and low-lying areas [37].

The comparison between Greater Lomé and Yaoundé, two cities characterised by contrasting climatic, topographical and morphological configurations, enables an analysis of a shared urban phenomenon across differentiated contexts. Each city is considered as a distinct configuration, and their analytical juxtaposition serves to elucidate urban dynamics operating within diverse environmental setting [38].

The study adopts two complementary levels of observation. The first corresponds to the citywide scale and covers the entire urban territories of Greater Lomé and Yaoundé. The second operates at the local scale and focuses on four peripheral sectors selected to represent distinct urbanisation trajectories. In each agglomeration, two types of urban peripheries were retained. The first comprises consolidated peripheral areas, whose development began during major phases of territorial restructuring between the 1980s and the 2000s. The second corresponds to recent urbanisation fronts that have emerged within the past decade. In Greater Lomé, the consolidated peripheral sector is located in the municipality of Agoè-Nyivé 5 and includes the neighbourhoods of Klémé Sanguéra, Sanyrako, Dekpo Sanguéra and Atigan Kopé, while the emerging peripheral sector lies in Agoè-Nyivé 6 and comprises Kladjemé, Kpokpome-Aguté, Kpotavé and Agotimé. In Yaoundé, the consolidated peripheral sector is situated in Yaoundé 5 and corresponds to the Simbock neighbourhood, whereas the emerging peripheral sector is located in Yaoundé 1 and mainly covers the Nyom 2 neighbourhood. Overall, the four study areas display broadly comparable spatial extents.

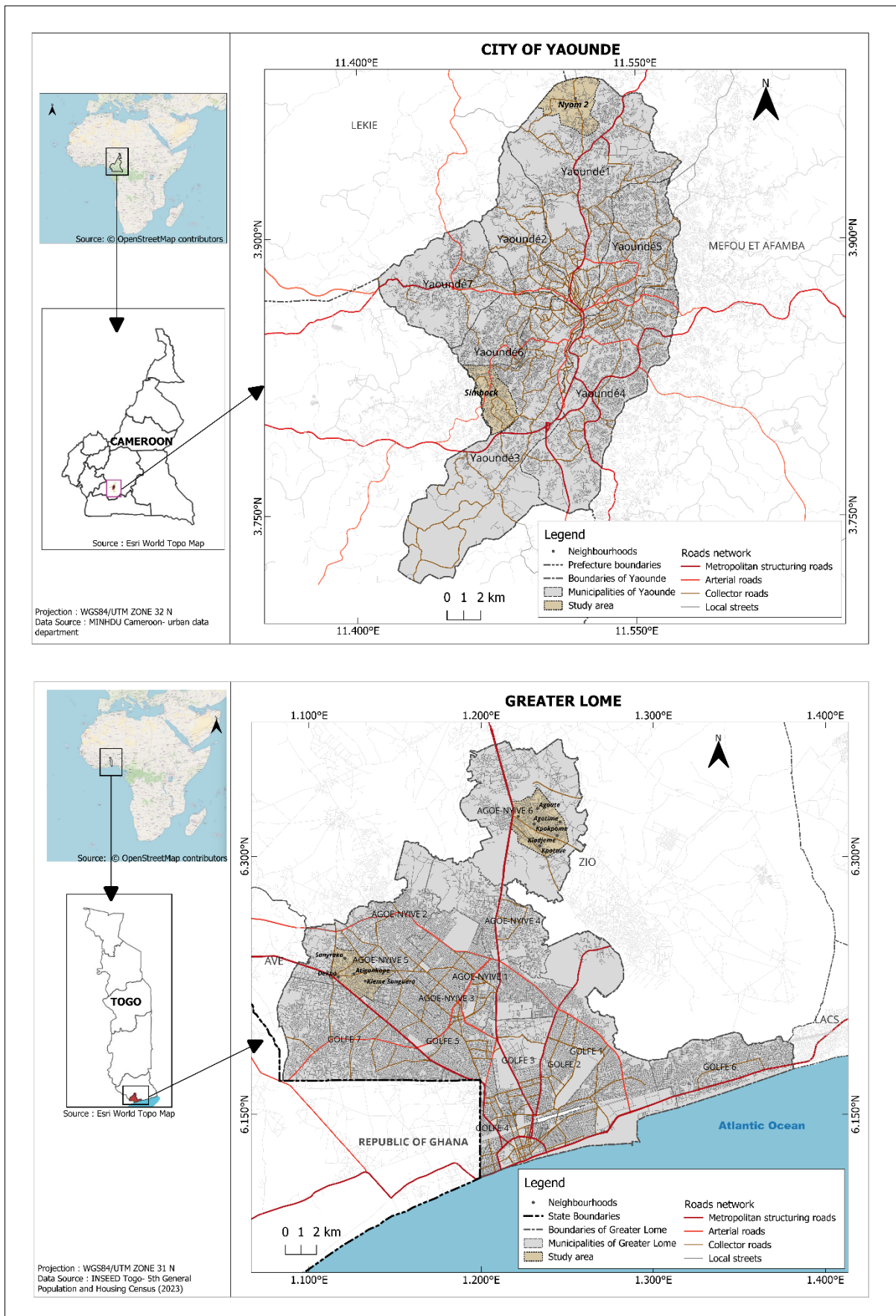


Figure 1. Location map of study sites.

Source: Field survey, April-September 2025.

## Methodological Approach

The methodological framework adopted is based on a mixed-methods approach combining quantitative and qualitative techniques. It relies on the collection of vector-based spatial data and GPS point surveys, complemented by field observations aimed at characterising public green spaces and the road public space. The analysis follows a sequential workflow comprising data acquisition, processing and analysis, followed by the interpretation of results. It mobilises GIS tools, accessibility indicators applied to public green spaces and urban road network, and the analysis of data derived from structured observation grids. The use of multiple indicators strengthens the findings, while the qualitative analysis provides contextual insights that cannot be fully captured by spatial metrics alone.

## Data Sources

Cartographic data were obtained from multiple sources, as detailed in Table 1. All preprocessing operations were performed using QGIS 3.44.2. Field data collection focused on validating the location of public green spaces and documenting the characteristics of road public space within the four study sectors. Field surveys were conducted in 2025, in Yaoundé (April-May) and in Greater Lomé (August-September), by two separate survey teams. In total, approximately 850 road segments were surveyed. Road widths were measured using a laser rangefinder and systematically cross-checked against high-resolution imagery (Google Earth). Prior harmonisation of survey protocols among observers ensured the consistency and reliability of the recorded observations.

**Table 1.** Sources of cartographic data

Data type	Vector geometry	Main content	Data source	Verification procedures
Public green spaces	Polygon	Location and surface area of public green spaces	Municipal authorities (both cities); INSEE (Togo); MINH DU (Cameroon); OpenStreetMap; literature review	Geometry verification and removal of duplicates
Administrative boundaries	Polygon	Delimitation of basic administrative units	INSEE (Togo); MINH DU (Cameroon)	Topological checks (closed and non-overlapping polygons)
Road network	Line	Hierarchised road network	OpenStreetMap	Verification of road graph connectivity
building centroids	Point	Building locations	OpenStreetMap	Data cleaning and duplicate removal

Source: Field survey, April–September 2025.

## Analysis of public green spaces

The analysis is structured around two complementary components: (i) the assessment of the spatial distribution of public green spaces at the citywide scale, and (ii) the analysis of population accessibility within the selected peripheral sectors.

### Identification, classification and distribution of PGS

Public green spaces were identified and classified according to a reference framework derived from the guidelines of UN-Habitat and Cerema [39, 40], retaining only the categories relevant to the urban context under study: (1) urban forests, (2) parks, (3) public gardens, (4) squares and plazas, and (5) specialised facilities. Street-aligned trees were also inventoried for their ecological functions. Public green spaces were further characterised through area calculations using the Zonal Statistics plugin and subsequently grouped into three size classes, expressed in hectares (ha): <0.5 ha, 0.5–1 ha, and >1 ha. Two indicators were subsequently applied:

- Public green space provision (PGSP), expressed in m<sup>2</sup> per inhabitant:

$$PGSP = \frac{1}{P} \sum_{i=1}^n S_{evp,i} \quad (1)$$

- Relative importance of public green spaces (RIPGS), calculated as:

$$RIPGS = \frac{1}{S} \sum_{i=1}^n S_{evp,i} \quad (2)$$

Where  $S_{evp,i}$ : total surface area of public green spaces; P: urban population; S: total surface area of the study zone.

The RIPGS index is assessed with reference to the 15% threshold recommended for open public spaces [41].

### Accessibility of populations to public green spaces

Potential accessibility to PGS was estimated using QGIS 3.44.2 through the OpenRouteService (ORS) plugin, which computes actual travel distances along the road network. This approach is comparable to web-based routing services commonly used in urban accessibility analyses [42]. Three distance thresholds (5, 10 and 12 km) were adopted to measure road-based access to public green spaces.

Population proxy points were derived from building footprints and selected on the basis of built-up density. This approach is widely recognised as improving the spatial representation of population distribution in contexts where fine-scale demographic data are unavailable [43]. Seven points were selected per peripheral sector, enabling the construction of an origin - destination matrix comprising more than 700 pairs linking origin points to PGS. This matrix was used to calculate the Relative Accessibility Index (RAI) and the Equity Gap (EG), which assess variations in accessibility to public green spaces between sectors.

- Relative Accessibility Index:  

$$RAI = A_{zone1} / A_{zone2} \tag{3}$$

- Equity Gap:  

$$EG = A_{zone1} - A_{zone2} \tag{4}$$

Where  $A_{zone1}$ : average number of public green spaces in the advantaged zone, and  $A_{zone2}$ : average number in the disadvantaged zone.

An RAI value greater than 1 indicates that zone 1 is more accessible than zone 2; RAI = 1 denotes equality; and RAI < 1 indicates lower accessibility in zone 1.

An EG value of 0 reflects the absence of inequity, whereas  $EG > 0$  indicates the presence of inequality. Together, these indicators provide a basis for assessing intra-urban disparities in access to public green spaces.

### Functional, Morphological and Environmental Analysis of the Road Network

#### Calculation of Spatial Indices

The hierarchical classification of the urban road network was established on the basis of the functional distinctions observed in the studied cities and the CEREMA reference framework [13]. A grid (500 m × 500 m) was used to generate the choropleth map [44] and to compute two main indicators.

- Urban road density (D) was calculated using the formula:  

$$D = L / A \tag{5}$$

Where, L: Total length of the road network (km) and A: area of the unit of analysis (km<sup>2</sup>).

- Network connectivity was assessed using the  $\beta$  index, derived from Kansky's graph theory (1960) [45]:  

$$\beta = A_r / C \tag{6}$$

where,  $A_r$ : number of arcs (road segments) and C: number of nodes.

A radial profile was subsequently constructed using five concentric rings extending from 5 to 30 km around the city centre, in order to analyse the spatial structuring of the urban fabric.

#### Functional and Environmental Quality of the Road Network

The delineation of the analysed road segments included all road sections located within the boundaries of the selected sectors. To assess the continuity of major roads, a methodological extension was applied: 500 m for structural and arterial roads, and 300 m for collector roads [33]. The resulting road hierarchy comprised four levels: (1) metropolitan structuring roads, (2) arterial roads, (3) collector roads, and (4) local streets. Only the hierarchical levels effectively present in each sector were retained for analysis. Each road segment was assessed using a purpose-designed evaluation grid (Table 2), inspired by normative reference works [12, 13], and structured around three complementary dimensions: functional (continuity, accessibility, interconnection), geometric (measured width, cross-section, surface condition), and environmental and pedestrian-related (sidewalks, lighting, green infrastructure, comfort). The grid was populated using indicator values derived from systematic field observations.

**Table 2.** Qualitative analysis framework for the road network

Road network hierarchy	Analytical dimensions	Assessment criteria (CEREMA/GEHL)
Metropolitan structuring roads (primary roads at the metropolitan scale)	Functional Geometric  Qualitative and environmental	Connectivity and continuity Indicative width: 20–40 m Surface: bituminous Sidewalks, lighting, green infrastructure
Arterial roads	Functional Geometric  Qualitative and environmental	Inter-neighbourhood connectivity Indicative width: 15–25 m Surface: bituminous Sidewalks, lighting, green infrastructure
Collector roads	Functional Geometric	Neighbourhood access Indicative width: 10–15 m Paved surface (minima)
	Qualitative and environmental	Sidewalks, lighting, green infrastructure
Local streets	Functional Geometric	Parcel-level access Indicative width: 6–10 m Paved surface
	Qualitative and environmental	Sidewalks, lighting, green infrastructure

Source: Field survey, April-September 2025.

Each criterion was scored using a three-level Likert scale (0 = non-compliant, 1 = partially compliant, 2 = compliant). A composite score for each road segment was then calculated as the arithmetic mean of the seven criteria. These scores were subsequently aggregated by city, type of peripheral area (consolidated or emerging), and road hierarchy level, allowing for a multi-level comparative analysis. A synthetic aggregation table of scores was produced. This approach aims to convert qualitative field observations into clear and robust composite indicators [46].

## RESULTS

### Characterisation of the Public Green Space Supply

Figures 2 and 3 illustrate the spatial distribution of public green spaces in Yaoundé and Greater Lomé, respectively, classified according to the adopted hierarchy: (1) urban forests, (2) urban parks, (3) public gardens, (4) green squares and plazas, and (5) specialised facilities. In Yaoundé, urban forests account for 84.14% of the total public green space area (257.51 ha), and four urban parks are identified. Public gardens (11) and squares (13), although more numerous, represent only 4.12% of the total area. These spaces primarily serve a neighbourhood-scale recreational function. In Greater Lomé, urban parks account for 53.2% of the total area, while the botanical garden (classified as a specialised facility) covers 19.96%. Public gardens (7) and squares (12) together represent 11.79% of the total area occupied by public green spaces (50.97 ha). In contrast to Yaoundé, these spaces are more clearly embedded within a neighbourhood-scale spatial network. Table 3 presents the size classes of public green spaces in each city (<0.5 ha; 0.5–1 ha; >1 ha).

**Table 3.** Morphological structure of public green spaces by surface area classes

Surface area class (ha)	Yaoundé			Greater Lomé		
	N*	S (ha)*	R (%) *	N	S (ha)	R (%)
Micro-spaces: < 0,5 ha	16	3.49	1.36	17	3.59	7.04%
Medium-sized spaces: 0,5–1 ha	6	4.51	1.75	2	1.419	2.78%
<b>Large spaces: &gt; 1 ha</b>	14	249.5	96.89	6	45.958	90.17%

\*N: number of public green spaces; S: Surface area; R: Ratio of the total surface area.

Source: Field survey, April-September 2025.

In Yaoundé, large green spaces (>1 ha) account for 96.89%, compared with 90.17% in Greater Lomé, indicating a strong concentration of vegetation within large-scale green spaces in both cities. Nevertheless, Greater Lomé

stands out for its more pronounced presence of neighbourhood-scale micro-spaces (<0.5 ha) dedicated to proximity and leisure uses, which represent 7.04% of the total area, compared with only 1.36% in Yaoundé.

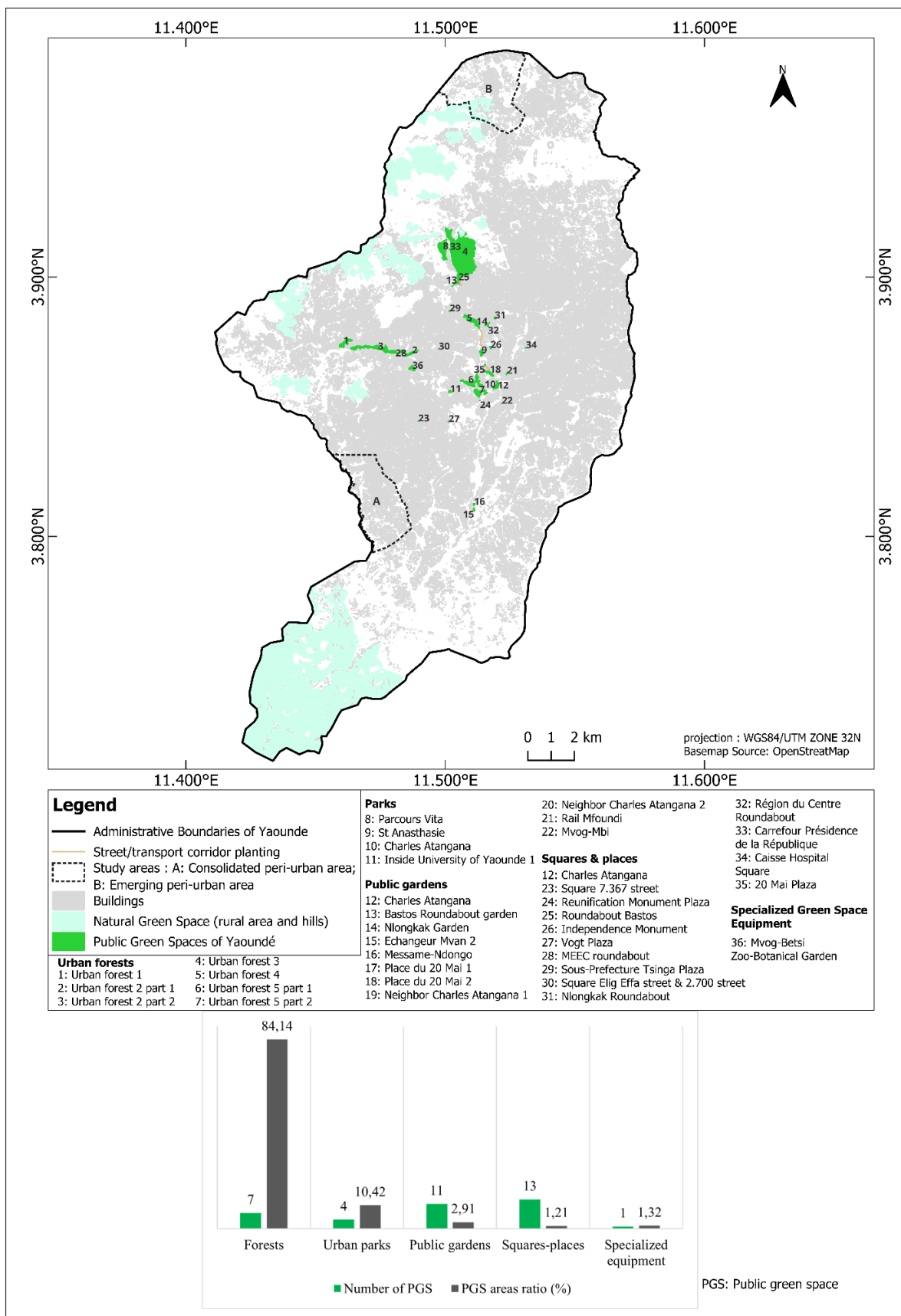


Figure 2. *Public green spaces of Yaoundé.*

Source: Field survey, April-September 2025.

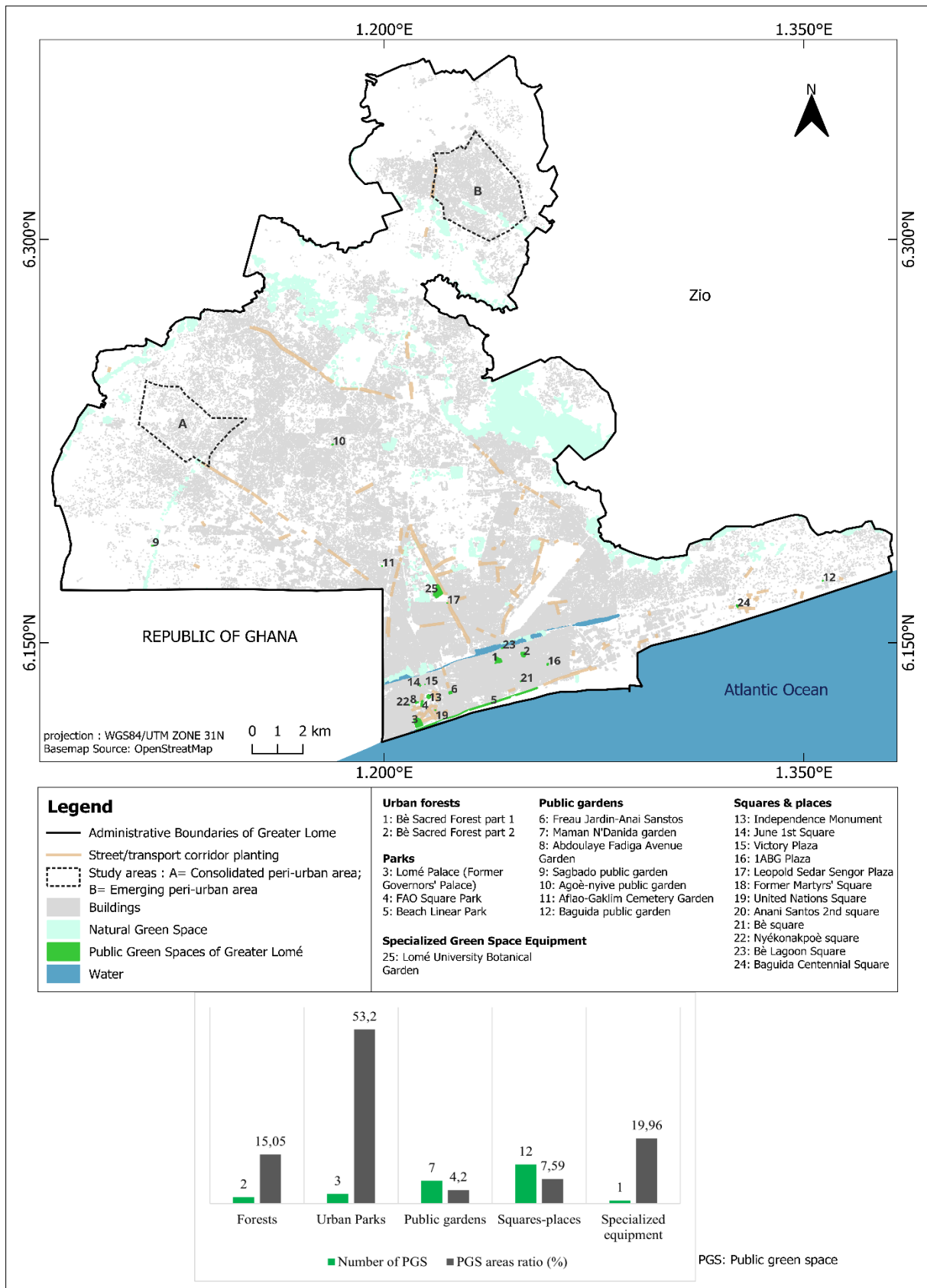


Figure 3. Public green spaces in Greater Lomé.

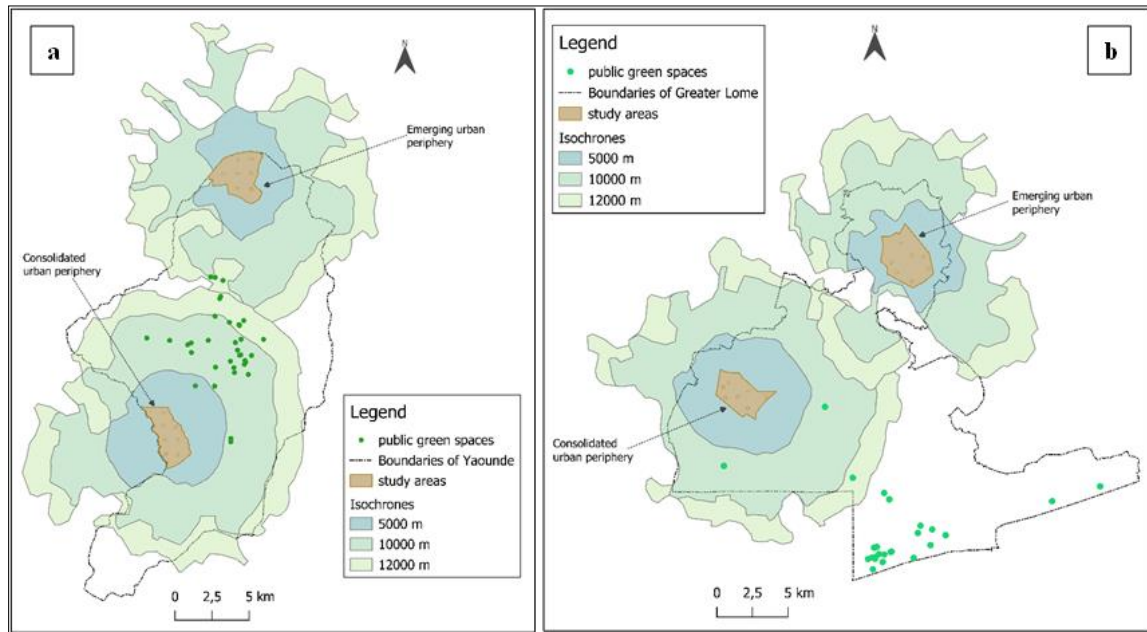
Source: Field survey, April-September 2025.

In both cities, PGS are preferentially located within the historic urban core. From a demographic perspective, provision levels (PGSP) remain very low, at 0.55 m<sup>2</sup> per inhabitant in Yaoundé and 0.25 m<sup>2</sup> per inhabitant in Greater Lomé. Similarly, the relative importance indices (RIPGS) observed are also low, at 0.84% in Yaoundé and

0.13% in Greater Lomé. These contributions remain marginal in relation to the 15% share of green spaces recommended for the urban fabric as a whole by UN-Habitat [41].

**Accessibility to public green spaces**

Figure 4 highlights pronounced disparities in isochrone-based access to public green spaces from the peripheral sectors under study, using the respective road networks of each city under normal traffic conditions.



**Figure 4. Isochrone-based access distances to public green spaces from peripheral sectors in Yaoundé (a) and Greater Lomé (b).**

Source: Field survey, April-September 2025.

In Yaoundé, the consolidated peripheral sector in the south benefits from markedly better spatial proximity, with most PGS located within access distances of 5–10 km (Figure 4a). By contrast, for the emerging peripheral sector located in the northern, the majority of public green spaces are reachable only at distances exceeding 12 km. In Greater Lomé, this spatial imbalance is even more pronounced. As shown in Figure 4b, public green spaces are predominantly situated beyond the limits of the computed isochrones, that is, at distances greater than 12 km. This accessibility deficit is particularly acute in the emerging peripheral sector located in the northern part of the city. The Origin–Destination matrix data summarised in Table 4 provide further clarification of these disparities.

**Table 4. Indicators of external accessibility to public green spaces in the peripheral areas of Yaoundé and Greater Lomé**

Dimensions	Indicators	Yaoundé		Greater Lomé	
		Emerging sector	Consolidated sector	Emerging sector	Consolidated sector
Urban supply	Total number of PGS in the city	36	36	25	25
Access distance	Mean distance to PGS (km)	15.85	11.42	25.40	18.20
Access effort	Distance to the nearest PGS (km)	9.74	3.92	14.00	4.90
Travel time	Mean travel time (min)	15.72	13.38	26.30	23.40
	Minimum travel time (min)	11.00	6.00	17.20	11.00
External functional accessibility	Median number of PGS accessible within the 20-minute threshold	18	24	0	4
External access performance to PGS	External coverage rate (%)	52.00	67.50	32.00	64.00
	Time/distance ratio	0.99	1.17	1.04	1.29

Source: Field survey, April-September 2025.

The results highlight limited external accessibility to PGS across all the peripheral areas examined, with clear contrasts according to the degree of urban consolidation and the city considered. As no PGS are located within the analysed peripheral sectors, minimum access distances largely exceed the World Health Organization guideline of 300 m. All indicators are based on travel times and distances derived from the Origin-Destination matrix, calculated between residential sectors and PGS located outside the sectors.

In both urban areas, consolidated peripheral sectors consistently exhibit better external accessibility performance than sectors undergoing urban formation. In consolidated sectors, the nearest PGS is located at 3.9 km in Yaoundé, compared with 4.9 km in Greater Lomé. In emerging peripheral sectors, the nearest PGS is 9.7 km away in Yaoundé and 14.0 km in Greater Lomé. Mean access distances confirm this intra-urban gradient, reaching 11.4 km in the consolidated sector of Yaoundé versus 15.9 km in its emerging sector, and 18.2 km (consolidated sector) versus 25.4 km (emerging sector) in Greater Lomé. These spatial disparities translate into differentiated temporal constraints, with mean travel times reaching 26.3 minutes in the emerging periphery of Greater Lomé and 15.7 minutes in that of Yaoundé.

The analysis of the time/distance ratio reveals more constraining travel conditions in consolidated sectors, despite shorter distances. In Yaoundé, the time cost per kilometre reaches 1.17 min/km in the consolidated sector, compared with 0.99 min/km in the emerging sector, while in Greater Lomé it rises to 1.29 min/km in the consolidated sector, the highest value observed across all sectors analysed. Inter-urban comparison shows that Greater Lomé is characterised by longer access distances, higher travel times, and greater time costs per kilometre, regardless of peripheral sector type. This pattern is reflected in lower external coverage rates, particularly in the emerging sector.

Table 5 presents the indicators of relative accessibility (RAI) and accessibility equity (Equity Gap) between the sectors studied, considering consolidated peripheral sectors as advantaged areas and sectors undergoing urban formation as disadvantaged areas within the cities analysed.

The Relative Accessibility Index (RAI) values indicate higher performance levels in consolidated peripheral sectors. In Yaoundé, the RAI for the number of PGS accessible within 20 minutes reaches 1.33, indicating that consolidated sector enjoy substantially better access than emerging peripheral area. In Greater Lomé, this ratio cannot be calculated due to the complete absence of PGS accessible from the emerging sector within 20 minutes. The Equity Gap further confirms this quantitative asymmetry, with a deficit of six accessible PGS in Yaoundé and four in Greater Lomé, disproportionately affecting emerging sectors. Disparities are even more pronounced with respect to minimum proximity to a PGS. The RAI for distance to the nearest park is 0.40 in Yaoundé and 0.35 in Greater Lomé, while the distance-based Equity Gap reaches 5.82 km and 9.10 km, respectively. These values reflect a particularly severe spatial inequality in minimum access to PGS.

**Table 5.** Disparities in access to public green spaces between advantaged and disadvantaged sectors in Yaoundé and Greater Lomé, based on the 20-minutes threshold.

Indicators	Yaoundé (Consolidated/ emerging)	Greater Lomé (consolidated / emerging)
<b>Relative Accessibility Index (RAI)</b>		
RAI: Accessible public green spaces	1,33	n.c*
RAI: Distance to the nearest park	0,40	0,35
<b>Equity Gap (EG)</b>		
Gap in the number of accessible public green spaces	6	4
Gap in distance to the nearest park (km)	5,82	9,10

\*n.c.: not calculable (no public green space accessible within  $\leq 20$  minutes).

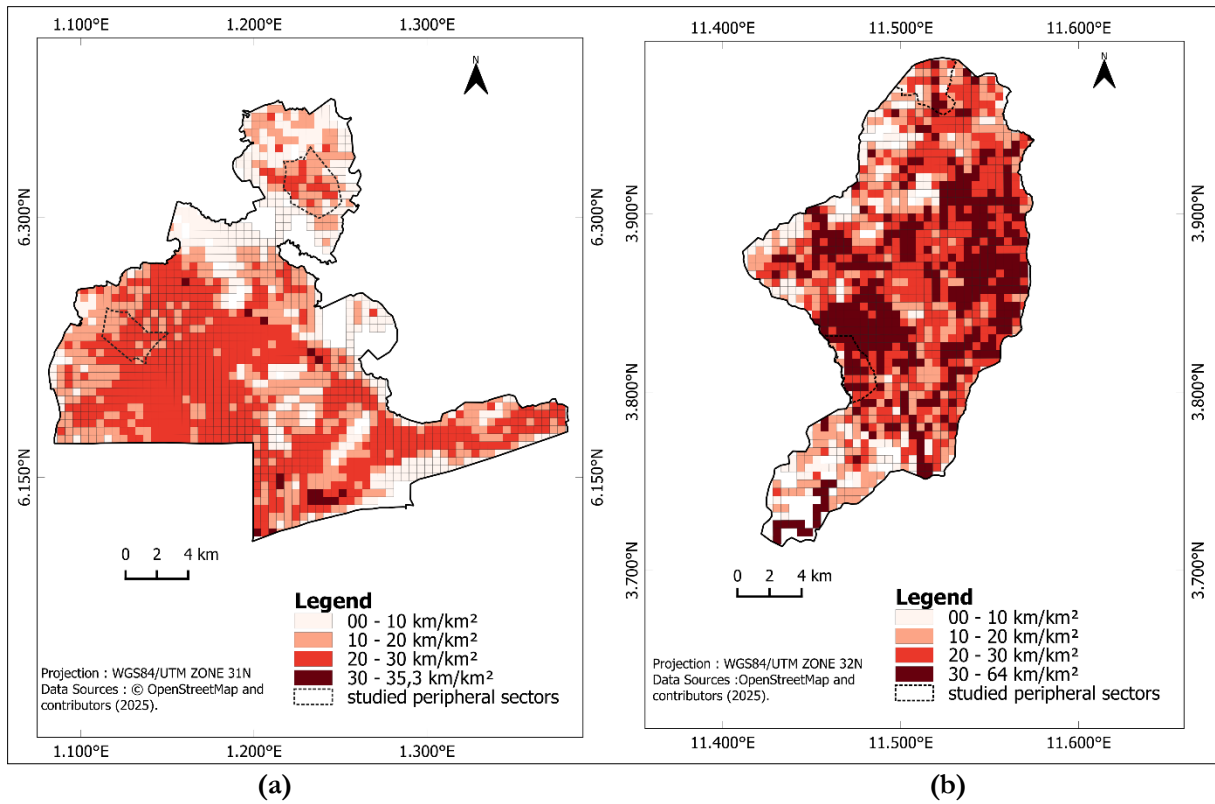
Source: Field survey, April-September 2025.

### Urban road network densities in Greater Lomé and Yaoundé

Figure 5 shows the spatial distribution of road network density in Greater Lomé (a) and Yaoundé (b). In Greater Lomé, the choropleth map reveals a structured and hierarchical gradient (0–35.5 km/km<sup>2</sup>). The central area displays high densities ( $\geq 30$  km/km<sup>2</sup>), while most pericentral areas fall within the 20–30 km/km<sup>2</sup> class. Peripheral areas present lower values (10–20 km/km<sup>2</sup>), and marginal, weakly developed sectors record densities below 10 km/km<sup>2</sup>. The mean road density is 16.9 km/km<sup>2</sup>, with a median of 18.9 km/km<sup>2</sup>, indicating a moderate level combined with marked variability. This heterogeneity is reflected in a standard deviation of 7.64 km/km<sup>2</sup> and

a wide range extending from 0.32 to 35.29 km/km<sup>2</sup>. The interquartile range (10.7–23 km/km<sup>2</sup>) shows that most of the network falls within intermediate density classes.

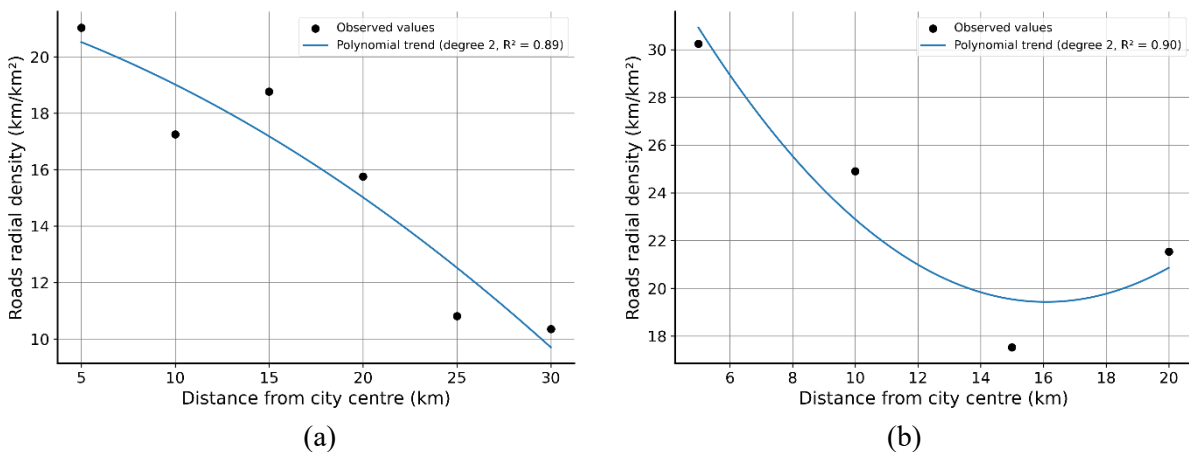
In Yaoundé, Figure 5(b) similarly reveals a pronounced hierarchical gradient in road network density. High densities (30–64 km/km<sup>2</sup>), partly corresponding to the historic core, are clearly distinguishable, while the eastern margins and parts of the western boundary display medium to high values. By contrast, the southern and north-western sectors show very low densities, close to zero, including areas entirely devoid of road infrastructure and appearing as distinct spatial voids. Road densities range from 0.2 to 64.4 km/km<sup>2</sup>, with a mean of 24.5 km/km<sup>2</sup> and a median of 24.83 km/km<sup>2</sup>. The distribution is slightly skewed and dominated by intermediate densities (15–30 km/km<sup>2</sup>; interquartile range = 15.38 km/km<sup>2</sup>), which are primarily concentrated in central and pericentral areas. Extreme values correspond either to highly serviced zones or to severely under-provided sectors. A standard deviation of 11.48 km/km<sup>2</sup> indicates strong spatial heterogeneity.



**Figure 5.** Choropleth map showing the spatial distribution of road network density in Greater Lomé (a) and Yaoundé (b).

Source: Field survey, April-September 2025.

Figure 6 illustrates the radial evolution of road network densities in the studied cities, from the urban core towards the peripheral areas.



**Figure 6.** Radial profile of road network densities in Greater Lomé (a) and Yaoundé (b).

Source: Field survey, April-September 2025.

Greater Lomé exhibits a more extensive spatial footprint than Yaoundé, which justifies the use of a 30-km analytical radius for greater Lomé, compared with a 20-km radius for Yaoundé. These two curves clearly reveal two distinct morphological patterns in the road network. In Greater Lomé (Figure 6a), road density shows a gradual decline between 5 and 30 km from the city centre, following a pronounced polynomial trend ( $R^2 = 0.89$ ). A moderate increase beyond 15 km reflects localised concentrations of higher road density, corresponding to the initial formation of secondary urbanisation nodes. In Yaoundé (Figure 6b), the radial profile of road density from the city centre also exhibits a strong polynomial fit ( $R^2 = 0.90$ ). Densities decrease steadily between 5 and 15 km, before rising again in the outer areas around 20 km. This pattern points to the emergence of secondary poles and reflects an ongoing process of polycentric urban development.

### Road network connectivity in Greater Lomé and Yaoundé

In Greater Lomé, at the scale of the entire urban area, the connectivity of the structuring road network, comprising transit, arterial and collector roads, is characterised by a  $\beta$  index of 0.90, indicating a low level of connectivity. This value situates the network between a tree-like configuration and a partially meshed structure. At the sectoral scale (urban peripheries), however, the indicators reveal higher levels of connectivity.

- In the consolidated sector, the  $\beta$  index for the structuring road network equals 1 (minimum connectivity), while the  $\beta$  index for the entire network reaches 1.55, reflecting a well-connected local network.
- In the emerging sector, the  $\beta$  index of the structuring network is 0.83, indicating weak connectivity, whereas the  $\beta$  index of the total network is 1.47, suggesting good internal connectivity.

Overall, peripheral sectors display higher levels of internal connectivity than those observed at the scale of Greater Lomé as a whole, highlighting structural differences between the primary network and local street systems.

In Yaoundé, at the urban scale, the structuring road network exhibits a  $\beta$  connectivity index of 1.25, reflecting a level of connectivity above the minimum threshold, while peripheral sectors show more contrasted patterns.

- In the consolidated sector, the  $\beta$  index of the primary network is 1.08 (minimal integration), whereas the  $\beta$  index of the total network is 0.59, indicating insufficient secondary meshing.
- In the emerging sector, the  $\beta$  index of the primary road network is 0.75, denoting under-connectivity, and the  $\beta$  index for the entire network is 0.61, reflecting a very weakly connected system.

Taken together, these results describe a hierarchical road system combining a pronounced radial structure, relatively high connectivity within the primary network, and peripheral configurations that remain incomplete and in the process of formation.

### Qualitative characterisation of public road space in the peripheral sectors of Greater Lomé and Yaoundé

Table 6 synthesises the assessment of road space quality based on the functional road hierarchy, the criteria defined in the observation grid, and the different types of peripheral areas. The results reveal marked disparities between the two cities, between peri-urban sectors, and across road categories. Field observations indicate a partially materialised road hierarchy organised into four levels: metropolitan structuring roads, arterial roads, collector roads and local streets, together with a progressive decline in both infrastructure quality and public space conditions from major corridors towards local access streets.

**Table 6.** Average road quality scores by city, sector, and road hierarchy.

Cities	Sectors	N*	Structural	Arterial	Collector	Local streets
Greater Lomé	Consolidated	215	1.43	–	0.71	1.00
Greater Lomé	Emerging	245	1.43	–	0.57	1.00
Yaoundé	Consolidated	225	–	0.86	0.71	0.57
Yaoundé	Emerging	205	–	–	0.43	0.43

\*N: number of road segments per sector; –: road type absent in the sector under study.

Likert scale: 0 = non-compliant, 1 = partially compliant, 2 = compliant.

Source: Field survey, April-September 2025.

In Greater Lomé, the metropolitan structuring road network, present in both sectors, records the highest scores and reaches a medium level of quality. This performance is largely attributable to geometries that are broadly compliant with standards and to the generally good condition of road surfaces, despite the discontinuity of

pedestrian facilities and the partial presence of a green infrastructure framework. Arterial roads are absent. Distributor (collector) roads exhibit the weakest performance (0.71 in the consolidated sector and 0.57 in the emerging sector), corresponding to a low-quality level linked to the lack of paving, sidewalks, adequate street lighting and street trees. Local streets attain a medium score (1.00) in both sectors due to their adequate width and good connectivity, but remain unpaved and poorly equipped, which significantly constrains their effective functionality.

In Yaoundé, metropolitan structuring roads are non-existent, and arterial roads, confined to the consolidated peripheral sector, display a low quality level (0.86) due to limited right-of-way widths and incomplete facilities, including partial pedestrian and lighting provision and the absence of green infrastructure. Distributor roads and local streets are generally deficient, with a critical situation in the emerging sector (0.43), indicating a network that is close to non-functional. These poor performances result from limited connectivity, insufficient road widths, the absence of sidewalks and green infrastructure, discontinuous lighting, and the fragmented nature of the network.

In comparative terms, peripheral areas of Greater Lomé exhibit higher overall levels of road quality than Yaoundé. In both cities, emerging peripheral sectors consistently record the lowest scores, while the road hierarchy is more complete and performs more effectively in Greater Lomé than in Yaoundé.

## DISCUSSION

### **Spatial inequalities in access to public green spaces: ecological marginalisation**

The results reveal pronounced spatial disparities in access to public green spaces across the sectors studied, confirming a marked decline in provision with increasing distance from urban centres [47]. In both cities, the analysed peripheral areas are devoid of PGS, and access distances largely exceed the 300 m threshold recommended by the World Health Organization, reflecting a deeply unequal distribution of environmental amenities. The surface share of public gardens and squares remains below 8%, while urban parks and forests, though fewer in number, account for most of the total green space area. This concentration of provision within historic urban cores reinforces a form of structural spatial injustice, depriving emerging peripheral areas of equitable access to PGS and their associated environmental benefits.

Synthetic indicators further corroborate these contrasts in access to public green spaces. Relative Accessibility Index (RAI) values above 1 indicate significantly more favourable access conditions in consolidated peripheral areas, whereas Equity Gap values well above 0, around 6 in Yaoundé and 8 in Greater Lomé, point to pronounced situations of spatial injustice between consolidated and emerging peripheral sectors. The latter clearly emerge as the most disadvantaged in both urban contexts. This configuration reinforces environmental inequalities already documented in sub-Saharan Africa [23, 47] and echoes forms of ecological marginality observed elsewhere, notably in M'Sila, Algeria [48]. In such contexts, inequalities are closely linked to the economic vulnerability of local populations and to planning priorities that favour housing production, relegating green spaces to a marginal position in urban development. In the same vein, Mustapha and Nuscia [49] show that rapid and insufficiently planned urbanisation intensifies land pressure, affecting both historically endowed neighbourhoods and newly developed urban extensions, thereby accelerating the progressive loss of public green spaces in favour of densification in cities of North and East Africa. Taken together, these findings suggest that the provision of PGS remains insufficiently integrated into contemporary urban planning practices in Africa cities. The RAI and Equity Gap values further confirm the specific vulnerability of peripheral areas to environmental inequalities.

### **The paradox of accessibility to PGS: between theoretical travel times and lived realities**

Moreover, GIS-based analyses conducted using the OpenRouteService (ORS) plugin indicate theoretically relatively short access times for the peripheral sectors studied. However, qualitative field observations reveal frequently degraded mobility conditions, linked to poor road surface quality and recurrent traffic congestion. The literature indeed underscores the prevalence of recurrent congestion, particularly in Yaoundé [50]. This discrepancy between modelled travel times and real mobility conditions confirms the limitations of approaches relying solely on theoretical travel times, as previously noted by Apparicio et al. [51] in the context of healthcare accessibility in Québec. The gap between theoretical and effective travel times, especially pronounced during peak hours, argues for a more systematic integration of lived mobility experience into accessibility assessments [52]. In Greater Lomé, trips to PGS are generally longer in terms of time–distance ratios than in Yaoundé, regardless of distance, reflecting more restrictive traffic conditions. This apparently counter-intuitive result, given the well-documented congestion levels in Yaoundé, can be explained by infrastructure characteristics: in Greater Lomé peripheries, distributor roads and local streets remain unpaved, despite rights-of-way that meet or exceed minimum standards, which substantially undermines traffic fluidity.

## **Contrasting road morphologies and dual connectivity structures within urban street networks**

The combined analysis of road network morphology, connectivity and environmental quality reveals marked structural contrasts between the two cities. These contrasts extend beyond formal differences and reflect enduring disparities in functional performance and the quality of road public space, with direct implications for daily mobility conditions and, more broadly, urban liveability [53].

From a morphological perspective, Greater Lomé is characterised by a moderate average road density and a largely monocentric structure. By contrast, Yaoundé exhibits a higher network density and a distinctly polycentric configuration, reflecting a multipolar urban structure. These contrasting patterns confirm that road network morphology is a relevant indicator of centrality patterns and modes of urban growth [53, 54]. These morphological differences are mirrored in connectivity structures. At the citywide scale, the primary road network is generally more connected in Yaoundé than in Greater Lomé. Conversely, this hierarchy is reversed in peripheral areas, where local connectivity levels are higher in Greater Lomé. This dissociation between global and local connectivity reveals two distinct network models: in Greater Lomé, relatively well-meshed peripheral areas embedded within a weakly structured urban system; in Yaoundé, a high-performing primary network combined with fragmented and poorly interconnected peripheral fabrics. These contrasts confirm the central role of connectivity in shaping the efficiency of daily mobility and the legibility of circulation systems [55, 54].

### **Public road space and environmental deficits: a constraint on user comfort**

Beyond morphological and structural attributes, the findings show a clear dissociation between network connectivity and the qualitative performance of road public space, varying across cities and scales. In both contexts, pedestrian discontinuities, inadequate lighting and the lack of street vegetation substantially constrain the quality of road space, particularly in emerging peripheral areas, without systematically corresponding to connectivity levels. In Greater Lomé, relatively high local connectivity, sometimes exceeding that of the citywide network, does not translate into qualitative performance, as it relies on dense but poorly equipped grids characterised by unpaved surfaces and discontinuous sidewalks. By contrast, in Yaoundé, connectivity is concentrated within the primary network, while peripheral areas remain both weakly connected and qualitatively deficient, indicating a limited transfer of network performance from urban cores to peripheral fabrics.

These contrasts underscore that road network analysis cannot be confined to a strictly structural or hierarchical reading, but must adopt a multi-scalar approach integrating connectivity, functional hierarchy and concrete conditions of use of road public space [56, 57]. The partial implementation of road hierarchy frameworks, notably those inspired by CEREMA [13], tends to prioritise major axes without ensuring qualitative improvements on secondary roads, where cumulative deficits in surfacing, lighting and pedestrian continuity are most acute. In the tropical contexts studied, the lack of shading and vegetation further exacerbates these imbalances by directly affecting thermal comfort and everyday appropriation of public space [12, 58]. Overall, the findings confirm that the environmental and functional quality of road public space is a key determinant of peripheral urban liveability, alongside morphology and connectivity, although operating through differentiated mechanisms across cities and spatial scales.

### **Theoretical contributions and planning implications**

The findings reveal a clear differentiation in the quality of public spaces across the two capitals studied (Greater Lomé and Yaoundé). In the peripheral sectors analysed, the absence of PGS contrasts with the presence of partially developed road infrastructure, revealing a heterogeneous urban fabric consistent with analyses of the social production of space [6] and with studies of urban fragmentation in African cities [59, 60]. This configuration illustrates how the unequal provision and organisation of urban infrastructure structure access to amenities and reproduce inequalities, in line with the spatial justice paradigm [18, 19].

Three key insights emerge from the analysis. First, public green spaces constitute a central determinant of neighbourhood quality of life, particularly in peripheral areas. This finding points not merely to the need for increased provision, but also to the establishment of qualitative standards and effective accessibility in line with recommended norms, which remain largely unmet. Second, roads should be conceived as public spaces in their own right. Beyond their circulation function, they support social, recreational and environmental practices [12, 61, 62]. This requires coherent and context-sensitive design, grounded in a legible road hierarchy, controlled density and connectivity, and consistent quality of associated elements (sidewalks, lighting and vegetation), as prerequisites for an integrated and sustainable network. Finally, access to public spaces, whether green spaces or other urban amenities, fundamentally relies on the road network and therefore calls for a multidisciplinary approach that combines urban morphology, conditions of use, environmental quality and residents lived experiences. In this

respect, the structuring of public spaces in peripheral areas emerges as a major lever for spatial justice, contributing simultaneously to improved living conditions and more balanced urban development.

Despite these methodological and empirical advances, the study presents several limitations which, without calling the reliability of the results into question, delineate clear directions for future research. OpenStreetMap data, although validated, may overlook certain cartographic features in rapidly transforming urban environments. Accessibility and connectivity indicators are derived from assumed travel speeds and do not account for congestion patterns or the actual condition of infrastructure. Finally, the environmental analysis does not incorporate dendrometric or microclimatic measurements, thereby constraining the precision of both green network characterisation and the assessment of thermal comfort. These limitations underscore the relevance of more refined hybrid approaches combining real-time data and multi-scale modelling. They also strengthen the case for tighter integration between scientific evidence and public policy, and provide a coherent transition towards a concluding argument on the necessity of proactive and collective action.

## CONCLUSION

This article jointly analysed public green spaces and the road public space in order to assess their contribution to accessibility and spatial equity in the urban peripheries of Greater Lomé and Yaoundé. In both cities, the peripheral sectors under study are characterised by a severe shortage of public green spaces, more pronounced in Greater Lomé, reflecting persistent environmental inequalities. The results reveal a partially structured road hierarchy and contrasted levels of connectivity across analytical scales. However, these morphological performances do not automatically translate into effective accessibility. In both contexts, deficiencies in pedestrian infrastructure, public lighting and street tree planting emerge as major limiting factors for local mobility, access to urban amenities and the environmental quality of public spaces. The combined use of GIS-based indicators, equity metrics and field observations thus demonstrates the necessity of integrating qualitative dimensions into urban accessibility analyses, in order to reduce the gap between theoretical connectivity and actual travel conditions. The comparison between Greater Lomé and Yaoundé further shows that distinct morphological configurations may generate convergent forms of access inequality, underscoring the influence of urbanisation trajectories. More broadly, these findings call for a rethinking of urban planning through the lens of spatial justice, by considering not only for physical structures but also for uses, surrounding environments and lived experiences. Finally, although this research relies on a largely static analytical framework, it opens avenues for future work, through the integration of temporal and participatory approaches and more refined connectivity models. Investigating the institutional determinants and actor dynamics underlying the observed deficits also emerges as a key research priority for supporting the production of sustainable living environments in Sub-Saharan African cities.

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## REFERENCES

- Paquot T. V / Usages et pratiques des espaces publics. *Repères*. 2024 ; 3:91–106. <https://shs.cairn.info/l-espace-public--9782348083068-page-91?lang=fr>.
- Ballarini L. *L'espace public au-delà de l'agir communicationnel. Quatre renversements de perspective pour sortir des impasses du modèle habermassien*. These. Université Paris VIII Vincennes-Saint Denis, 2010.
- Diaw A. Nouveaux contours de l'espace public en Afrique. *Diogène*. 2004; 206(2):37–46. <https://doi.org/10.3917/dio.206.0037>.
- Diangitukwa F. The Distant Origin of African Governance: The Palaver Tree. *Revue Gouvernance / Governance Review*. 2014; 11(1):1-20. <https://doi.org/10.7202/1038881ar>.
- Dahou T. L'espace public face aux apories des études africaines \*. *Cahiers d'études africaines*. 2005; 45(178):327–349. <https://doi.org/10.4000/etudesafriaines.5412>.
- Lefebvre H. La production del espacio. *Revista de sociología*. 1974; 3:219–229.
- UN-Habitat. *Global Public Space Toolkit from Global Principles to Local Policies and Practice*. 2nd ed. Nairobi GPO Kenya: United Nations Human Settlements Programme (UN-Habitat); 2015.

- Mensah C.A. Urban Green Spaces in Africa: Nature and Challenges. *International Journal of Ecosystem*. 2014; 4(1):1–11. <https://doi.org/10.5923/j.ije.20140401.01>.
- Somadjago M. Dynamique urbaine et problématique des espaces verts dans la ville de Lomé: enjeux et perspectives. These. Université de Lomé, 2018. Catalogue en ligne <h3>Direction de la Bibliothèque et des Archives (DBA-Université de Lomé)</h3>.
- Cissé M., Morenikeji O., Mertens E., Fall A.N., Okhimamhe A.A. Assessment of Green Space Dynamics Under Urban Expansion of Senegalese Cities: The Case of Dakar. *Urban Science*. 2024; 8:258. <https://doi.org/10.3390/urbansci8040258>.
- Alhammad BA, Altwaijri AK, Alhowaish AK. Global Knowledge Structure of Urban Green Space Research in Hot–Humid Regions (2000–2025): A Bibliometric Analysis. *Journal of Cultural Analysis and Social Change*. 2026; 11(1):635–54. <https://doi.org/10.64753/jcasc.v11i1.3923>.
- Gehl J. *Cities for People*. Island Press; 2013.
- Cerema. *Voirie urbaine: guide d'aménagement 2016*. <https://doc.cerema.fr/Default/digital-viewer/c-14600>.
- UN-Habitat. *National Urban Policies Driving Public Space Led Development: A Quick Thematic Guide for Mainstreaming Safe, Inclusive and Accessible Public Spaces into National Urban Policies*. Nairobi GPO KENYA: United Nations Human Settlements Programme (UN-Habitat); 2020.
- Blakime T-H, Adjonou K, Komi K, Hlovor AKD, Gbafa KS, Zoungrana J-BB, et al. Dynamics of Built-Up Areas and Challenges of Planning and Development of Urban Zone of Greater Lomé in Togo, West Africa. *Land*. 2024; 13(84):1-16. <https://doi.org/10.3390/land13010084>.
- Pettang C, Louzolo-Kimbembé P, Eteme AA. Application à la ville de Yaoundé. *Journal of Decision Systems*. 2004; 13(3):307–326. <https://doi.org/10.3166/jds.13.307-326>.
- Nouembissi Feukam E, Youta HJ. Expansion urbaine et vulnérabilité aux mouvements de masse dans la commune de Yaounde 6: approche par SIG. *Journal of the Cameroon Academy of Sciences*. 2025; 21(3):187–202. <https://doi.org/10.4314/jcas.v21i3.3>.
- Harvey D. The Right to the City. *New Left Revue*. 2008; 53:23–40. <https://doi.org/doi.org/10.64590/fmh>.
- Soja EW. *Seeking Spatial Justice*. University of Minnesota Press; 2010. <https://doi.org/10.5749/minnesota/9780816666676.001.0001>.
- Bullard R.D. *Dumping In Dixie: Race, Class, And Environmental Quality*, 3rd Ed. Taylor & Francis; 2018.
- Agyeman J. *Introducing Just Sustainabilities: Policy, Planning, and Practice*. 1st ed. Bloomsbury Publishing; 2013. [https://www.bloomsbury.com/us/introducing-just-sustainabilities-9781780324081/?utm\\_source=chatgpt.com](https://www.bloomsbury.com/us/introducing-just-sustainabilities-9781780324081/?utm_source=chatgpt.com).
- Belaidi N. Théorie du droit et front écologique: apport à la (re)définition de la justice environnementale. *Développement durable et territoires Économie, géographie, politique, droit, sociologie*. 2015. <https://doi.org/10.4000/developpementdurable.10806>.
- Diallo M. La fabrique des acteurs de la justice environnementale dans l'Aire marine protégée du Bamboung au Sénégal. *Vertigo*. 2019; 19(1):1-25. <https://id.erudit.org/iderudit/1065408ar>.
- Parnell S, Pieterse E. *Africa's Urban Revolution*. Zed Books, London and New York. 2014.
- Kpassokro A.S.G. Cameroun. *Annuaire sur le Financement du Logement en Afrique 2023*. Centre for Affordable Housing Finance in Africa (CAHF), Cape Town, South Africa: CAHF. 2023; 65–70. *Annuaire du financement du logement en Afrique – CAHF | Centre for Affordable Housing Finance Africa*.
- Assogbavi K.A. Togo. *Annuaire sur le Financement du Logement en Afrique 2023*. Centre for Affordable Housing Finance in Africa, Cape Town, South Africa: CAHF. 2023; 309–313. *Annuaire du financement du logement en Afrique – CAHF | Centre for Affordable Housing Finance Africa*.
- Heinrichs D., Ehebrecht D., Lenz B. Moving beyond informality? Theory and reality of public transport in urban Africa. *Urban Mobilities in the Global South*. Routledge. 2017; 134–154. <https://doi.org/10.4324/9781315265094-8>.
- Skinner C., Watson V. The informal economy in urban Africa: Challenging planning theory and praxis. *The Informal Economy Revisited*. Routledge; 2020; 123–131. <https://doi.org/10.4324/9780429200724-21>.
- Haase D., Larondelle N., Andersson E., Artmann M., et al. A Quantitative Review of Urban Ecosystem Service Assessments: Concepts, Models, and Implementation. *AMBIO*. 2014; 43:413–433. <https://doi.org/10.1007/s13280-014-0504-0>.
- Negron P., Lord S., Zembri P., Després M. Les enjeux d'accessibilité dans la ville: entre équité spatiale et exclusion sociale. *Territoire en mouvement, Revue de géographie et aménagement*. 2018. <https://journals.openedition.org/tem/4648> (accessed December 2, 2025).
- Akomolehin O.F., Aluko O.R., Akomolehin B. V. Urban Poverty and Spatial Inequality: A Geospatial Analysis of Slum Dynamics in Rapidly Growing African Cities. *International Journal of Innovative Science and Research Technology*. 2025; 2035–2051. <https://doi.org/10.38124/ijisrt/25aug1266>.

- Conzen M.R.G. Alnwick, Northumberland: A Study in Town-Plan Analysis. 2nd ed. Londres: Institute of British Geographers, Institute of British Geographers Publication 27. 1969.
- Lagesse C., Bonnin P., Bordin P., Douady S. Méthodologie de modélisation et de caractérisation des réseaux spatiaux. Application au réseau viaire de Paris. Flux. 2016; 105:33–49. <https://doi.org/10.3917/flux.105.0033>.
- Beck H.E., McVicar T.R., Vergopolan N., Berg A., Lutsko N.J., Dufour A., et al. High-resolution (1 km) Köppen-Geiger maps for 1901–2099 based on constrained CMIP6 projections. 2023. <https://doi.org/10.6084/m9.figshare.c.6395666.v1>.
- INSEED. 5e Recensement général de la population et de l'Habitat (RGPH-5) de Novembre 2022 : Distribution spatiale de la population résidente par sexe. Lomé. 2023. <https://inseed.tg/resultats-definitifs-du-rgph-5-novembre-2022/>.
- INS. Annuaire statistique de la Région du Centre/ Statistical Yearbook of the Center Region. Yaoundé. Institut National de la Statistique du Cameroun. 2024. Microsoft Word - Annuaire statistique du Centre À©dition 2024 \_RÃ©parÃ©\_ \_1\_.
- Lebga AK, Nyonkwe Ngo Ndjem MLS, Yemmafouo A. Peri-urban dynamics: The case of Yaounde town and its environs. International Journal of Scientific & Engineering Research. 2018; 9(11):1952–1957.
- Robinson J. Introduction: Generating concepts of 'the urban' through comparative practice. Urban Studies. 2022; 59(8):1521–1535. <https://doi.org/10.1177/00420980221092561>.
- UN-Habitat. Global public space programme, Annual Report 2021. Nairobi GPO KENYA: United Nations Human Settlements Programme; 2022. <https://unhabitat.org/global-public-space-programme-annual-report-2021>.
- Cerema. Nature en ville - série de fiches: Fiche n° 1: La nature comme élément du projet d'aménagement urbain 2019. <https://doc.cerema.fr/Default/digital-viewer/c-17057>.
- Rudd A. City-Wide Public Space Strategies: A Guidebook for City Leaders | UN-Habitat. Nairobi 00100: UN-Habitat; 2020. City-Wide Public Space Strategies: A Guidebook for City Leaders | UN-Habitat.
- Zhang J., Yue W., Fan P., Gao J. Measuring the accessibility of public green spaces in urban areas using web map services. Applied Geography. 2021; 126:102381. <https://doi.org/10.1016/j.apgeog.2020.102381>.
- Du X., Zhang X., Wang H., Zhi X., Huang J. Assessing Green Space Potential Accessibility through Urban Artificial Building Data in Nanjing, China. Sustainability. 2020; 12(23): 9935. <https://doi.org/10.3390/su12239935>.
- Slocum T.A., McMaster R.B., Kessler F.C., Howard H.H. Thematic Cartography and Geovisualization. 4th ed. Boca Raton: CRC Press; 2022. <https://doi.org/10.1201/9781003150527>.
- Beauguitte L. Indices Kansky. HyperGeo. 2020. <https://hypergeo.eu/indices-kansky/> (accessed December 3, 2025).
- Ahmed F., Rahman M.A., Mia M.S., Magazzino C. Service Quality and Customer Satisfaction in The Fast-Food Industry of Malaysia. Journal of Cultural Analysis and Social Change. 2026; 1754–69. <https://doi.org/10.64753/jcasc.v10i4.3528>.
- Kabanyegeye H., Masharabu T., Sikuzani Y.U., Bogaert J. Perception sur les espaces verts et leurs services écosystémiques par les acteurs locaux de la ville de Bujumbura (République du Burundi). Tropicultura. 2020. <https://doi.org/10.25518/2295-8010.1655>.
- Mili M., Boutabba H., Boutabba S-D. La nature urbaine: dégradation quantitative et qualitative des espaces verts urbains, cas de la ville steppique de M'Sila, Algérie. urbe, Revista Brasileira de Gestão Urbana. 2019; 11: e20180138. <https://doi.org/10.1590/2175-3369.011.e20180138>.
- Mustapha E.H., Nuscia T. A. Le paysage colonial en Afrique ; Le végétal dans l'espace public des villes coloniales de Marrakech, Alger, Antananarivo et Toliara. Enjeux socio-environnementaux d'un «patrimoine» vert dans un contexte urbain en mutation. Africana Studia. 2019; (32): 27-38. (hal-02984884).
- Kengmoé Tchoungsi E. Mobilité Urbaine et Engorgement de la Voirie dans la Commune d'arrondissement de Yaoundé IVème. East African Scholars J Edu Humanit Lit. 2025; 8(6): 220–237. <https://doi.org/10.36349/easjehl.2025.v08i06.009>.
- Apparcio P., Gelb J., Dubé A-S., Kingham S., Gauvin L., Robitaille É. The approaches to measuring the potential spatial access to urban health services revisited: distance types and aggregation-error issues. International Journal of Health Geographics. 2017; 16(32): 1-24. <https://doi.org/10.1186/s12942-017-0105-9>.
- Garcia K., Rodhain A., Gourmelen A., Masson J. L'accessibilité alimentaire: Une approche par l'expérience vécue des étudiants décohabitants. Recherche et Applications En Marketing (French Edition). 2024; 39(3):123–164. <https://doi.org/10.1177/07673701241247629>.
- Marshall S. Streets and Patterns. London: Routledge; 2004. <https://doi.org/10.4324/9780203589397>.
- El Gouj H., Rincón-Acosta C., Lagesse C. Urban morphogenesis analysis based on geohistorical road data. Applied Network Science. 2022; 7(6). <https://doi.org/10.1007/s41109-021-00440-0>.

- Pouyanne G. *Forme Urbaine et Mobilité Quotidienne*. These. Université Montesquieu - Bordeaux IV. 2004. <https://theses.hal.science/tel-00071608>.
- Stransky V. *Forme et fonction d'un réseau: cas de la voirie urbaine de desserte locale*. Theses. Université Paris XII Val de Marne. 1995. <https://theses.hal.science/tel-00129522>.
- Nabaa M. *Morphodynamique de réseaux viaires - Application au risque*. Theses. Université du Havre. 2011. <https://theses.hal.science/tel-00623691>.
- Perrau A. *Towards a Wind Urbanism in Tropical Environments*. *Journal of Architectural/Planning Research and Studies (JARS)*. 2023; 20(2): 85–104. <https://doi.org/10.56261/jars.v20.252710>.
- Jaglin S., Didier S., Dubresson A. *Métropolisations en Afrique subsaharienne: au menu ou à la carte? Metropoles*. 2018. <https://doi.org/10.4000/metropoles.6065>.
- UN-Habitat. *Bridging the Affordability Gap: Towards a Financing Mechanism for Slum Upgrading at Scale in Nairobi*. Nairobi GPO Kenya: UN-Habitat; 2019. *Bridging the Affordability Gap: Towards a Financing Mechanism for Slum Upgrading at Scale in Nairobi | UN-Habitat*.
- Vallée J., Commenges H., Perchoux C., Kestens Y., Chaix B. *Mobilité quotidienne et accès potentiel aux ressources urbaines: quelles inégalités sociales? Données urbaines*. (7), *Economica*. 2015; 87–95. [halshs-01230217](https://halshs-01230217).
- Viana Cerqueira E. *L'accessibilité aux équipements dans le périurbain de Lille: quelles inégalités? Territory in movement* *Journal of geography and planning*. 2020. <https://doi.org/10.4000/tem.7068>.