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International Journal of Transportation and Logistics Research

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Pendular Mobility in Yaoundé: Determinants, Constraints and Sustainable Perspectives

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How To Cite: Nguiadem, A.S.; Wounba, J.F.; Fondzenyuy, S.K.; et al. Pendular Mobility in Yaoundé: Determinants, Constraints and Sustainable Perspectives. *International Journal of Transportation and Logistics Research* **2025**, *1*(1), 7. https://doi.org/10.53941/ijtlr.2025.100007

Received: 4 August 2025
Revised: 12 October 2025
Accepted: 4 November 2025
Published: 17 November 2025

Abstract: Urban mobility in Yaoundé is increasingly constrained by rapid demographic growth, unbalanced spatial development, and the absence of structured public transport. Daily commutes between peripheral neighbourhoods and the city centre are characterised by long travel times, heavy congestion, and strong reliance on informal modes. This study addresses the central question of which factors explain long commuting times in Yaoundé, and how they can be mitigated to improve daily mobility conditions. The analysis, based on a survey of 214 respondents (205 valid cases), complemented by spatial analysis, used a binary logit model to estimate the factors affecting the duration of commutes. The results show that over 18% of commuters report trips exceeding one hour, mostly using shared taxis and private cars. There is a significant use of motorcycle taxis to meander in traffic and reduce travel times often without regard for safety. Distance from the city centre, presence of traffic congestion and absence of reliable public transport are the most significant determinants of long commutes, whereas motorcycle taxis reduce the travel duration. Spatial analysis highlights recurrent bottlenecks where large incoming flows converge without adequate infrastructure or effective traffic management. Policy recommendations for efficient pendular mobility in Yaoundé include structuring public transport corridors with options, improved city planning, and strengthening governance through a metropolitan mobility authority, and regulating informal modes. These findings underline the urgency of integrated and inclusive strategies to foster sustainable commuting in Yaoundé.

Keywords: commuting; Yaoundé; informal transport; binary logit; accessibility

1. Introduction

In rapidly expanding cities in Africa, daily commutes are a major challenge for residents. This is because these cities are usually characterised by unplanned urban growth and saturated transport infrastructure. Commutes for various purposes reflect deep-seated tensions among urbanization, accessibility, and the organization of transport systems, especially as home-to-work (HW) and home-to-school (HS) journeys are traditionally considered as determining factors for the shape and dimensioning of transport networks [1]. Recent literature sheds complementary light on these dynamics, drawing from multidisciplinary approaches that combine urban planning, transport geography, and social sciences.

The concentration of services, employment opportunities, and administrative institutions in the city centre exerts increasing pressure on the already fragile transport networks, particularly during peak hours. This excessive

centralization, compounded by uncontrolled suburban sprawl, results in prolonged travel times, rising transport costs, and a decline in the overall quality of life for users [2]. Empirical evidence from African cities, though limited, reveals persistent spatial inequalities in mobility. In Dakar, service distribution and transport coverage remain uneven [3]. In Nairobi, precarious workers alternate between walking and informal minibuses to manage cost and time constraints [4]. In Yaoundé, the lack of a structured public transport network reinforces disparities linked to both residential location and social status [5]. Together, these cases illustrate that commuter needs are insufficiently understood and poorly integrated into urban transport policies [6].

In the absence of reliable public transportation, informal modes (motorcycle taxis, minibuses, and shared taxis) carry the majority of daily home-to-work trips. Informal transport providers are very essential in city life across Africa as they serve the urban and marginalised groups and enable daily movements [7]. While informal transport meets the immediate need, they fail to ensure effective regulation or environmental sustainability as these are usually associated with transport safety risks, unpredictable costs, traffic congestion, local pollution, and the exclusion of vulnerable populations [6,8,9]. One of the transport risks associated with such an unstructured system is road crashes. In Yaoundé, over 480 crashes were reported in 2019 affecting all the available transport modes [10] and the key barriers to adopting public transportation are long waiting times and traffic congestion [11]. These issues, projected to worsen if left unchecked, underscore the need for a good transport system.

Drawing on the theoretical foundations of transaction cost economics [12] and urban transport geography, pendular mobility is interpreted here as the outcome of individual trade-offs between time, cost, and uncertainty within a transport environment marked by weak formal provision and pervasive informality. Commuters face several constraints, including but not limited to traffic congestion, absence of efficient connections in the transport network and dominance of informal transport. These reflect shortcomings in the infrastructure and city planning showing that planners and decision makers have shown limited interest [13,14].

The prevailing modes of transport in Yaoundé are informal. Cars and motorcycles, comprised of personal and commercial (taxis) vehicles, dominate the transport system. Studies in other Sub-Saharan cities showed that the most valued perceived interventions to improve daily commutes were improving the public transport system by increasing bus routes, ensuring public transport vehicles roadworthiness, improved frequency of buses, and safety of users [6].

The analysis is theoretically framed within the “predict and prevent” approach of sustainable urban mobility and the transaction cost theory [15,16]. According to these frameworks, travel behaviour results from negotiated compromises between accessibility, affordability, and time, constrained by institutional inefficiencies and spatial structures. Prior studies in Sub-Saharan Africa confirm that informality and centralization increase transaction costs and shape commuting choices[13]. Integrating these concepts provides a coherent explanation for how structural constraints and user decisions jointly determine pendular mobility outcomes.

In order to understand the challenges and provide tailored recommendations, this paper aims to analyse commuting dynamics between communes in Yaoundé, identify the determinants of extended travel durations and provide an analytical foundation for guiding public policy choices toward more fluid, inclusive, and sustainable urban mobility. The novelty of this paper is two-fold. First, it uses survey data (information on the mobility of workers (and students), which has become significantly poorer in quality [1], with secondary data cross referenced from other sources, and spatial mapping to explore intercity commuter mobility (pendular mobility) in a sub Saharan African city. Secondly, the study harmonises objective indicators (distance, congestion, mode of transport) and subjective perceptions (comfort, reliability, cost). It combines quantitative modelling, spatial mapping, and qualitative feedback, an approach rarely applied in Central African urban studies. This multidimensional perspective contributes methodologically by linking user behaviour and territorial constraints within a single analytical framework.

2. Materials and Methods

This paper implements a combined methodological approach of empirical field data with statistical and spatial analysis tools to analyse and understand urban mobility patterns of road users in Yaoundé.

A qualitative survey was used to collect road user perspectives. Out of 213 responses collected, 8 were excluded because they were incomplete and inconsistent, and 205 responses were used for the study. The survey focused on home-to-work (h-w) trips for people who live and/or work in Yaoundé. The survey was conducted from February to March 2025, during regular weekdays and peak commuting hours (6:30–9:30 a.m. and 4:30–8:30 p.m.). A stratified sampling strategy was implemented to ensure that all seven communes of Yaoundé were proportionally represented according to population density and socio-economic profile. Within each commune, respondents were selected at major transport nodes (markets, intersections, taxi parks) and stratified by gender and

professional status. Only adult residents commuting at least three times per week between home and workplace or school were eligible. Field observations identified congestion hotspots and adaptive behaviours, while the interviews contextualized the quantitative findings by highlighting systemic constraints. The minimum sample size was derived using Cochran's formula:

$$n_0 = \frac{Z^2 \times p \times q}{e^2} \quad (1)$$

where:

- Z = 1.96 for a 95% confidence interval
- p = 0.5 (maximum proportion for a conservative sample)
- $q = 1 - p = 0.5$
- e = 0.07 (desired margin of error) yielding $n_0 \approx 196$.

The response rate was 91.5% (205 valid responses out of 214 approached).

Additionally, interviews were conducted including municipal transport officers, taxi union representatives, and neighbourhood associations. Selection was based on their direct involvement in transport regulation or daily commuting management.

The questionnaire captured socio-demographic profiles, modes of transport used, average duration and cost, as well as users' perceptions of their travel conditions. In addition to the questions for the road users, relevant institutional and professional personnel (municipal staff, urban transport officials, taxi and motorcycle riders) were interviewed as well as direct observations of traffic conditions were conducted. These direct observations were carried out at strategic locations (intersections, taxi stops, market areas) to assess and quantify congestion, waiting times, and modal changes.

Data analysis comprised of identifying trends in the collected data, to show the modal share by profile, trip duration by origin and/or destination, costs and distribution of routes taken. Binary variables were created for travel time thresholds (≤60 min = 0; >60 min = 1). Factors influencing the travel time were identified as sets and their intersections were demonstrated using an UpSet plot [17]. A binary logit model was implemented to identify factors significantly influencing the likelihood of commuting for more than one hour. The logistic model used is based on the logit function, defined as follows:

$$\log \frac{\pi i}{1 - \pi i} = \beta_0 + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \cdots + \beta_k \cdot X_k \quad (2)$$

where:

- πi is the probability that an individual experiences a commute longer than one hour
- $X_1, X_2, \ldots X_k$ represent explanatory variables
- $\beta_0, \beta_1, \beta_2, \ldots \beta_k$ are coefficients to be estimated

The logit model was estimated using the Statsmodels library in Python to compute the coefficients, odds ratios, and confidence intervals for six explanatory variables (Distance; Transport mode used; Perceived level of congestion; Presence or absence of formal public transport; Occupation types; and Gender). The adequacy of the sample size was verified through a post-hoc power analysis adapted to binary logistic regression models. Following the widely accepted 10-events-per-variable (EPV) rule, a minimum of 60 positive cases was required for a model including six explanatory variables [18]. In our dataset of 205 valid responses, 38 participants (18.5%) reported commuting times exceeding one hour. This corresponds to an EPV ratio of 6.3, which, although slightly below the theoretical optimum, remains statistically acceptable for exploratory behavioural models with well-balanced predictors. A post-hoc calculation using an alpha of 0.05 and an expected moderate effect size (Cohen's $f^2 = 0.35$) produced a statistical power of 0.82, indicating that the sample was sufficiently powered to detect significant effects at the 5% level. Model validity was ensured by testing multicollinearity among independent variables using the Variance Inflation Factor (VIF) and the recommended threshold guidance [19]. The results from the logit model were transformed into odds ratio (OR).

This methodological approach, combining quantitative, qualitative, and spatial components, offers a multidimensional perspective on the interplay between individual perceptions, structural constraints, and territorial mobility dynamics.

3. Results

Yaoundé, the capital of Cameroon, is home to over 4.8 million residents [20]. For analysis purposes, the area of Yaoundé considered in this study fall within the limits of the seven communes of the city. The hilly topography of the city and its unequal distribution of streets greatly influences the intercity commuter mobility.

The structured questionnaire received 213 responses from road users around the previously mentioned strategic locations. Of the total responses, 205 were valid. The questionnaire comprised of demographic and commute related questions. The demographic information with the respective distribution according to travel time is summarized in Table 1. The data is characterized by varying gender (65% male and 35% female), age, occupation and travel modes. The modes of transport used are mainly cars and motorcycles (personal and taxis) and a small insignificant proportion walk and use buses. These travel modes are usually combined for some users during the same commute. Over 81% of respondents reported journeys of 1 h and under, mainly by shared taxi and motorcycle taxi.

Table 1. Survey summary: travel time distribution by demographics and purpose.

		***n* = 205**	**Percentage**	**Travel Time (No. of Responses)**	
			%	**1 h and below**	**Over 1 h**
Gender	Male	133	64.9	112	20
	Female	71	34.6	52	17
	Unspecified	1	0.5	0	1
Age	17 and under	8	3.9	7	1
	18–25	64	31.2	54	8
	26–36	66	32.2	50	15
	37–45	40	19.5	34	6
	46–55	19	9.3	14	5
	56 and up	8	3.9	5	3
Employment	Unemployed	19	9.3	19	1
	Student	62	30.2	53	8
	Employed—public sector	46	22.4	34	12
	Employed—private sector	44	21.5	36	7
	Employed—independent	33	16.1	23	10
	Other	1	0.5	1	0
Travel mode	Walking	1	0.5	1	0
	Motorcycle—personal	11	5.4	8	3
	Motorcycle—taxi	44	21.5	41	1
	Car—shared taxi	134	65.4	107	25
	Car—taxi service	6	2.9	6	0
	Car—personal	37	18.0	27	10
	Bus	4	2.0	3	1
Origin	Yaoundé 1	18	8.8	12	6
	Yaoundé 2	13	6.3	9	4
	Yaoundé 3	25	12.2	22	2
	Yaoundé 4	25	12.2	18	6
	Yaoundé 5	18	8.8	16	2
	Yaoundé 6	83	40.5	68	14
	Yaoundé 7	10	4.9	9	1
	Out of Yaoundé	13	6.3	10	3
Destination	Yaoundé 1	25	12.2	19	6
	Yaoundé 2	21	10.2	11	10
	Yaoundé 3	56	27.3	50	6
	Yaoundé 4	23	11.2	14	8
	Yaoundé 5	10	4.9	9	1
	Yaoundé 6	60	29.3	53	6
	Yaoundé 7	5	2.4	5	0
	Out of Yaoundé	5	2.4	3	1

Secondary data from local urban mobility projects supplemented the survey responses [21,22]. Combined findings indicate that a majority of road users depend on informal transport modes (59.6% of respondents use shared taxis as their primary mode of transport, while 17.3% use motorcycle taxis), followed by personal vehicles.

Based on individual origins, destinations and frequent possible paths taken, journey distances were estimated and split in two classes: less than 7 km (<7 km) and greater or equal to 7 km (≥7 km). This cut off distance of 7 km was corroborated from secondary data [21,22]. Over 18% of road users self-reported commute durations equal or greater than 60 min as shown in Figure 1A. For respondents from (peripheral areas such as Ekounou, Nkoabang, or Mvan), travel times regularly exceed 60 min. Associated travel costs are significant with daily expenditures ranging between 600 and 1500 FCFA, representing up to 35% of monthly income for low-income households.

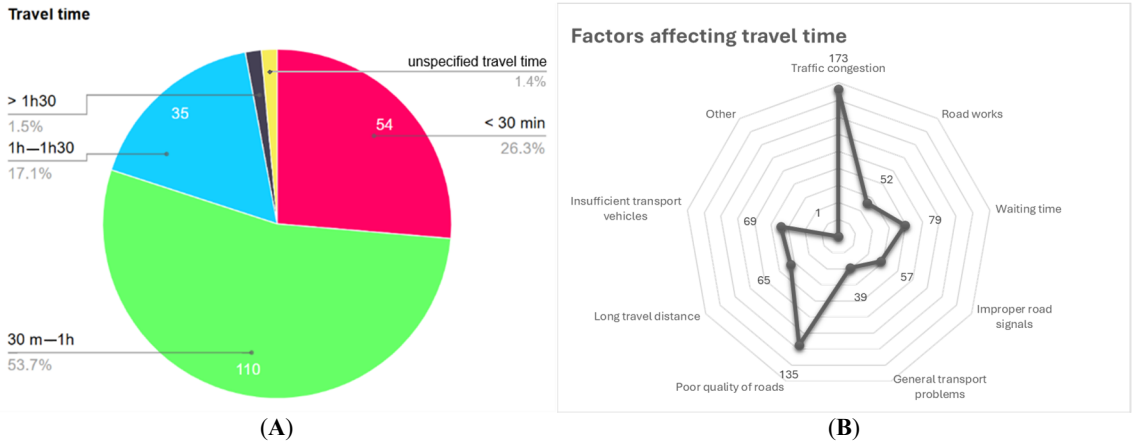

Figure 1. (**A**) distribution of travel times (**B**) user reported factors affecting traveling time.

The survey and the 2025 traffic study [21] revealed that the most constrained mobility corridors are those leading from Mvan, Ekonou, Nkoabang, Simbok and Nkolbisson to the city centre (Poste Centrale), and these are all peri-urban areas. These areas carry large amounts of traffic without appropriate infrastructure to facilitate the traffic flow.

Figures 2 and 3 illustrate the spatial distribution of commuting flows and the magnitude of travel-time losses along these routes. These figures were produced in ArGIS 10.8 by geocoding origin–destination pairs from the survey and overlaying delay estimates from the survey responses and the data of the 2025 traffic study [21]. Colour gradients indicate density and congestion levels, allowing easy identification of saturation zones and priority intervention areas. These critical points currently absorb high pendular flows without appropriate traffic management or infrastructure adaptation, leading to prolonged delays and uncoordinated modal transfers.

Several factors were identified by the road users as contributing to the unsustainable commutes in Yaoundé as shown in Figure 1B. These road users' challenges were represented as sets in Figure 4. This shows that the main identifiable factors that affect the commute are traffic congestion, insufficient transport vehicles (inadequate public transport), waiting time and long travel distance. The other identified factors exist in combination with one or more of these main factors, as they have intersections as shown in Figure 4.

From the logit model, distances greater than 7 km had an odds ratio (OR) of 13.7 showing that the probability for commuters with distances over 7 km to have travel times over 1 h is 14 times more compared to less than 7 km. Road users who experience congestion also have a three times chance of long travel durations (OR = 3.04). On the contrary, motorcycle taxi users reduce their chances for time-consuming commutes by 66%.

Three intermediate time values (cut-offs) were set for sensitivity analysis. The sensitivity analysis was conducted to examine the robustness of the model across the different threshold values for commuting time: >45 min, >60 min (primary threshold), and >75 min. Cutting off at 45 min and 60 min as the expected travel time, resulted in the same count as 45- and 60-min fall in the same range of the recorded travel time, showing no difference in the results. With a cut-off at 75 min, just 1.5% of respondents would be considered to have long commutes. Despite the smaller sample size at the highest threshold, the estimated coefficients and significance levels of the core variables, particularly commuting distance and perceived congestion, remained stable.

The binary logistic regression model identifies the most significant factors associated with travel durations exceeding one hour, as shown in Table 2. Correlation test of the independent variables with VIF showed that distance and congestion showed the strongest structural constraints. The VIF for all the independent variables were less than 5 indicating acceptable levels of correlation among predictors. These results support the reliability and robustness of the findings based on the one-hour cutoff.

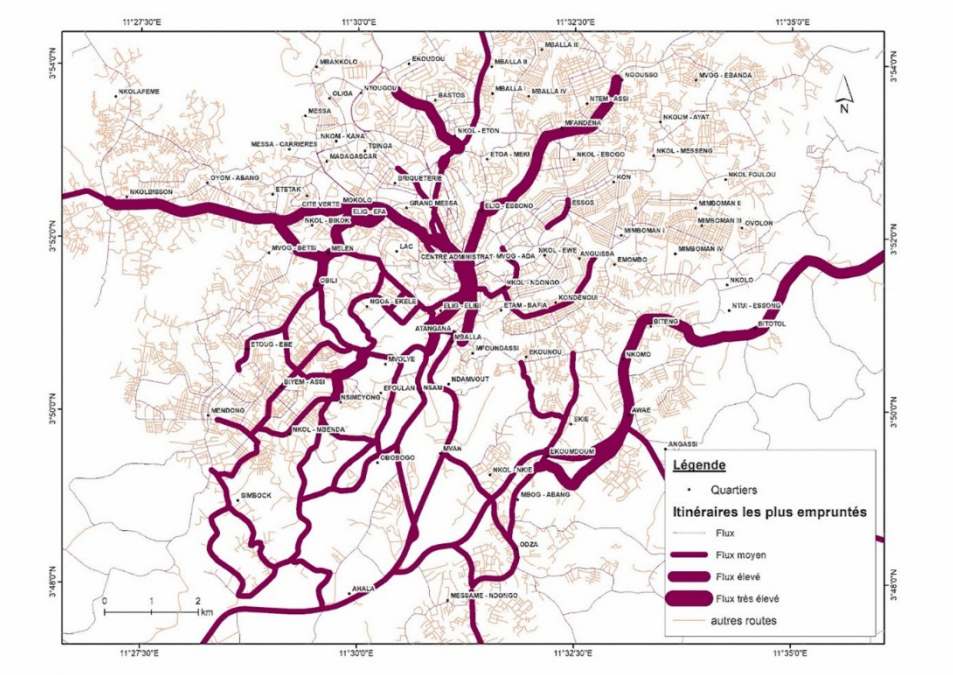

Figure 2. Map showing commuting flows toward the Yaoundé city center.

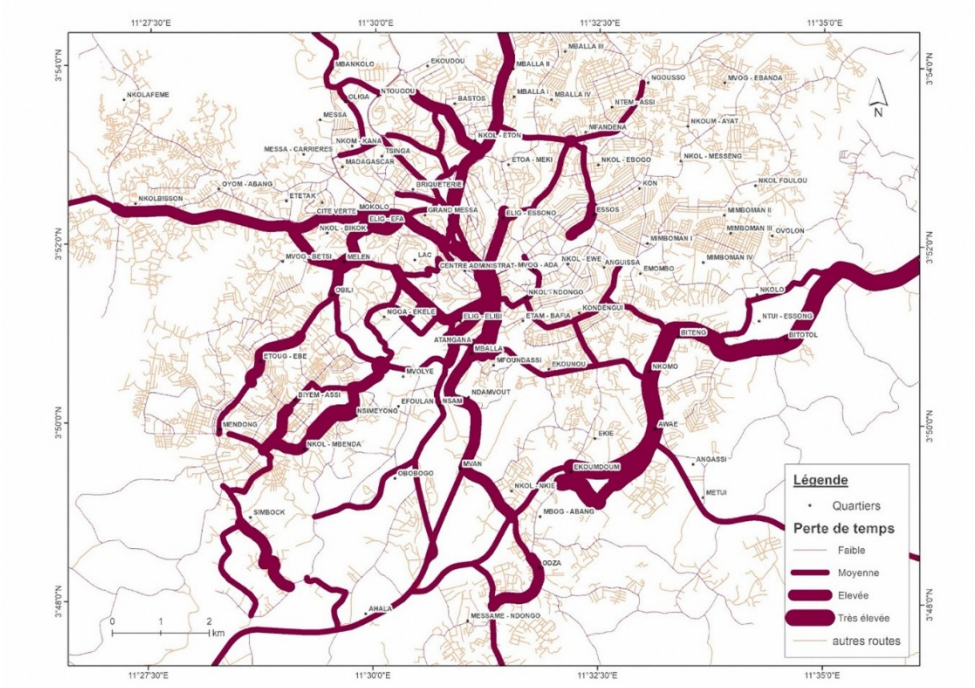

Figure 3. Map of travel time losses along commuter routes.

The sensitivity analysis to assess the robustness of the binary logistic regression model across varying thresholds of commuting time: greater than 45 minutes, 60 minutes (the primary threshold), and 75 minutes is shown in Table 3. Across all three thresholds, the core explanatory variables—namely travel distance and perceived traffic congestion—remained statistically significant, confirming their structural importance in shaping commuting durations. At the 60-minute threshold, which captured 18.5% of the sample, additional variables such as motorcycle taxi use and public transport inadequacy also emerged as significant predictors. At the 45-minute threshold, which included a broader segment of the sample (29.3%), distance, congestion, and public transport issues remained significant, while the model's explanatory power (Nagelkerke $R^2 = 0.34$) was comparable to the primary threshold. At the 75-minute threshold, the sample size dropped to 1.5%, limiting statistical power;

however, the coefficients for distance and congestion remained stable, suggesting consistent effects even in extreme cases.

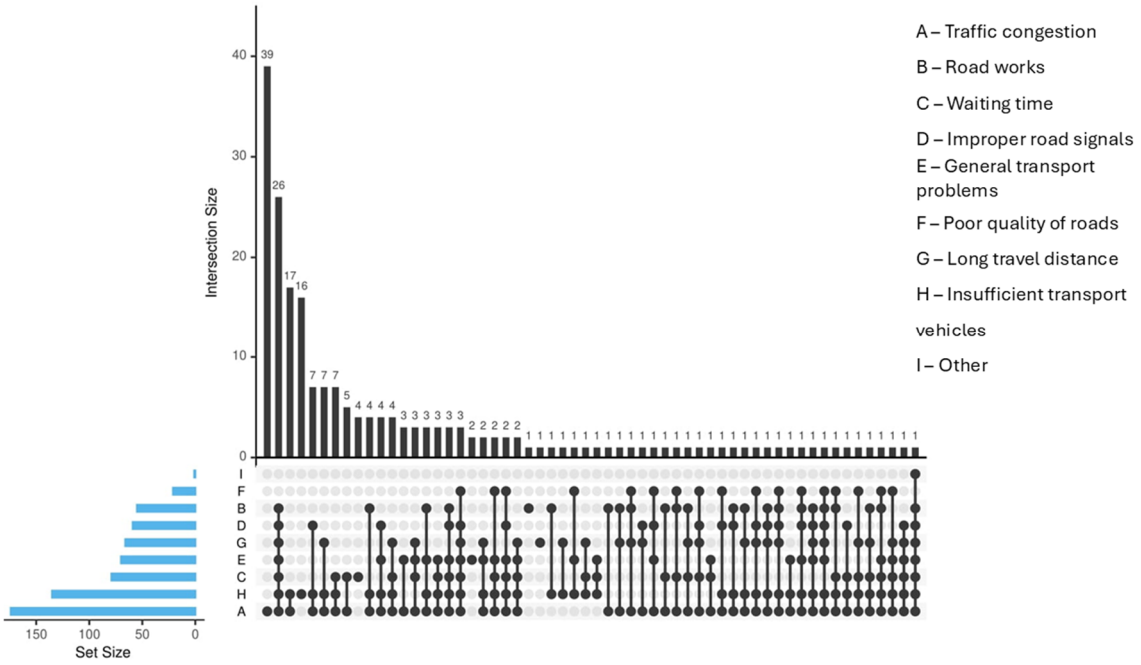

Figure 4. Visualisation of factors affecting travel time.

Table 2. Results of the logistic regression.

Variable	Coefficient (β)	*p*-Value	OR	95% CI for OR	Interpretation
Traffic congestion	+1.11	0.013	3.04	[1.27–7.31]	Risk tripled
Long travel distance	+2.62	0.001	13.70	[3.01–62.43]	Risk multiplied by 13.7
Public transport issues	+1.16	0.016	3.18	[1.24–8.13]	Risk multiplied by 3.2
Mode: Motorcycle taxi	−1.09	0.029	0.34	[0.13–0.90]	66% risk reduction
Constant	−0.57	0.155	0.57	[0.26–1.24]	Not significant

Confidence intervals (95%) provide an additional measure of reliability. For example, the OR = 13.7 for distance > 7 km ([3.01–62.43]) and OR = 3.04 for congestion ([1.27–7.31]) do not cross 1, confirming that their effects are both significant and stable. Conversely, variables whose intervals include 1 would be considered statistically uncertain or non-significant.

Table 3. Sensitivity Analysis results summary.

Time Threshold	Sample Share (%)	Nagelkerke R^2	Key Significant Variables ($p < 0.05$)	Stability of Coefficients
>45 min	29.3	0.34	Distance, Congestion, Public Transport	Stable (signs and magnitudes consistent)
>60 min (primary)	18.5	0.36	Distance, Congestion, Motorcycle Use, Public Transport	Stable (reference model)
>75 min	1.5	0.35	Distance, Congestion	Stable but limited sample size

The overall model fit was assessed using the Nagelkerke R^2, which provides a pseudo-coefficient of determination adapted for logistic regression models. The estimated value of $R^2 = 0.36$ indicates that approximately 36% of the variance in commuting time (over one hour) is explained by the selected variables, notably travel distance, perceived congestion, transport mode, and availability of public transport.

This level of explanatory power is consistent with empirical studies of urban mobility in developing contexts, where behavioural and infrastructural factors interact in complex ways that are only partially captured by quantitative models. The result suggests a moderately strong model, reflecting both the statistical adequacy of the predictors and the multidimensional nature of commuting decisions in Yaoundé.

4. Discussion and Recommendations

The findings of this research emphasize how various factors shape daily commuting in Yaoundé. It is shown that the majority of respondents (81.4%) reported travel times of one hour or less, while only a small proportion experiencing commutes exceeding 60 min. The overall stability of coefficient signs and magnitudes across thresholds (Table 3) reinforces the reliability of the model and validates the selection of the 60-minute cutoff for primary analysis.

These journeys are predominantly carried out using shared taxis and private cars, and also motorcycle taxis for shorter trips. These are the cheapest options that provide the fastest travel times, similar reasons for choice of transport modes in Lusaka [23]. Active modes such as walking are largely absent. Apart from the long distances, it has also been shown that students in higher socioeconomic areas of Cameroon had lower odds of actively commuting [24]. This lack of alternatives causes the road users to rely on informal transport modes [25]. These informal modes (mainly motorcycle taxis, shared taxis and clandestine vehicles) fragilely support mobility in Yaoundé. This widespread dependence on informal systems is attributed to the absence of a structured public transport system. Most road users do not have the choice of transport modes due to limited options.

While informal transport modes permit mobility especially for low- and middle-income households in the city, they do so at the cost of safety, reliability, and environmental sustainability. This aligns with recent studies in Sub-Saharan Africa showing that informal transport is indispensable in the short term but unsustainable as a long-term strategy for inclusive urban mobility. Motorcycles have become more widespread through household ownership and the development of motorcycle taxi services[25]. This is a result of households being able to afford motorized two-wheelers than personal cars, and they can weave in and out of four-wheeled vehicle traffic, usually at high risk, to reduce the amount of time spent on congested roads [26].

The travel distance is the main factor contributing to the long commutes. Commuters who travel 7 km or more are 14 times more likely to travel over an hour as compared to commuters who travel less than 7 km, according to the odds ratio. Similarly, the absence and inadequacy of public transport supply amplify inequalities among road users where users depending on public transport spend three times more in traffic. Interestingly, motorcycle taxis greatly reduce the duration of commutes by about 66% confirming their role as a coping mechanism in a congested urban environment [27–29].

Thresholds of 45, 60 and 75 min of travel time for sensitivity analyses confirmed that the distance, presence of traffic congestion, and absence of reliable public transport are consistent determinants of home-to-work commutes in Yaoundé. There exists a small statistical significance due to the very small sample size, although coefficient signs remain consistent. Overall, the findings confirm that the results do not depend on an arbitrary cut-off.

The spatial analysis agrees with the technical findings of the urban studies carried out in Yaoundé where similar critical travel corridors and patterns are observed [5,11,21]. The main routes from the city centre to the outer part of the city are systematically overloaded during peak hours with severe bottlenecks at the main intersections. These findings are consistent with previous research on African cities [2,3,30] that have highlighted the central role of weak planning, sprawling residential development, and overreliance on informal transport.

The factors identified as the main constraints in urban mobility in Yaoundé, reflect a form of economic exclusion in which mobility, far from enabling opportunity, becomes a daily obstacle. This inequality also manifests spatially through territorial imbalance as residential areas are increasingly distant from employment centres due to land pressure and unplanned urban sprawl. From these factors, the pendular mobility of Yaoundé could be improved and made sustainable by targeted actions in the provision of public transport, inclusive urban planning and government regulations [31]. The planning (and structuring) of the city should be improved, priority/main public transport lines should be implemented along the most congested routes and then proceed to integrate and professionalise the informal transport sector where public transport is not able to cover. Findings have shown that public transportation use in Yaoundé would be favoured if it is affordable and has reduced travel time [11]. The city should be replanned for a more inclusive transport system ensuring multimodal interchange hubs, promotion of active travel and safety of road users and a restructuring of corridors for efficient flow of traffic. Regulatory and policy reforms would be key for these improvements through the establishment of a metropolitan mobility authority, financing priorities and citizen engagement.

5. Limitations

Considering the limited sample size (n = 205) and the focus on subjective perceptions as well as one-way inbound flows toward the city centre, the principal limitation of this study lies in data availability. The sample size, although limited, provides a good foundational study for the home-work trips in Yaoundé. Perceptual bias could be eliminated by triangulation with field data (not only relying on subjective responses). It will also be

interesting to observe across town and centrifugal movements. Limited availability of data hinders the ability to finely model mobility patterns or forecast congestion peaks. In a smart mobility context, the collection and use of geolocated data are essential prerequisites for designing intelligent, adaptive, and user-centred transport systems.

6. Conclusions

Rapid urbanization in Yaoundé and a challenging structured transport system greatly affects the home-to-work trips from other parts to the city centre. The objective of this study was to understand these challenges and provide tailored recommendations for improved daily commutes for the city residents. This work analysed the commuting dynamics and identified the main causes of extended travel durations.

By combining field data, statistical methods, and spatial analysis of travel flows, 205 responses were collected from field surveys and analysed with a logit model. Sensitivity analyses and variance inflation factors were used to test the model. Results showed that extended travel times were a consequence of travel distance, road congestion, the absence of formal public transport, and individual coping strategies. Informal transport options reign emphasizing the limitations of current fragmented urban planning, with motorcycle taxis prevailing as they are used to shorten travel time, regardless of safety and regulations. These results emphasise that commuting challenges in Yaoundé are not only linked to individual choices but are the consequence of structural mismatches between urban growth, transport infrastructure, and governance.

Despite its limitations, chiefly the small sample and reliance on self-reported data, this research offers a strong analytical basis for designing inclusive and sustainable mobility policies in Yaoundé. Three priorities for improving the commutes were identified as improved urban planning, provision of robust public transport and regulations from the government. Ultimately, this research underlines the urgency of shifting from fragmented, informal practices towards integrated mobility solutions that combine efficiency, accessibility, and equity.

Future research could build upon this foundation by integrating spatial simulation tools to model the impact of urban development scenarios or the deployment of new transport services across Yaoundé's districts. Other modelling solutions could be explored such as the Probit model or ML classifiers.

Author Contributions

Writing and original draft preparation, N.T.A.S.; writing and formal analysis, N.T.L.; review and editing, J.F.W.; review and editing, S.K.F.; supervision and review, N.G.E. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding. It was conducted as part of a master's thesis at the National Advanced School of Public Works of Yaoundé and its partner institutions.

Institutional Review Board Statement

The Ethical Committee of the National Advanced School of Public Works, Yaoundé, approved this study. No personally identifying data were collected; responses were anonymised and stored on password-protected drives accessible only to the research team. Data handling complied with international confidentiality standards and the principles of the General Data Protection Regulation (GDPR). Participants were free to withdraw at any stage without consequence.

Informed Consent Statement

Before participation, respondents were informed of the study's objectives and gave informed consent (verbal or written).

Data Availability Statement

The data are available upon request.

Acknowledgments

We acknowledge the support of the administrative staff and students at the National Advance School of Public Works and their partners.

Conflicts of Interest

The authors declare no conflicts of interest.

Use of AI and AI-assisted Technologies

During the preparation of this work, the authors used ChatGPT (OpenAI) to assist with language grammar, formatting and workflow checks. After using this tool/service, the authors thoroughly reviewed, verified, and edited all generated content as needed and take full responsibility for the accuracy, integrity, and originality of the final published article

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