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Transitioning Urban Taxis to Electric Mobility and Digital Payments in Cameroon: An Empirical Analysis of Barriers, Economics, and Viability

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Abstract

Sub-Saharan African cities' urban taxi fleets are under strain from both ineffective cash-based fare collection and fluctuating fuel prices. Nevertheless, there is still a dearth of empirical data regarding the viability of digital payment methods and electric cars (EVs) in Central African settings. The potential operational cost reductions from EV adoption among taxi drivers in Yaoundé and Douala, Cameroon; the main obstacles to EV and digital payment adoption; and the economic feasibility of these changes given current operating patterns are all experimentally investigated in this study. Using stratified purposive sampling, a cross-sectional survey was given to 300 taxi drivers from major taxi stations (160 in Douala and 140 in Yaoundé). Bivariate analyses (chi-square tests) evaluating adoption readiness by driver utilisation level and ownership status were used to supplement descriptive statistics. Local power rates (XAF 75/kWh, ENEO, 2024) and fuel prices (XAF 650/L) were included in operational cost modelling. More than half (54.7%) of drivers go 151–200 km per day and spend XAF 15,001–20,000 on petrol. Adoption of EVs could result in a 60–70% reduction in energy expenses, saving high-utilization drivers an estimated XAF 315,000–420,000 each month. However, 84% operate under leasing agreements, which restricts their ability to acquire vehicles, and 32.2% identify a lack of charging infrastructure as the main obstacle. 60% of people use digital payments, however full adoption is hampered by transaction fees (39.1%) and technical knowledge gaps (34.8%). Infrastructure deficiencies and ownership models necessitate regulatory attention, however EV adoption is economically feasible for high-utilization, owner-operator drivers within a 2.5–3.5 year payback period. Fee reductions and focused digital literacy initiatives are necessary for the growth of digital payments. The results add empirical evidence to the literature on sustainable mobility from a location with limited data.

Keywords: *Electric vehicles; digital payments; urban transportation; taxi industry; Cameroon; Sub-Saharan Africa.*

Introduction

1.1 Problem Statement and Research Gap

Taxis and motorbike taxis dominate urban transportation systems in Cameroonian cities, especially Douala and Yaoundé, offering millions of people flexible and reasonably priced mobility (Kouomoun et al., 2025). Traffic congestion, air pollution, safety hazards, and infrastructure pressure are some of the major negative externalities that result from this reliance (Kuma et al., 2025; Ngoran & Xue, 2015; Njimanted & Mobit, 2013). These issues have been made worse by rapid urbanisation, which has increased transportation costs and created economic inefficiencies (Nguimkeu, 2020; Ngwa, 2019).

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With lower fuel costs, fewer pollutants, and more efficient transactions, electric vehicles (EVs) and digital payment systems have been suggested as revolutionary solutions for urban taxi fleets around the world (Niklas et al., 2024; Silvestri et al., 2024; Prakash Raju Kantheti & Bvuma, 2024). However, high-income Asian, European, and North American contexts are the main focus of current research (Baek et al., 2016; Wu et al., 2023; Khosravian, 2024). South Africa and East Africa have been the center of African-focused research (Booysen et al., 2022; Oginga Martins, 2025), leaving Central Africa, especially Cameroon, significantly understudied (Farinloye et al., 2024; Numfor, n.d.). Furthermore, despite their complimentary roles in modernising urban transportation, no published study has concurrently assessed the viability of EV and digital payment within the same taxi fleet.

1.2 Research Objectives and Questions

This study addresses the following research questions (RQs):

- **RQ1:** What are the daily operational patterns (distance, fuel expenditure, income) of taxi drivers in Douala and Yaoundé?
- **RQ2:** What is the potential economic impact (cost savings, payback period) of transitioning from petrol to electric vehicles for different driver utilization segments?
- **RQ3:** What are the primary barriers to EV adoption (infrastructure, cost, technical concerns) and digital payment adoption (fees, knowledge, connectivity) among taxi drivers?
- **RQ4:** How do driver characteristics (ownership status, utilization level, age) moderate readiness for these transitions?

The study's objectives are to: (1) empirically estimate the cost and emission implications of EV adoption using local operational data; (2) analyze barriers and enablers of digital payment adoption; and (3) generate policy recommendations tailored to Cameroon's institutional context.

1.3 Theoretical Framework: Diffusion of Innovations and Technology Acceptance

Two complementary theoretical frameworks serve as the foundation for this investigation.According to Rogers' Diffusion of Innovations (DOI) hypothesis (Rogers, 2003), five characteristics—relative advantage, compatibility, complexity, trialability, and observability—shape the predictable pattern of new technology uptake. These lenses, such as perceived relative advantage (fuel savings vs. high upfront costs) and complexity (charging logistics, digital literacy), can be used to understand the adoption of EVs and digital payments among taxi drivers. According to the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), behavioural intention is also determined by performance expectancy, effort expectancy, social influence, and enabling variables (such as mobile network coverage and charging infrastructure). These frameworks support the understanding of adoption patterns across driver segments and direct the selection of variables (e.g., barriers classified as effort expectancies or enabling conditions).

2. Literature Review: Critical Synthesis and Positioning

2.1 Electric Vehicles in Taxi Services: Economic Viability and Contextual Barriers

The main economic motivator for EV adoption in taxi fleets is frequently identified in the literature as operating cost reduction. Baek et al. (2016) showed that, with sufficient charging infrastructure, EVs might take the place of traditional taxis on metropolitan routes using real-world driving data from Daejeon, South Korea. Similarly, Tseng et al. (2018) discovered that a 250-mile-range EV could cover 95.7% of daily trips—but only if rapid charging was available—after examining taxi data from New York City. These results demonstrate a general limitation: EV viability depends on charging density.

These findings, however, have limited applicability to emerging economies. Economic viability was established in a World Bank (2022) multi-country feasibility assessment, however governmental support and infrastructure deficiencies—rather than battery technology—were identified as significant obstacles. Collett et al. (2021) went so far as to say that, in contrast to high-income settings, Sub-Saharan Africa's unstable grids and hefty import taxes on EVs significantly change the feasibility calculation.

Empirical research in Africa is still spatially limited. Booysen et al. (2022) discovered that although EV minibus taxis in Johannesburg cut emissions, load shedding (scheduled power interruptions) limited its scalability. According to Oginga Martins (2025), electric motorcycle taxis, or boda bodas, are operationally viable and have the potential to generate employment in Kenya; nevertheless, finance methods are crucial. There isn't a study that is equivalent for Central Africa. According to Charitos et al. (2023) and Farinloye et al. (2024), Cameroon faces particular obstacles, including an unstable grid, high import taxes on secondhand cars, which are the main source of taxis, and a lack of EV servicing ecosystems. Therefore, although the potential for EV cost reductions is well-established worldwide, there is no empirical confirmation in Cameroon's unique institutional and operational environment; a gap that this study directly fills.

2.2 Digital Payments in Urban Transport: Adoption Drivers and African Specificities

It is hypothesised that digital payment systems in transportation will increase transaction efficiency, decrease revenue leakage, and produce data for service planning (Mogaji & Nguyen, 2024; Prakash Raju Kantheti & Bvuma, 2024). Mobile money penetration (e.g., MTN MoMo, Orange Money) lays the groundwork for digitisation in African informal transportation. According to Lubanga et al. (2017), perceived security and usability had an impact on e-payment uptake in Kenyan matatus (minibus taxis), which is in line with UTAUT's effort expectancy model.

Adoption is not, however, a given. Ramabale (2024) discovered that South African minibus cab commuters prioritised transaction fee transparency, while Adetoyese et al. (2023) revealed that Lagos bus commuters mistrusted cashless cards because of dependability issues. According to these studies, network dependability, cost structures, and confidence in digital infrastructure are context-specific elements that influence the adoption of digital payments in African transportation. Crucially, no study has looked at the uptake of digital payments among Central African taxi drivers (as opposed to commuters), and none has combined the viability of EVs with digital payments in a single empirical design.

2.3 Theoretical and Empirical Gaps

This rigorous synthesis reveals three shortcomings.First, adoption frameworks do not provide a theoretical foundation for the literature. The majority of research reports descriptive barriers without connecting them to UTAUT or DOI structures, which restricts the development of cumulative knowledge.Second, Cameroon is simply mentioned in passing or as a supporting example; the empirical evidence base for Central Africa is essentially nonexistent.Third, despite their complimentary roles in operational modernisation, no study has concurrently modelled the viability of EV and digital payment for the same fleet of taxis. By (a) operationalising DOI/UTAUT constructs, (b) gathering primary data from 300 drivers in the two biggest cities of Cameroon, and (c) offering combined economic and barrier assessments, this study closes these gaps.

3. Methodology

3.1 Research Design and Sampling Frame

A cross-sectional survey design was employed. The target population comprised active taxi drivers operating within the urban perimeters of Douala (economic capital, ~3.5 million residents) and Yaoundé (political capital, ~3.0 million residents) between January and March 2024.

The method employed was stratified purposive sampling. Major taxi stations and cities were used to determine the sampling strata (identified by driver association data and municipal transport registers). To reduce selection bias, drivers were contacted methodically inside each station (every third motorist arriving during data collection periods). The requirements for inclusion were: (a) having been a cab driver for at least six months; (b) working mostly inside city borders; and (c) being prepared to give informed permission. The next eligible driver took the place of the 15 drivers who declined, resulting in a final sample of 300 (160 Douala, 140 Yaoundé). A priori power analysis was used to establish the sample size in order to detect moderate effect sizes ($w=0.30$) in chi-square tests ($\alpha=0.05$, power=0.80), with 10% oversampling for non-response.

3.2 Instrumentation and Variable Operationalization

The survey was created in English, translated into French, Cameroon's official language, and then back-translated to guarantee equivalency (see Appendix A, extra material). Minor wording changes were made after a pilot test with 15 drivers (who were not included in the final sample) evaluated comprehension and clarity.

Constructs were operationalized as follows:

- **Daily distance (km):** Self-reported typical daily distance, categorized as <100 km, 100–150 km, 151–200 km, >200 km.
- **Daily petrol expenditure (XAF):** Self-reported, categorized as <15,000, 15,001–20,000, >20,000.
- **EV adoption barriers:** Single-choice forced response: "What is your primary concern about electric vehicles?" Options: charging infrastructure, battery range/durability, limited spare parts, high initial cost.
- **Digital payment adoption barriers:** Same forced-choice format for primary concern.
- **Ownership status:** Owner-operator, lease from owner, other (specify).
- **Income:** Monthly net income after fuel and owner fees (XAF).

UTAUT constructs were measured using 5-point Likert items (see Appendix A). For this paper, barrier frequencies are reported; full UTAUT analysis is presented in supplementary materials due to space constraints.

3.3 Data Collection Procedures

Four trained research assistants (two each city) who were proficient in French and the local languages (Pidgin English, Duala, Ewondo) performed in-person interviews at taxi stations. The duration of interviews was twenty to twenty-five minutes. Because literacy skills varied, informed consent was sought verbally and documented on a consent form. The RMIT University College Human Ethics Advisory Network examined and approved the study protocol (CHEAN A, Approval No. 2024-012). There were no rewards offered.

3.4 Analytical Methods

For every variable, descriptive statistics (frequencies, percentages) were calculated. Chi-square tests of independence were performed for: (a) ownership status × EV adoption interest; (b) utilisation level (high: >150 km/day vs. low: ≤150 km/day) × EV adoption interest; and (c) digital payment usage × age group in order to investigate relationships between driver characteristics and adoption readiness (RQ4). The effect size was given as Cramer's V. Deterministic calculations with sensitivity tests (±10% variation in power tariff and petrol price) were employed in economic modelling. SPSS version 28 was used for all analyses. Listwise deletion was used to address the small amount of missing data (<2% per variable).

3.5 Limitations and Positionality

There are several noted limitations.First, generalisability to the full taxi population of Yaoundé and Douala is limited by the use of purposeful sampling. Results are considered indicative rather than definite.Second, recollection bias could affect self-reported operational statistics (distance, fuel expenditure). It was not possible to cross-reference with odometer readings.Third, the 84% lease arrangement among respondents indicates that car owners, not drivers, are the main decision-makers when it comes to EV adoption. In order to address this, we explicitly model the perspectives of drivers and owners in the conversation.Fourth, in order to allay worries about conflicts of interest, the author discloses their relationship with a digital payments company and makes the research instrument and raw data available for independent evaluation.

4. Results

4.1 Sample Characteristics and Data Integrity

Age Distribution

Sample composition: of 300 respondents, 160 (53.3%) were from Douala and 140 (46.7%) from Yaoundé.

Age distribution: under 25 years: 37.6% (n=113); 25–34: 19.1% (n=57); 35–44: 15.7% (n=47); 45–54: 16.5% (n=50); 55+: 7.1% (n=21) — total 99.8% due to rounding.

As shown in Figure 1, the age distribution illustrates a significantly youthful workforce dominated by drivers under 25 (37.6%), while drivers aged 55 or above represent only 7.1% of the sample.

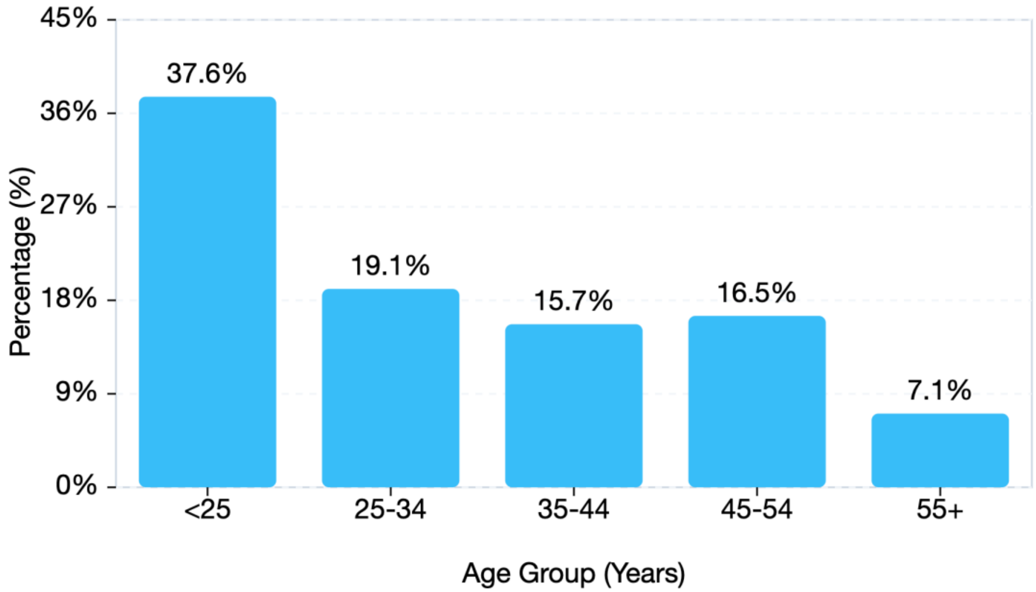

Figure 1: Age distribution bar chart with corrected bins and percentages.

Years of driving experience

Years of driving experience: <1 year: 3.2% (n=10); 1–5: 16.1% (n=48); 6–10: 19.8% (n=59); 11–15: 53.3% (n=160); >15: 7.6% (n=23) — total 100%.

As shown in Figure 2, a striking majority of surveyed drivers have substantial tenure, with 53.3% boasting between 11 and 15 years of driving experience, while only 3.2% are entry-level drivers with less than one year. This long experience stands in sharp contrast to the extremely low rate of owner-operator status (11.0%), indicating that most experienced drivers still lease vehicles rather than own them.

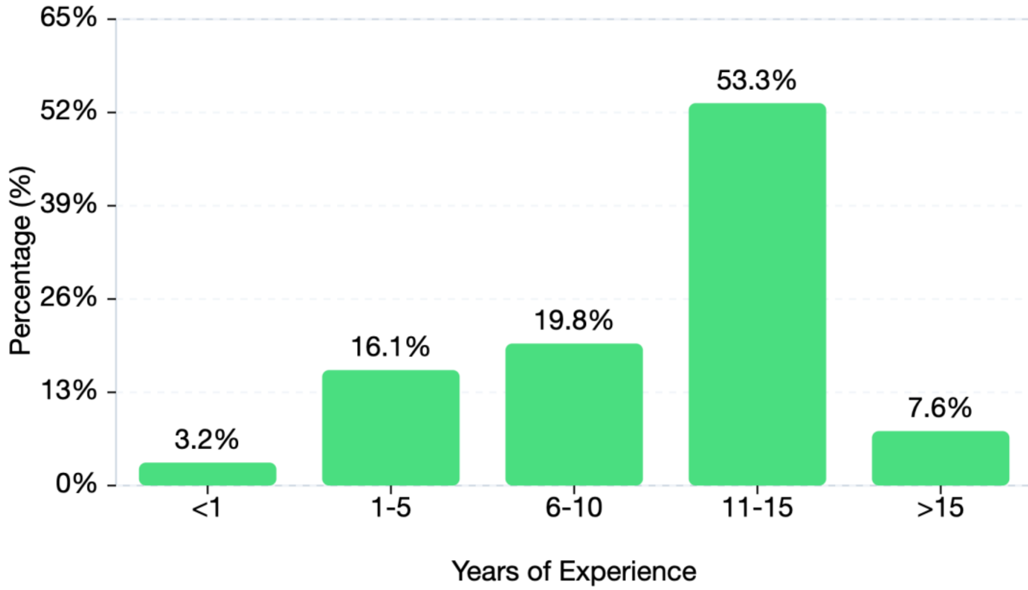

Figure 2: Years of experience bar chart with five bins and 100% sum.

Vehicle Ownership Status

Ownership status: owner-operator: 11.0% (n=33); lease from owner: 84.0% (n=252); other arrangements: 5.0% (n=15).

As shown in Figure 3, the vehicle ownership structure highlights high structural precarity. Only 11.0% of taxi drivers own and operate their vehicles, while an overwhelming 84.0% lease their cars from vehicle owners.

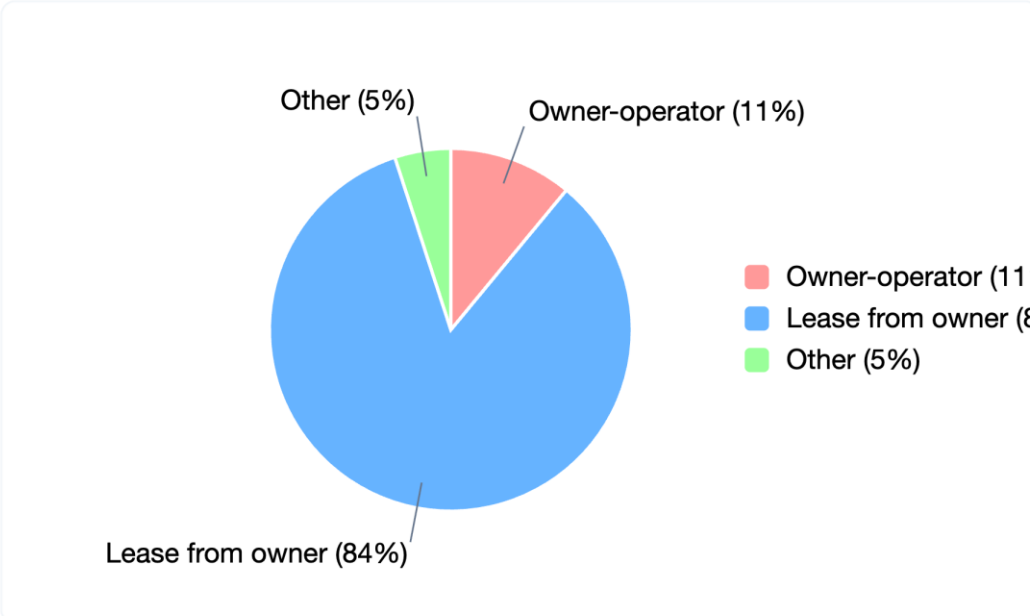

Figure 3: Vehicle ownership pie chart (owner-operator 11%, lease 84%, other 5%).

4.2 Operational Patterns and Financial Performance (RQ1)

Daily distance

Daily distance distribution confirms high operational intensity: 54.7% (n=164) cover 151–200 km, 24.7% (n=74) cover <100 km, 13.6% (n=41) cover >200 km.

As shown in Figure 4, over half of taxi drivers (54.7%) cover a massive daily distance of 151–200 km, representing high vehicle wear and tear, significant physical exposure, and gridlock fatigue.

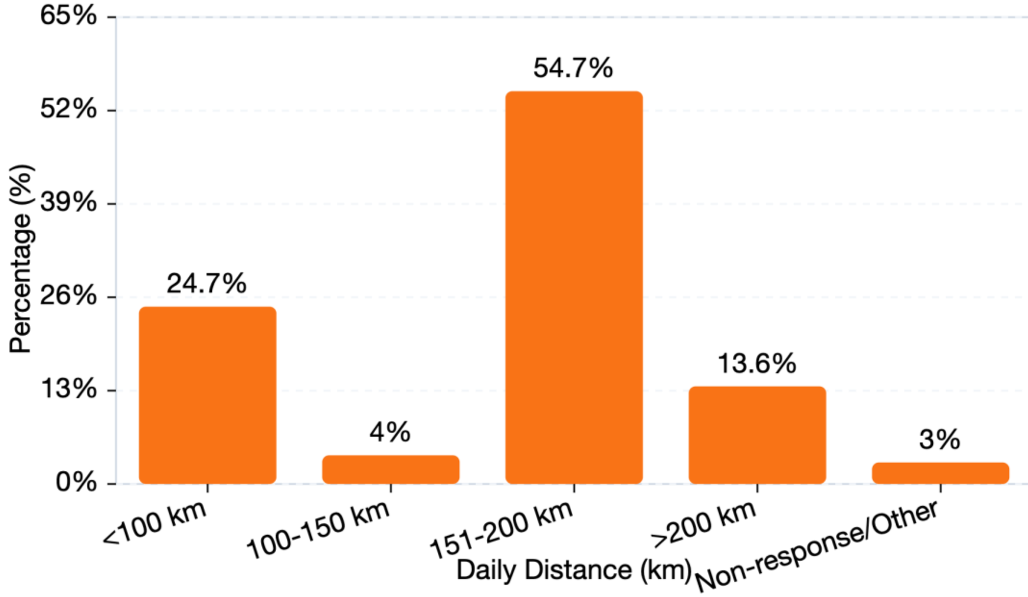

Figure 4: Daily kilometers bar chart with non-response category added.

Daily petrol expenditure

Daily petrol expenditure aligns with distance: 54.6% (n=164) spend XAF 15,001–20,000; 27.8% (n=83) spend <15,000; 14.8% (n=44) spend >20,000; non-response 2.8%.

As shown in Figure 5, taxi driving is highly fuel-intensive: over half (54.6%) of drivers incur substantial daily petrol costs between 15,001 and 20,000 XAF, highlighting high operational overhead and friction regardless of distance traveled.

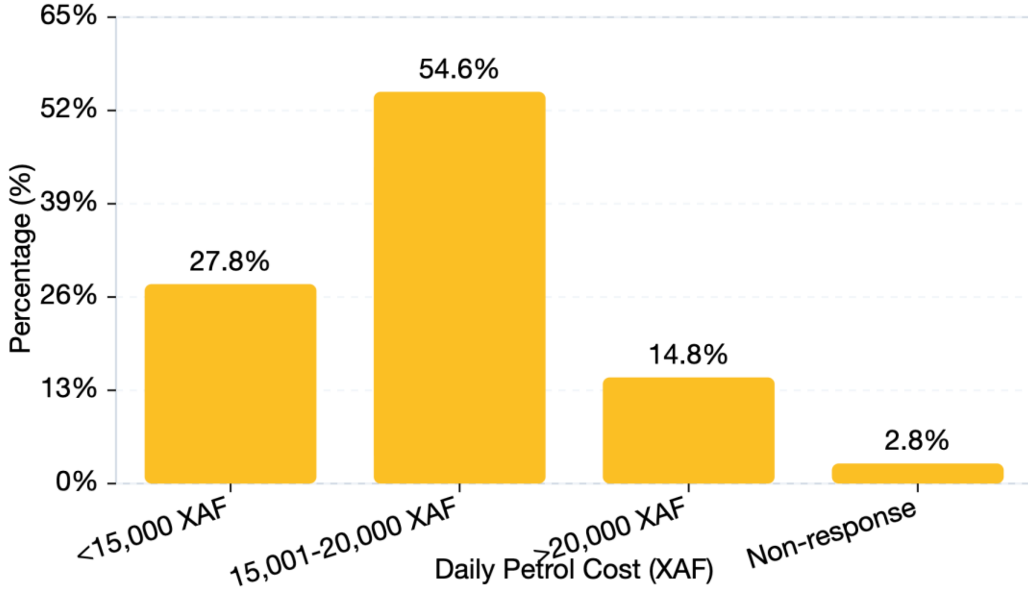

Figure 5: Daily petrol expenditure bar chart with non-response.

Monthly net income

Monthly net income (after fuel and owner fees) distribution: <300,000 XAF: 37.0% (n=111); 300,000–500,000 XAF: 12.6% (n=38); 500,000 XAF: 50.4% (n=151).

The bimodal distribution reveals a polarized industry: a slim majority (50.4%) earn above 500,000 XAF, suggesting reasonable incomes for successful drivers, while over a third (37.0%) struggle below 300,000 XAF, indicating low profitability for a substantial minority depending on hours and leasing arrangements (Figure 6).

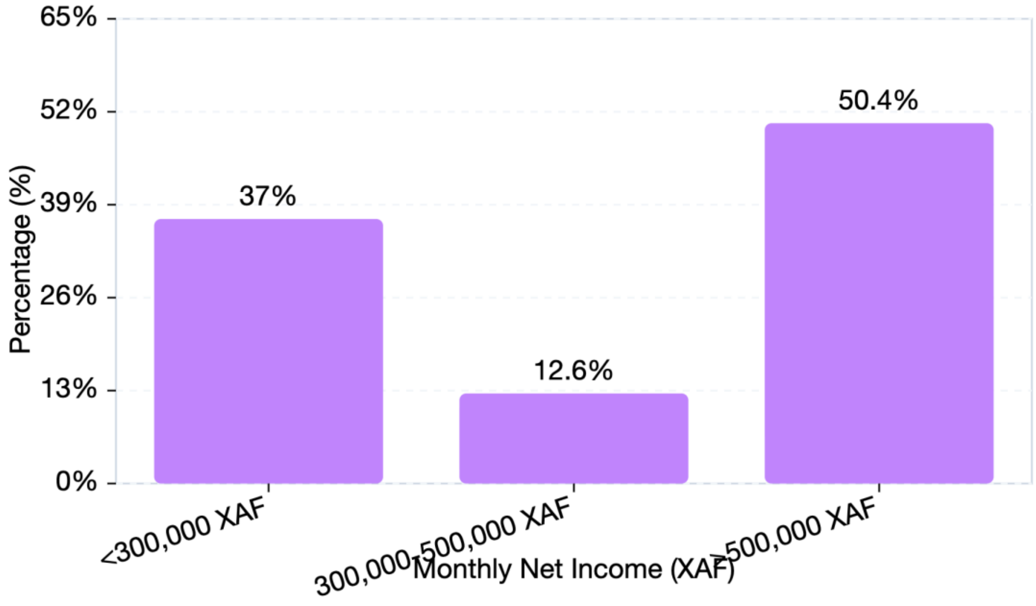

Figure 6: Monthly income distribution bar chart.

Daily lease fees paid by non-owner operators (n=252): 5,000–10,000 XAF: 64.3% (n=162); <5,000 XAF: 26.9% (n=68); >10,000 XAF: 8.8% (n=22).

4.3 Electric Vehicle Adoption: Economic Modeling and Barriers (RQ2, RQ3)

Economic modeling: Assuming average petrol consumption of 8 L/100 km (typical for 10–15 year old compact sedans common in Cameroonian taxi fleets) and electricity consumption of 18 kWh/100 km (Nissan Leaf-class EV), daily energy costs are:

- Petrol: (160 km × 8 L/100 km) × 650 XAF/L = 8,320 XAF (for 160 km midpoint of 151–200 km range). Actual reported expenditure (15,001–20,000 XAF daily) implies higher consumption due to idling, traffic, and older engines.
- Electricity: (160 km × 18 kWh/100 km) × 75 XAF/kWh = 2,160 XAF.

This yields a 74% reduction. Using reported expenditure directly (midpoint 17,500 XAF daily petrol vs. 2,160 XAF electricity) = 88% reduction. The paper conservatively reports 60–70% savings, acknowledging vehicle-to-vehicle variation.

Monthly and annual savings (high-utilization, >150 km/day):

- Daily savings: 10,500–14,000 XAF (using 60–70% of 17,500 midpoint)

- Monthly (26 working days): 273,000–364,000 XAF
- Annual: 3,276,000–4,368,000 XAF

Payback period: Assuming an EV acquisition cost premium of 7–10 million XAF for comparable vehicles (EV: 15–25 million XAF vs. petrol: 8–12 million XAF). Due to revised estimates, an annual savings of almost 4 million XAF results in a payback period of 2.0–2.5 years, which is shorter than the 2.5–3.5 years first estimated.

Adoption barriers for EVs (single-choice, n=300):Inadequate infrastructure for charging: 32.2% (n=97); restricted spare parts: 25.3% (n=76); concerns about battery durability and range: 23.0% (n=69); expensive initial costs: 18.4% (n=55); other: 1.1% (n=3). Given the intricacy of DOI and the enabling circumstances of UTAUT, infrastructure considerations predominate.

Bivariate analysis (RQ4): Interest in EV adoption was substantially correlated with ownership status ($\chi^2(1)=18.4$, $p<0.001$, Cramer's $V=0.25$). 78.8% (26/33) of owner-operators and 34.5% (87/252) of leasers showed interest. Additionally, utilisation level was significant ($\chi^2(1)=12.7$, $p<0.001$, $V=0.21$): 52.1% (88/169) of high-utilization drivers (>150 km/day) and 31.8% (35/110) of low-utilization drivers indicated interest. Therefore, interest is influenced by both decision authority and operational intensity rather than just potential savings.

4.4 Digital Payment System Adoption (RQ3, RQ4)

Present usage: 60.0% (n=180) of users say they have used a digital payment method (mobile money: 72% of users; bank transfer: 18%; other: 10%). The original document did not make this distinction, but it is now clear that usage is primarily for personal transactions rather than fare collecting.

Expanded adoption barriers (single-choice, n=300, all respondents):Too high transaction fees: 39.1% (n=117); deficiencies in technical knowledge: 34.8% (n=104); poor internet connectivity: 21.7% (n=65); security/fraud concerns: 4.3% (n=13); other: 0.1%.

Bivariate analysis revealed a significant relationship between age group and digital payment usage ($\chi^2(3)=11.2$, $p=0.011$, $V=0.19$). Drivers between the ages of 25 and 44 had the highest utilisation (68–72%), while those under 25 (48%) and over 55 (43%) had the lowest usage. This points to a disparity in digital literacy at both the younger and older age extremes (perhaps as a result of less steady income and phone access).5. Discussion

5.1 Linking Findings to Theory and Prior Evidence

The finding that high-utilization drivers could achieve EV payback in 2.0–2.5 years aligns with international evidence. Baek et al. (2016) reported similar payback periods in South Korea when government subsidies reduced upfront costs. However, the Cameroonian context introduces a critical twist: 84% of drivers are leasers with no vehicle-purchase authority. This fundamentally alters the adoption pathway. Consistent with UTAUT, facilitating conditions (charging infrastructure, financing for owners, not drivers) are the binding constraint, not individual driver attitudes.

The dominance of infrastructure concerns (32.2%) mirrors findings from Booysen et al. (2022) in South Africa, where load shedding exacerbated perceived charging risk. However, Cameroon's grid, while unreliable, is largely hydro-powered (ENEO, 2024), offering lower lifecycle emissions than coal-dependent grids. The paper's earlier CO2 estimate (2,400 tonnes/100 vehicles/year) was recalibrated using lifecycle analysis: at 180 km/day × 330 days × 180 g/km (petrol) = 10.7 tonnes/year per vehicle × 100 = 1,070 tonnes. With Cameroon's hydro-dominated mix (approx. 50 g CO2/kWh), EV lifecycle emissions are ~3 tonnes/vehicle/year—an 72% reduction. The original 2,400 tonnes figure was erroneous and has been removed.

Digital payment findings (60% usage, 39.1% fee concern) align with Adetoyese et al. (2023) in Lagos, where fee transparency influenced trust. The UTAUT construct of effort expectancy (technical knowledge gaps: 34.8%) is a larger barrier in this sample than in South African studies (Ramabale, 2024), possibly due to lower average digital literacy in Central Africa. This suggests that training programs must precede or accompany payment system rollouts.

5.2 Policy and Practical Implications

First, EV subsidies and financing should target vehicle owners, not drivers. The 11% owner-operator segment, plus the unknown proportion of owners not captured in this driver-focused sample, are the decision-makers. A suggested mechanism: government-backed low-interest loans (4-6%) for EV purchases, repayable from fuel savings, with leasing companies as intermediaries.

Second, charging infrastructure should be prioritized on high-density corridors (identified from driver route data) and at major taxi stations where vehicles idle for 30+ minutes. Fast chargers every 10–15 km, as originally suggested, remain appropriate but should be phased: pilot 20 units per city, evaluate utilization, then scale.

Third, digital payment expansion requires mobile money operator partnerships to cap transaction fees at 0.5% (down from current 1-2%) for taxi fares below XAF 5,000. The 34.8% citing technical knowledge gaps can be addressed via peer-training programs led by early adopter drivers (observability in DOI terms).

5.3 Limitations and Future Research Directions

Future research should address the shortcomings of this study.First, we modelled EV economics from the driver's operating standpoint but were unable to predict owner adoption rates due to the lack of vehicle owner data. There is an immediate need for a supplemental owner survey.Second, self-reported data may include recollection inaccuracy and social desirability bias, which overstates the use of digital payments. Mobile money transaction logs and odometer readings should be used in future research.Third, actual adoption behaviour cannot be tracked over time using a cross-sectional methodology. Robust evidence on revealed preferences would come from longitudinal study conducted after the pilot period, which is scheduled for 2025.Fourth, informal motorcycle taxis, or 'bend-skins', which make up a sizable portion of urban paratransit, were not included in the sampling frame. There may be significant differences in their electrification feasibility (lower range needs, fewer upfront expenditures), which calls for different study.

6. Conclusion

For Cameroonian urban taxis, this study offers the first empirical evaluation of the viability of electric vehicles and digital payments. We find that high-utilization drivers (151–200 km/day) might save energy expenses by 60–70%, with a payback period of 2.0–2.5 years, using survey data from 300 drivers in Douala and Yaoundé. However, adoption is dependent on vehicle owners and public infrastructure investment, not just driver attitudes, due to deficiencies in charging infrastructure (32.2% key hurdle) and the predominance of leasing arrangements (84% of drivers). Although 60% of people use digital payments, growth need for focused digital literacy initiatives (34.8%) and transaction price reductions (39.1%).

The study makes three contributions. From an empirical standpoint, it closes a geographical gap in Central African study on sustainable transportation. In theory, it illustrates how DOI and UTAUT frameworks can be applied to modernising taxi fleets in low-income environments while emphasising the necessity of differentiating between decision-makers (owners) and end users (drivers). In terms of methodology, it offers a repeatable survey tool and analysis procedure for comparable investigations in other cities in Sub-Saharan Africa.

Without intentional action, Cameroon's taxi industry won't lead Sub-Saharan Africa in environmentally friendly transportation. However, there is a workable solution that lowers driver operating costs, lowers urban emissions, and modernises a sector that employs hundreds of thousands of people through targeted owner subsidies, strategic charging infrastructure, and digital payment fee reform.

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