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# Assessment of Urban Traffic Characteristics, Vehicular Composition, and Stakeholder Perspectives on Emission Control in Major Cities of Nigeria

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**ABSTRACT**
Rapid urbanisation and motorisation in Nigeria have intensified vehicular emissions, contributing to air pollution and associated health risks. This study examined traffic characteristics, vehicular composition, and stakeholder perspectives on emission control in three major cities: Abuja, Kano, and Lagos. It combines quantitative traffic counts conducted from 6:00 a.m. to 6:00 p.m. along key urban corridors with surveys of 384 stakeholders, including government officials, commercial vehicle operators, transport union members, auto technicians, environmental advocates, and urban residents. Traffic data were analyzed for daily, hourly, and directional patterns, while vehicular composition and Passenger Car Unit calculations were used to assess road capacity impact. Survey responses were analyzed using descriptive statistics to summarize awareness, perceptions of emission sources, policy adequacy, and preferred mitigation strategies. Results revealed peak traffic periods in the morning and evening, with Lagos–Ibadan Expressway recording the highest volumes. Cars, mini buses, and heavy-duty vehicles were the most prevalent, while heavy vehicles exerted disproportionate influence on congestion and emissions. Stakeholders identified old vehicles, poor fuel quality, and weak regulation as major emission contributors, with 70% supporting stricter emission control measures. Suggested interventions included vehicle emission testing, phasing out high-emission vehicles, promoting public transport, strengthening enforcement, and raising public awareness. The findings underscore the critical link between traffic dynamics, vehicle types, and urban air pollution, highlighting areas for targeted policy and operational interventions. Implementing recommended strategies can reduce emissions, improve air quality, and guide sustainable transport planning in Nigerian cities, contributing to environmental protection, public health, and urban mobility efficiency.

**Keywords:** Emissions, Traffic, Air pollution, Stakeholders, Control strategies, Urban transport

## INTRODUCTION

Rapid urbanisation and motorisation have intensified traffic congestion and air pollution in major cities worldwide, posing serious risks to environmental quality, public health, and sustainable development. Road transport is a major source of greenhouse gas emissions and pollutants such as carbon monoxide, nitrogen oxides, and particulate matter, which contribute to respiratory and cardiovascular diseases as well as climate change (Wang et al., 2021; Ajayi et al., 2023; World Health Organization, 2023). Recent global assessments also indicate that transport related emissions remain a major contributor to deteriorating urban air quality, particularly in rapidly urbanising cities where increasing vehicle ownership and inefficient transport systems continue to exacerbate environmental challenges (IQAir, 2024). In developing countries, mixed traffic flows with diverse vehicle types and frequent stop and go movements further increase emission intensity, particularly during peak travel periods (Ayeni & Iyeke, 2024). Despite growing awareness of these challenges, integrated studies that combine traffic characteristics with stakeholder perspectives on emission control remain limited in sub Saharan Africa, including Nigeria (Onyeka et al., 2020).

In Nigeria, road transport dominates urban mobility, creating significant environmental challenges. Studies in Uyo and other Nigerian cities have shown that peak traffic periods correspond with pollutant concentrations exceeding recommended limits, highlighting the influence of congestion, prolonged vehicle idling, and ageing vehicle fleets on urban air pollution (Subair, Ibitoye, & Kuranga, 2024). In Lagos, traffic patterns and vehicular composition have been associated with elevated concentrations of carbon monoxide and particulate matter, demonstrating the need for improved traffic management and cleaner transport systems (Adediran et al., 2025). Furthermore, surveys of residents and transport operators indicate increasing awareness of the health risks associated with traffic related pollution, suggesting that stakeholder perceptions can provide valuable inputs for emission control policies (Ajayi et al., 2023). Globally, sustainable urban transport strategies, including improved public transportation, cleaner vehicle technologies, and effective emission regulations, have been identified as essential measures for reducing transport related pollution and improving urban air quality (International Energy Agency, 2024; World Bank, 2024).

This study investigates urban traffic characteristics, vehicle composition, and stakeholder perspectives on emission control in major Nigerian cities by integrating quantitative traffic measurements with qualitative stakeholder insights. Specifically, the study analyses temporal and spatial traffic

patterns, assesses the distribution of vehicle types, and examines stakeholder perceptions of emission sources, policy adequacy, and preferred mitigation strategies. By combining engineering based traffic analysis with stakeholder perspectives, the study contributes to a better understanding of the interactions between urban traffic dynamics, vehicle composition, and emission control, thereby addressing an important gap in Nigeria focused transport and environmental research (Ayeni & Iyeke, 2024; Onyeka et al., 2020).

The findings are expected to support evidence-based policy formulation, urban traffic management, and sustainable emission reduction strategies that are tailored to Nigerian cities. In particular, the study advances knowledge by linking observed traffic characteristics with stakeholder perspectives on emission regulation, providing practical insights for improving air quality management and sustainable urban mobility. The findings are also consistent with current international priorities that advocate integrated transport planning, cleaner vehicle technologies, and strengthened regulatory frameworks as key pathways towards sustainable urban development (World Bank, 2024; United Nations Environment Programme, 2025; Krejcie & Morgan, 1970).

## MATERIALS AND METHODS

This study uses a mixed methods research design combining quantitative traffic counts with stakeholder surveys to assess urban traffic characteristics, vehicular composition, and perspectives on vehicular emission control in three major Nigerian cities: Abuja, Kano, and Lagos. These cities were purposively selected because they represent Nigeria's principal administrative, commercial, and industrial centres and experience some of the highest levels of vehicular activity and transport related emissions in the country.

Within each city, one major arterial corridor was selected for traffic observation: Airport Road in Abuja, Kano-Kaduna Expressway in Kano, and Lagos Ibadan Expressway in Lagos. These corridors were selected purposively because they serve as primary transport arteries that accommodate substantial commuter, commercial, and freight traffic, thereby providing representative traffic conditions for evaluating urban vehicular movement and emission characteristics. Although multiple corridors could provide broader spatial coverage, the selected routes were considered appropriate because they carry a significant proportion of daily traffic within their respective metropolitan areas and have been widely recognised as strategic transport corridors linking major activity centres.

A sample size of 384 respondents was determined using the Krejcie and Morgan (1970) sample size determination table. To ensure proportional representation, the sample was allocated according to the observed traffic volumes in each study city. Consequently, 134 questionnaires (34.9%) were administered in Abuja, 84 questionnaires (21.9%) in Kano, and 166 questionnaires (43.2%) in Lagos. Respondents comprised government officials, commercial vehicle operators, transport union members, auto technicians, environmental nongovernmental organisation representatives, and urban residents selected through purposive sampling based on their direct involvement in urban transport and environmental management.

Manual traffic counts were conducted from 6:00 a.m. to 6:00 p.m. using six trained enumerators for each traffic direction operating in two six hour shifts. Vehicle movements were recorded on structured tally sheets covering cars, motorcycles, tricycles, taxis, minibuses, pickups, lorries, tankers, trailers, and large buses. Daily traffic volumes, hourly traffic distributions, directional flows, and vehicular composition were subsequently computed.

The traffic data were entered, cleaned, and analysed using Microsoft Excel and Minitab statistical software. Passenger Car Unit values were estimated using TORA software to evaluate the relative effects of different vehicle categories on roadway capacity. Questionnaire responses were coded and analysed using descriptive statistics, including frequencies and percentages, to examine stakeholder characteristics, awareness of vehicular emissions, perceived emission sources, policy adequacy, and preferred mitigation strategies. The integration of traffic measurements with stakeholder perceptions provided a comprehensive assessment of urban traffic characteristics and vehicular emission issues in the selected Nigerian cities.

## RESULTS AND DISCUSSION

### Comparative Summary of Urban Traffic Characteristics

This section provides a comparative summary of traffic characteristics across the three surveyed urban corridors: Airport Road, Kano-Kaduna Expressway, and Lagos Ibadan Expressway. It presents detailed analyses of daily and hourly vehicular traffic volumes, vehicular composition, inflow and outflow traffic patterns, and variations between weekday and weekend traffic.

**Table 1: Daily Vehicular Traffic Volume along the Surveyed Routes**

| S/N | Route | Mon | Tue | Wed | Thurs | Fri | Sat | Sun | Total | Avrg. Daily |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Airport Road, Abuja | 53,353 | 50,526 | 46,507 | 31,854 | 42,085 | 32,999 | 36,644 | 293,968 | 41,995 |
| 2 | Kano-Kaduna, Kano | 28,234 | 25,702 | 23,919 | 28,105 | 26,827 | 26,159 | 23,482 | 182,428 | 26,061 |
| 3 | Lagos-Ibadan, Lagos | 57,429 | 52,266 | 48,629 | 47,780 | 53,892 | 53,501 | 47,794 | 361,291 | 51,613 |
| Total | | 139,016 | 128,494 | 119,055 | 107,739 | 122,804 | 112,659 | 107,920 | 837,687 | 139,615 |
| Average | | 69,508 | 64,247 | 59,528 | 53,870 | 61,402 | 56,330 | 53,960 | 418,844 | |
| % | | 16.6 | 15.3 | 14.2 | 12.9 | 14.7 | 13.4 | 12.9 | 100.0 | |

Source: Authors' Field Survey (2025)

Table 1 presents the weekly distribution of vehicular traffic along Airport Road, Kano Kaduna Expressway, and Lagos Ibadan Expressway. The Lagos Ibadan Expressway recorded the highest traffic volumes throughout the week, peaking at 57,429 vehicles on Monday and maintaining the largest weekly total of 361,291 vehicles. This finding reflects the corridor's strategic importance as one of Nigeria's busiest transport routes, supporting intensive commuter, commercial, and freight movements between Lagos and other parts of the country. Airport Road followed with a weekly total of 293,968 vehicles, highlighting its role as a major urban arterial serving government institutions, business districts,

residential areas, and the Nnamdi Azikiwe International Airport in Abuja. In contrast, the Kano Kaduna Expressway recorded the lowest weekly total of 182,428 vehicles, although it remains a vital corridor for regional mobility and intercity trade in northern Nigeria.

The three corridors recorded a combined weekly traffic volume of 837,687 vehicles. Traffic was highest at the beginning of the week, with Monday accounting for 16.6% of total traffic, while Thursday and Sunday recorded the lowest proportions at 12.9% each. The predominance of weekday traffic reflects increased commuting, commercial activities, official engagements, and freight movement associated with the work week, whereas the reduction towards the weekend may be attributed to fewer business related trips and changes in travel behaviour.

These findings are consistent with those of Adediran et al. (2025), who reported significantly higher traffic volumes and associated vehicular emissions along major road corridors in Lagos due to rapid urbanisation, economic activities, and increasing vehicle ownership. Similarly, Ayeni and Iyeke (2024) observed that principal urban arterial roads in Nigerian cities experience substantially higher traffic demand than secondary roads because they connect major residential, commercial, industrial, and institutional land uses. The observed dominance of weekday traffic also agrees with the findings of Subair et al. (2024), who noted that traffic congestion on urban roads is generally more severe during working days as a result of increased commuter travel and commercial operations. Comparable observations were reported by Wang et al. (2021), who found that major urban transport corridors consistently experience higher traffic densities during weekdays, resulting in increased congestion and pollutant concentrations. Although the magnitude of traffic volumes reported in the present study differs from those of previous studies, these variations are expected because of differences in study locations, observation periods, traffic growth rates, urban development patterns, and socioeconomic characteristics.

Table 2 presents the hourly distribution of vehicular traffic along the study corridors. The data reveal a pronounced double peak traffic pattern typical of major urban and interregional transport routes. Morning traffic increased sharply between 7:00 a.m. and 9:00 a.m., reflecting inbound commuter movements to business districts, government institutions, schools, and commercial centres. The evening peak between 5:00 p.m. and 6:00 p.m. recorded the highest hourly traffic volume of 109,015 vehicles, representing 13.0% of the total traffic, indicating intense outbound movements associated with the close of official and commercial activities. This pattern demonstrates the strong influence of daily socioeconomic activities on urban traffic demand and the concentration of travel during conventional working hours.

Across the three corridors, the Lagos Ibadan Expressway consistently recorded the highest hourly traffic volumes, particularly during peak periods, underscoring its strategic role as a major economic corridor supporting both passenger and freight transportation. Airport Road displayed a relatively stable traffic flow throughout the day, reflecting its function as a principal urban route serving administrative, residential, and airport related activities within the Federal Capital Territory. In contrast, the Kano Kaduna Expressway exhibited a gradual increase in traffic towards the evening, suggesting a greater proportion of intercity passenger travel and freight movements that typically intensify later in the day.

These findings are consistent with those of Ayeni and Iyeke (2024), who reported pronounced morning and evening peak periods on major urban arterial roads in Nigeria, attributing the pattern to concentrated commuter movements and mixed traffic operations. Similarly, Subair et al. (2024) observed that urban road congestion is most severe during peak commuting periods because of increased demand relative to available road capacity. The higher hourly traffic volumes recorded along the Lagos Ibadan Expressway also agree with the findings of Adediran et al. (2025), who identified the corridor as one of the busiest transport routes in Nigeria, with elevated traffic densities contributing significantly to vehicular emissions and declining air quality. Comparable traffic patterns have also been reported internationally. Wang et al. (2021) found that urban transport corridors in rapidly developing cities exhibit distinct morning and evening traffic peaks, which coincide with periods of elevated pollutant concentrations due to increased vehicle activity and recurrent congestion. Although the exact peak traffic volumes differ from those reported in previous studies, such variations are expected because of differences in traffic demand, population size, land use characteristics, observation periods, and the economic functions of the study locations.

**Table 2: Hourly Vehicular Traffic Volume along the Surveyed Routes**

| S/N | Route | 6:Am -7:Am- | 7:Am-8:Am | 8:Am-9:Am | 9:Am-10:Am | 10:Am-11:Am | 11am-12:Noon | 12:00-1:00pm | 1:Pm-2:Pm | 2:Pm-3:Pm | 3:Pm-4pm | 4pm-5:Pm | 5:Pm-6:Pm | Total Vehicle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Airport Road, Abuja | 25,837 | 24,864 | 25,354 | 24,878 | 22,967 | 21,917 | 23,177 | 23,695 | 23,877 | 25,718 | 26,047 | 25,637 | 293,968 |
| 2 | Kano-Kaduna, Kano | 7,427 | 11,431 | 13,216 | 15,260 | 15,568 | 15,344 | 15,925 | 15,043 | 14,035 | 15,246 | 15,568 | 28,365 | 182,428 |
| 3 | Lagos-Ibadan, Lagos | 22,505 | 31,997 | 36,309 | 31,829 | 27,510 | 23,954 | 21,756 | 24,045 | 27,489 | 28,784 | 30,100 | 55,013 | 361,291 |
| Total | | 55,769 | 68,292 | 74,879 | 71,967 | 66,045 | 61,215 | 60,858 | 62,783 | 65,401 | 69,748 | 71,715 | 109,015 | 837,687 |
| Average | | 27,885 | 34,146 | 37,440 | 35,984 | 33,023 | 30,608 | 30,429 | 31,392 | 32,701 | 34,874 | 35,858 | 54,508 | 418,844 |
| % | | 6.7 | 8.2 | 8.9 | 8.6 | 7.9 | 7.3 | 7.3 | 7.5 | 7.8 | 8.3 | 8.6 | 13.0 | 100.0 |

Source: Authors' Field Survey (2025)

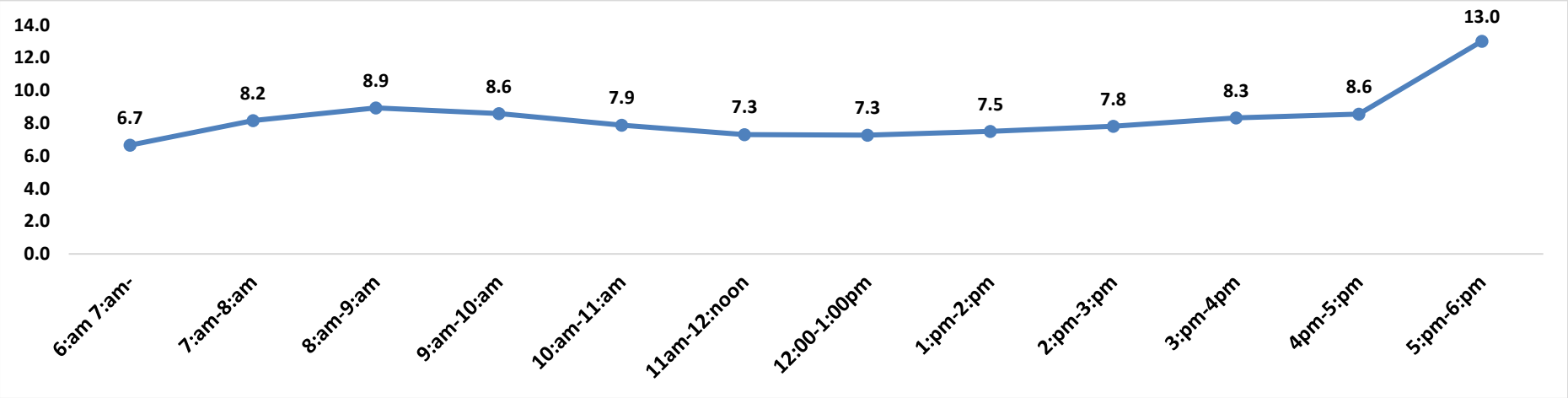


Figure 1: Trend of Hourly Vehicular Traffic flow along the Surveyed Routes
Source: Authors' Field Survey (2025)

**Table 3: Vehicular Composition of Traffic along the Surveyed Routes**

| S/N | Flow Direction | Car | Tricycle | Motorcycle | Mini Bus | Taxi | Pick Up & Lorry | Mid & Big Bus | Tanker & Trailer | Total Vehicle |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Airport Road, Abuja | 126,028 | 11,242 | 15,050 | 26,383 | 76,622 | 16,366 | 11,179 | 11,098 | 293,968 |
| 2 | Kano-Kaduna, Kano | 46,627 | 54,544 | 34,846 | 14,091 | 1,330 | 15,337 | 476 | 15,177 | 182,428 |
| 3 | Lagos-Ibadan, Lagos | 168,903 | 2,338 | 8,015 | 100,646 | 427 | 31,052 | 20,146 | 29,764 | 361,291 |
| Total | | 341,558 | 68,124 | 57,911 | 141,120 | 78,379 | 62,755 | 31,801 | 56,039 | 837,687 |
| Average | | 170,779 | 34,062 | 28,956 | 70,560 | 39,190 | 31,378 | 15,901 | 28,020 | 418,844 |
| % | | 40.8 | 8.1 | 6.9 | 16.8 | 9.4 | 7.5 | 3.8 | 6.7 | 100.0 |
| Passenger Car Unit (PCU) | | 341,558 | 51,093 | 43,433 | 423,360 | 78,379 | 62,755 | 95,403 | 168,117 | 1,264,098 |

Source: Authors' Field Survey (2025)

Table 3 shows the vehicular composition across the surveyed routes, highlighting a diverse mix of passenger and freight vehicles that support both urban and intercity mobility. Cars constituted the largest vehicle category, accounting for 40.8% of the total traffic, indicating a high dependence on private vehicles for daily travel. Mini buses accounted for 16.8%, while taxis represented 9.4%, underscoring the continued importance of commercial passenger transport in meeting urban mobility demands. Tricycles and motorcycles also constituted a significant proportion of the traffic, particularly along the Kano Kaduna corridor, where they provide affordable and flexible transport for short distance trips and areas with limited formal public transport services. Freight vehicles, including pick-ups, lorries, tankers, and trailers, featured prominently across the surveyed corridors, reflecting their critical role in the movement of goods, petroleum products, and industrial materials. Furthermore, the Passenger Car Unit analysis indicates that although heavy vehicles constitute a smaller proportion of the traffic stream, they exert a disproportionately greater impact on roadway capacity because of their larger size, lower operating speeds, and greater road space requirements.

These findings are consistent with those of Adediran et al. (2025), who reported that passenger cars dominate traffic composition on major highways in Lagos, while freight vehicles contribute substantially to congestion and vehicular emissions despite their relatively lower numbers. Similarly, Ayeni and Iyeke (2024) found that mixed traffic conditions characterised by the coexistence of private cars, commercial vehicles, motorcycles, and heavy trucks significantly reduce traffic efficiency and level of service on urban arterial roads in Nigeria. The substantial presence of motorcycles and tricycles observed in the northern corridor also agrees with the findings of Subair et al. (2024), who noted that these modes have become indispensable components of urban mobility in many Nigerian cities due to their affordability, accessibility, and ability to navigate congested road networks. Comparable observations have been reported internationally. Wang et al. (2021) demonstrated that heterogeneous traffic streams containing a high proportion of heavy vehicles and mixed transport modes increase roadway congestion and contribute disproportionately to vehicular emissions and deteriorating urban air quality. Although the proportions of individual vehicle categories differ from those reported in previous studies, these differences are expected because of variations in regional travel patterns, socioeconomic characteristics, freight demand, transport policies, and the level of urbanisation across study locations.

**Table 4: Comparison of Inflow and Outflow Vehicular Traffic along the Surveyed Routes**

| S/N | Location | Inflow | Outflow | Total | % Am | % Pm |
|---|---|---|---|---|---|---|
| 1 | Airport Road, Abuja | 134,304 | 159,664 | 293,968 | 45.7 | 54.3 |
| 2 | Kano-Kaduna, Kano | 89,912 | 92,516 | 182,428 | 49.3 | 50.7 |
| 3 | Lagos-Ibadan, Lagos | 181,055 | 180,236 | 361,291 | 50.1 | 49.9 |
| Total | | 405,271 | 432,416 | 837,687 | | |
| Average | | 202,636 | 216,208 | 418,844 | | |
| % | | 48.4 | 51.6 | 100.0 | | |

Source: Authors' Field Survey (2025)

Table 4 presents a comparison of inflow and outflow vehicular traffic along the surveyed routes, highlighting directional patterns in daily road use. Overall, the outflow of vehicles slightly exceeded inflow, with 51.6% of traffic moving outward compared with 48.4% moving inward, indicating a predominance of outbound travel during the observation period. Airport Road recorded the greatest directional imbalance, with a higher proportion of vehicles leaving the city, reflecting its role as a major urban exit corridor linking Abuja with surrounding satellite towns, residential suburbs, and neighbouring states. In contrast, the Kano Kaduna Expressway exhibited a more balanced traffic distribution, suggesting relatively stable bidirectional intercity travel driven by commercial, social, and regional economic activities. Similarly, the Lagos Ibadan Expressway maintained nearly equal inbound and outbound traffic volumes, demonstrating its function as a major commercial transport corridor supporting continuous passenger movement and freight distribution in both directions.

These findings are consistent with those of Ayeni and Iyeke (2024), who reported that major arterial roads serving mixed urban and intercity functions generally exhibit distinct directional traffic patterns that vary according to land use, employment centres, and commuting behaviour. The relatively balanced inflow and outflow observed along the Lagos Ibadan Expressway also agrees with the findings of Adediran et al. (2025), who found that the corridor supports sustained two way traffic because of its strategic importance for commerce, logistics, and regional connectivity. Similarly, Subair et al. (2024) observed that highways linking major urban centres often experience relatively symmetrical traffic flows due to the continuous movement of passengers and goods throughout the day. Internationally, Wang et al. (2021) reported that directional traffic imbalances are common on urban corridors serving administrative and employment centres, where commuting patterns generate concentrated inbound traffic during the morning and outbound traffic during the evening. The slight differences between the present findings and those reported in previous studies may be attributed to differences in corridor functions, surrounding land use patterns, observation periods, traffic management practices, and the socioeconomic characteristics of the study areas.

**Table 5: Comparison of Weekday and Weekend Traffic Variation along the Surveyed Routes**

| S/N | Location | Average Weekday Traffic | Average Weekend Traffic | Average Daily Traffic (ADT) | % Variation of Avg. Weekday Traffic W.R.T. ADT | % Variation of Average Weekend Traffic W.R.T. ADT |
|---|---|---|---|---|---|---|
| 1 | Airport Road, Abuja | 56,081 | 34,822 | 41,995 | 33.5 | -17.1 |
| 2 | Kano-Kaduna, Kano | 33,197 | 24,821 | 26,061 | 27.4 | -4.8 |
| 3 | Lagos-Ibadan, Lagos | 64,999 | 50,648 | 51,613 | 25.9 | -1.9 |
| Total | | 154,277 | 110,290 | 119,670 | 28.9 | -7.8 |
| Average | | 77,139 | 55,145 | 59,835 | | |

Source: Authors' Field Survey (2025)

Table 5 shows the variation between weekday and weekend traffic along the surveyed routes, highlighting substantially higher traffic volumes during weekdays than weekends. This pattern reflects the concentration of work related commuting, commercial activities, institutional travel, and freight movement during the working week. Airport Road exhibited the largest variation, with weekday traffic exceeding the average daily traffic by 33.5% and weekend traffic falling 17.1% below the average. This finding reflects the corridor's primary function as a major access route to government offices, business districts, and the Nnamdi Azikiwe International Airport in Abuja, all of which generate significant weekday travel demand. The Kano Kaduna Expressway recorded a 27.4% increase in weekday traffic and a relatively modest 4.8% decline during weekends, suggesting that regional trade, intercity passenger transport, and freight activities remain relatively consistent throughout the week. In contrast, the Lagos Ibadan Expressway exhibited the smallest variation, with weekday traffic exceeding the average by 25.9% and weekend traffic declining by only 1.9%, indicating sustained traffic demand resulting from continuous commercial, industrial, recreational, and long distance travel activities.

These findings are consistent with those of Subair et al. (2024), who reported that traffic volumes on major urban roads in Nigeria are generally higher during weekdays because of increased commuting, business activities, and goods distribution, while weekends are characterised by reduced traffic demand. Similarly, Ayeni and Iyeke (2024) observed that weekday traffic on urban arterial roads is significantly influenced by employment related trips and institutional activities, whereas weekend traffic reflects more discretionary and recreational travel. The relatively small weekday weekend variation observed along the Lagos Ibadan Expressway also agrees with the findings of Adediran et al. (2025), who attributed the sustained traffic volumes on the corridor to its strategic role in supporting continuous economic activities, freight transportation, and interstate mobility. Comparable findings were reported by Wang et al. (2021), who noted that major urban transport corridors in rapidly developing cities typically experience higher weekday traffic volumes due to concentrated economic activities, although transport corridors with substantial freight movement often maintain relatively high traffic levels during weekends.

Stakeholders' Perspectives on Vehicular Emissions in Major Nigerian Cities

This part presents insights from government officials, transport operators, auto technicians, environmental advocates, and urban residents in Abuja, Kano, and Lagos regarding vehicular emissions. Using proportionate sampling based on observed traffic volumes, with Abuja at 35.1%, Kano at 21.8%, and Lagos at 43.1%, approximately 450 participants were surveyed. Stakeholder responses complement technical emission data by providing practical perspectives on the causes, severity, and mitigation of urban air pollution from vehicles, offering evidence based guidance for policy and intervention strategies.

**Table 6: Demographic and Professional Profile of Respondents**

| Variables | Frequency | Percentage (%) |
|---|---|---|
| **Locations** | | |
| Abuja | 134 | 34.9 |
| Kano | 84 | 21.9 |
| Lagos | 166 | 43.2 |
| **Sex Distribution of Respondents** | | |
| Male | 235 | 61.2 |
| Female | 149 | 38.8 |
| **Age Distribution of Respondents** | | |
| Below 18 | 9 | 2.3 |
| 18–24 | 54 | 14.1 |
| 25–34 | 132 | 34.4 |
| 35–44 | 86 | 22.4 |
| 45–54 | 60 | 15.6 |
| 55–64 | 29 | 7.6 |
| 65 and above | 14 | 3.6 |
| **Highest Educational Qualification** | | |
| Primary | 11 | 2.9 |
| Secondary | 61 | 15.9 |
| Tertiary | 189 | 49.2 |
| Postgraduate | 109 | 28.4 |
| Others | 14 | 3.6 |
| **Stakeholder Group** | | |
| Government official (e.g., FRSC, VIO, Ministry) | 74 | 19.3 |
| Commercial vehicle operator | 103 | 26.8 |
| Auto mechanic / technician | 57 | 14.8 |
| Transport union member | 32 | 8.3 |
| Environmental NGO representative | 12 | 3.1 |
| Urban resident | 106 | 27.6 |
| **Total** | **384** | **100.0** |

Source: Authors' Field Survey (2025)

The survey involved valid responses from 384 stakeholders from Abuja, Kano, and Lagos, with Lagos contributing the largest share at 43.2%, followed by Abuja at 34.9% and Kano at 21.9%. Males formed the majority of respondents at 61.2%, while females accounted for 38.8%. Most participants were aged between 25 and 34 years (34.4%), with notable representation from the 35 to 44 and 45 to 54 age groups. Educationally, nearly half held tertiary qualifications (49.2%), and 28.4% had postgraduate degrees. Respondents represented diverse stakeholder groups, including commercial vehicle operators (26.8%), urban residents (27.6%), government officials (19.3%), auto mechanics and technicians (14.8%), transport union members (8.3%), and environmental NGO representatives (3.1%).

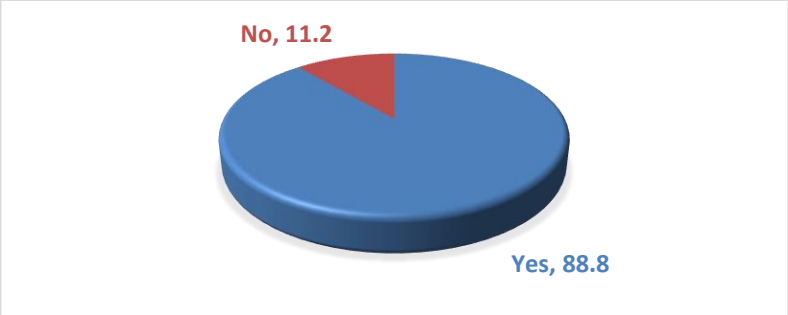


Figure 2: Awareness of the Environmental Impact of Vehicle Exhaust Emissions
Source: Authors' Field Survey (2025)

The data presented in Figure 2 reveals a high level of awareness among stakeholders regarding the environmental impact of vehicle exhaust emissions. Out of the total respondents, an overwhelming majority of 341 individuals, representing 88.8%, indicated that they are aware of the harmful environmental consequences associated with vehicular emissions. Only 43 respondents, accounting for 11.2%, reported a lack of awareness on this issue. The high awareness rate may be attributed to increased exposure to environmental education, media coverage of air quality issues, and direct experience with the health or environmental effects of emissions in urban settings. It also reflects the growing relevance of environmental sustainability within public discourse and policy advocacy efforts in Nigerian cities.

**Table 7: Perception of the Seriousness of Vehicular Emissions**

| Response Option | Frequency | Percentage (%) |
|---|---|---|
| Very serious | 44 | 11.5 |
| Serious | 76 | 19.8 |
| Moderate | 103 | 26.8 |
| Not serious | 89 | 23.2 |
| Not sure | 72 | 18.8 |
| Total | 384 | 100.0 |

Source: Authors' Field Survey (2025)

The data in Table 7 shows that stakeholders widely recognise vehicular emissions as an environmental concern, with 31.3% rating it as serious or very serious. A larger segment, 26.8%, considered the issue moderate, suggesting awareness without perceiving it as urgent. Meanwhile, 23.2% viewed emissions as not serious, and 18.8% were uncertain, reflecting gaps in knowledge or limited exposure to the environmental and health impacts of vehicle exhaust.

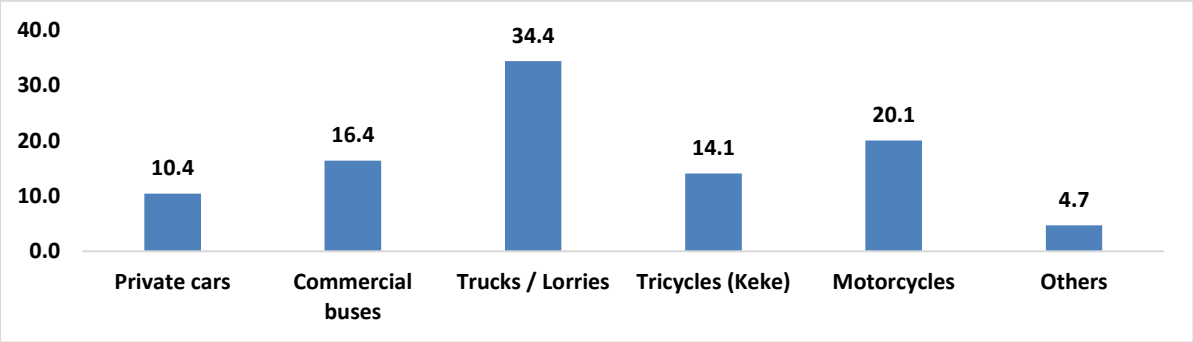


Figure 3: Perceived Major Contributors to Vehicular Emissions
Source: Authors' Field Survey (2025)

Stakeholder responses from Abuja, Kano, and Lagos indicate that trucks and lorries are viewed as the leading contributors to vehicular emissions, accounting for 34.4% of responses due to their older engines, heavy diesel use, and frequent urban operation. Motorcycles follow at 20.1%, reflecting their high numbers, outdated engines, and poor maintenance, especially in cities like Kano. Commercial buses (16.4%) and tricycles (14.1%) also contribute significantly, as they operate continuously with limited emission controls. Private cars represent 10.4% of perceived sources, with older models still impacting air quality, while 4.7% of responses cited other vehicles.

**Table 8: Familiarity with Emission Standards (e.g., Euro 4)**

| Response Option | Frequency | Percentage (%) |
|---|---|---|
| Yes | 225 | 58.6 |
| No | 35 | 9.1 |
| Heard of it but do not understand it | 124 | 32.3 |
| Total | 384 | 100.0 |

Source: Authors' Field Survey (2025)

As presented in Table 8, stakeholder responses from Abuja, Kano, and Lagos show that 58.6% of participants are familiar with emission standards such as Euro Four, indicating growing awareness among key actors in urban transport and environmental management. However, 32.3% have heard of these standards but do not fully understand them, reflecting a notable knowledge gap, while 9.1% are completely unfamiliar. These findings are consistent with those of Ajayi et al. (2023), who reported that although awareness of vehicle emission control measures and their environmental implications is increasing among transport stakeholders in Lagos, a substantial proportion of road users still have limited understanding of emission standards and regulatory requirements. This suggests that while awareness is gradually improving, there remains a need for sustained public education, stakeholder engagement, and clearer communication of emission regulations to promote compliance and support effective implementation of vehicular emission control policies in Nigeria.

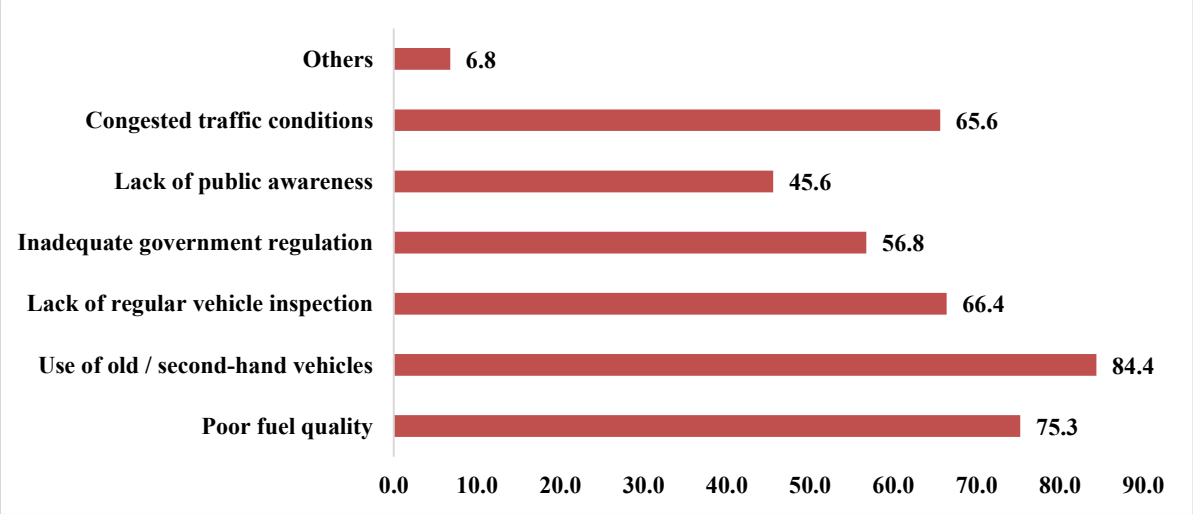


Figure 4: Perceived Main Causes of High Vehicular Emissions
Source: Authors' Field Survey (2025)

Stakeholders identified several key causes of high vehicular emissions. The most frequently cited was the use of old or second hand vehicles (84.4%), followed by poor fuel quality (75.3%), lack of regular vehicle inspection (66.4%), congested traffic (65.6%), and inadequate government regulation (56.8%). Inadequate public awareness accounted for 45.6%, while 6.8% cited other factors such as poor road conditions and limited alternative transport. These findings indicate that vehicular emissions in Nigeria are driven by a combination of vehicle, regulatory, infrastructural, and behavioural factors. The results are consistent with Ajayi et al. (2023), who identified ageing vehicles, poor fuel quality, and traffic congestion as major contributors to urban vehicular emissions in Lagos. Similarly, Adediran et al. (2025) reported that older vehicles and persistent congestion significantly increase emissions on major road corridors.

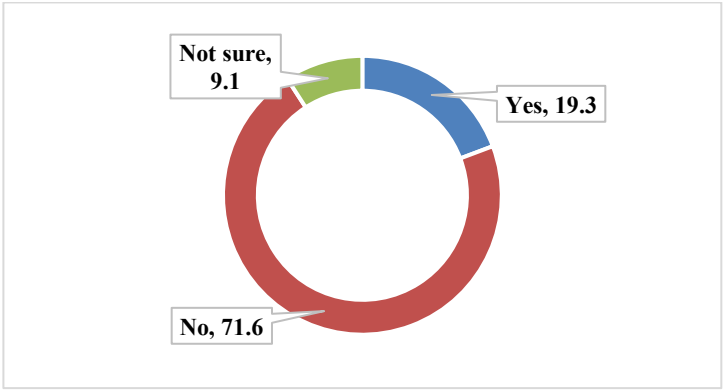


Figure 5: Perception of Sufficiency of Current Policies and Enforcement Mechanisms
Source: Authors' Field Survey (2025)

Figure 5 shows that most respondents (71.6%) considered existing policies and enforcement mechanisms inadequate for controlling vehicular emissions, while only 19.3% regarded them as sufficient and 9.1% were unsure. This finding suggests widespread concern over the effectiveness of current regulatory frameworks and their implementation. The result is consistent with Ajayi et al. (2023), who reported that weak enforcement of emission regulations and limited institutional capacity have constrained efforts to reduce vehicular emissions in Nigeria. Similarly, Adediran et al. (2025) emphasized that ineffective policy implementation remains a major challenge to improving urban air quality despite existing emission control measures. These findings highlight the need to strengthen policy enforcement, institutional capacity, and public awareness to achieve effective vehicular emission control.

**Table 9: Attitude toward Stricter Emission Control Laws**

| Response Option | Frequency | Percentage (%) |
|---|---|---|
| Strongly supportive | 126 | 32.8 |
| Supportive | 143 | 37.2 |
| Neutral | 69 | 18.0 |
| Opposed | 32 | 8.3 |
| Strongly opposed | 14 | 3.6 |
| Total | 384 | 100.0 |

Source: Authors' Field Survey (2025)

Table 9 shows that most stakeholders support stricter emission control laws, with 70.0% expressing either strong support or support, while 18.0% were neutral and 11.9% opposed stricter regulations. The high level of support reflects growing public recognition of the environmental and health impacts of vehicular emissions, although opposition may be linked to concerns over compliance costs and enforcement challenges. These findings are consistent with Ajayi et al. (2023), who reported strong stakeholder support for stricter emission control measures in Lagos due to increasing awareness of air pollution and its health effects. Similarly, Adediran et al. (2025) emphasized that effective emission reduction requires stronger regulatory frameworks supported by public acceptance and consistent enforcement. The findings therefore suggest that strengthening emission control policies is likely to receive broad stakeholder support if accompanied by effective implementation and public sensitisation.

**Table 10: Suggested Interventions for Reducing Vehicle Emissions (Multiple responses allowed)**

| Response Option | Frequency | Percentage (%) |
|---|---|---|
| Phasing out old / high-emission vehicles | 304 | 79.2 |
| Promoting use of public transportation | 278 | 72.4 |
| Introducing vehicle emission testing centres | 321 | 83.6 |
| Subsidising cleaner fuels or technologies | 252 | 65.6 |
| Creating public awareness campaigns | 215 | 56.0 |
| Strengthening policy enforcement | 312 | 81.3 |
| Others | 20 | 5.2 |

Source: Authors' Field Survey (2025)

Table 10 shows that stakeholders strongly support multiple interventions to reduce vehicular emissions. Establishing vehicle emission testing centres received the highest support (83.6%), followed by strengthening policy enforcement (81.3%) and phasing out old and high emission vehicles (79.2%). Other preferred measures included promoting public transportation (72.4%), subsidising cleaner fuels and technologies (65.6%), and increasing public awareness (56.0%). These findings indicate broad stakeholder recognition that effective emission control requires a combination of regulatory, technological, and behavioural interventions. The results are consistent with Ajayi et al. (2023), who identified vehicle inspection, improved public transport, and cleaner transport technologies as key strategies for reducing vehicular emissions in Nigeria.

## CONCLUSION

This study examined traffic patterns, vehicle composition, and stakeholder perspectives on vehicular emissions in Abuja, Kano, and Lagos. Peak traffic periods, heavy vehicles, and directional flows exacerbate congestion and emissions, while old vehicles, poor fuel quality, and weak regulation remain major contributors. Stakeholders strongly support interventions such as vehicle emission testing, phasing out high-emission vehicles, promoting public transport, and strengthening enforcement. Implementing these measures can reduce urban air pollution and guide sustainable transport planning in Nigeria's major cities.

## RECOMMENDATIONS

In line with findings of this study, the following recommendations are proposed:

i. Government should strengthen the enforcement of vehicular emission regulations through regular monitoring and stricter compliance measures.
ii. Functional vehicle emission testing centres should be established and integrated into periodic vehicle inspection programmes across major cities.
iii. Policies should be introduced to gradually phase out old and high emission vehicles while promoting the adoption of cleaner and energy efficient alternatives.
iv. Investment in safe, affordable, and reliable public transportation should be increased to reduce dependence on private vehicles.
v. Fuel quality standards should be strengthened and consistently enforced to minimize harmful vehicular emissions.
vi. Public awareness campaigns should be intensified to educate road users on the environmental and health impacts of vehicular emissions and the importance of vehicle maintenance.
vii. Traffic management strategies, including intelligent traffic control systems and road infrastructure improvements, should be implemented to reduce congestion and unnecessary vehicle idling.
viii. Future studies should expand traffic surveys to additional corridors and incorporate continuous air quality monitoring to provide a more comprehensive assessment of urban transport emissions.

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