Ghana Journal of Geography

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Traffic Flow Analysis and Congestion Issues in Lokoja City, Kogi State, Nigeria.

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article info

Article history:
Received 23rd May 2024
Accepted 2nd November 2024
Published 31st December 2024

Keywords:
Traffic flow;
Congestion;
Traffic volume;
Radial Roads;
Axial Roads.

abstract

The considerable traffic congestion on some roads in Lokoja city of Kogi State, Nigeria prompted this study. This paper thus, aims to analyze the traffic flow and congestion issues, particularly on the radial and axial roads in the town. The study's objectives are to identify the characteristics and condition of road infrastructure; assess the variation in congestion on axial and radial roads; identify the key factors contributing to traffic congestion; and the effects and management techniques of traffic congestion. A purposive sampling was used to select six roads comprising 3 each of the radial and axial roads with a noticeable amount of traffic. The study employs accidental sampling to administer 267 and 99 copies of the questionnaire to the commuters and operators on the selected roads respectively. Findings of the study reveal that the roads are of good width, (20-22.5m) comprising of 4 lanes for radial roads and 2 lanes for axial roads, but the incidence of potholes is numerous and up to 95 on radial roads. It, however, constitutes a great threat to smooth rides for vehicle operators, thereby increasing the possibility of traffic congestion. Traffic counts study shows that vehicles plying the radial road were higher (504, 426) than that of the axial roads (262,469). At the same time, the afternoon peak hour (4-5 pm) generates a higher traffic density than the morning peak period (7-8 am) on both radial and axial routes. Further analysis shows that disobedience to traffic rules and poor transport design and planning amidst increasing usage of vehicles contributed to the traffic congestion encountered on the roadways. The study, therefore, recommended the need for control measures such as strict enforcement of traffic laws, provision of traffic warden and lights, parking restriction, and rehabilitation of roads ravaged by potholes.

Introduction

Efficient transport systems are vital for economic growth, social integration, and improved quality of life in urban areas across the world, particularly in rapidly growing cities in developing countries. In Nigerian cities, effective transport systems facilitate the movement of people, goods, and services, enabling economic activities to thrive. According to Adesanya (2011), well-functioning transport systems can help reduce poverty by improving access to jobs, education, healthcare, and markets. Transport networks are also critical for urban residents' social well-being, as they enhance connectivity within and between cities. Although the Nigerian transport system is characterized by road, rail, air, and water transportation, road transport dominates the country's transportation network, handling more than 90% of all goods and passengers transported within the country (Ademiluyi & Solanke, 2013). Road transport plays a crucial role in connecting and facilitating the efficient operation of other modes of transport. It is an essential and vital component of industrialized economies and it accounts for over 70% of total freight movement in most countries, making it a critical component of the supply chain (OEDC, 2019). Regrettably, the current road infrastructure in Nigeria, particularly the motorway system, is experiencing a rapid surge in traffic congestion due to the growing number of vehicles and the inability to construct more, wider roads.

The transportation route is a crucial component of differentiated growth, while the layout of road networks, often characterized by regular street patterns, is an essential aspect of human existence, development, and civilization (Bailey, Mokhtarian & Littlel, 2008).

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http://dx.doi.org/10.4314/gjg.v16i4.4

Road networks are evaluated based on their accessibility, connection, traffic density, level of service, compactness, and density of specific roads. However, the level of service is a metric used to assess the quality of service on transport devices or infrastructure. The level of service considers several parameters that indicate traffic density and congestion, rather than focusing solely on the overall speed of the journey. (Mannering *et al.*, 2004). Unfortunately, Nigeria's transport infrastructure is in a deplorable state and fails to meet the expectations of ensuring efficient movement between and within different cities of the country. It is insufficient as a tool for achieving a nation's rapid economic growth and development. As noted by Aderamo (2012), the insufficient infrastructure and lack of maintenance of the available ones have resulted in traffic congestion in many Nigerian urban centres.

The need for the development of various transportation routes has become pivotal to physical and economic developments. Such routes include the radial and axial routes in any Nigerian city. Radial and axial roads are terms used to describe the pattern of road networks in urban planning and transportation engineering. Radial roads radiate from a city centre and connect the city centre to outlying areas or suburbs, while axial roads run parallel to each other, often in a grid-like pattern connecting radial roads and providing cross-town routes. Traffic congestion is a critical challenge affecting urban centers across the world, particularly in rapidly growing cities in developing countries. In Nigeria, where urbanization and population growth are accelerating, the strain on existing road networks is evident in many cities, leading to severe traffic issues (Adeniji, 2020). Studies on traffic flow in Nigeria highlight that poor road infrastructure, weak traffic management, and the lack of alternative transportation modes are key contributors to urban congestion (Olawole & Aluko, 2016). Almost all capital cities in Nigeria are currently plagued by the issue of traffic congestion (Moses, 2011). This is exemplified by Lokoja city, which previously did not

experience traffic congestion, is now encountering significant traffic congestion on several of its urban roadways, especially on the radial and axial routes of the city.

Scholars have described congestion in a variety of ways. Congestion, in the context of traffic flow, is typically defined as a situation where the travel demand exceeds the capacity of the road. (Aftabuzzaman, 2007). Traffic congestion in numerous major centres in Nigeria persists despite the implementation of various remedial measures by different governments throughout the years. For example, the duration of trips between different locations within a municipality has consistently been unpredictable, causing citizens to experience significant transportation disruptions (Joseph and Anderson, 2012). Advanced traffic control and management strategies have become standard and effective alternatives to alleviate traffic congestion and increase the levels of service and efficiencies of urban transport networks (Feifei et al., 2016).

Traffic congestion in Lokoja is a growing challenge because of the city's role as a key transportation hub serving as a significant transit point linking northern and southern parts of Nigeria. In addition, its status as the capital of Kogi State contributes to its heavy traffic volumes, particularly along its axial and radial roads. These roads serve as critical transit routes for both local and inter-regional traffic, including commercial vehicles, commuters, and heavy-duty trucks traveling between northern and southern Nigeria. Moreover, the rapid urbanization and population growth in Lokoja have exacerbated the issue of traffic congestion. As more people migrate to the city in search of employment opportunities and better living conditions, the existing road infrastructure has proven inadequate to accommodate the increasing number of vehicles (Olajide & Ajayi, 2018). This has resulted in frequent traffic jams, especially during peak hours, which is negatively impacting travel time, fuel consumption, and air quality. Despite the recognition of these challenges, studies have revealed that insufficient traffic control mechanisms, and narrow and poorly maintained roads that cannot handle the rising number of vehicles have made it difficult to eradicate the significant traffic challenges (Adedeji et al. 2017; Akpan & Okon, 2019). Therefore, a comprehensive study on traffic flow and congestion in Lokoja that reveals the current status of road characteristics and conditions is necessary to inform effective transport policies and infrastructural improvements. This is the research gap that this study intends to fill.

Study Area

Lokoja is located between latitudes 7° 45' N and 8° 45' N north of the equator and between longitudes 6°00'E and 6°45'E east of the Greenwich meridian (see figure 1) The city is the administrative centre of the Kogi State and is located at the point where the Niger and Benue rivers meet, near the lower Niger basin. It covers an approximate area of 63.82 square kilometres (Adeoye, 2012).

The town's administrative, commercial, and financial activities, together with others, have resulted in significant transformations in its size, structure, population, and socio-economic development, particularly in the past three decades (Atomode and Makanjuola, 2016). The surge in human population led to swift development, resulting in alterations to land use practices in the region. Currently, Lokoja serves as a hub for commerce in fishing and agricultural goods due to its strategic position at the confluence of the Niger and Benue rivers. Furthermore, the city experiences prospering in transit services, banking, tourism, light manufacturing, and recreational services.

Lokoja is a home of different ethnic nationalities as a result of various migratory movements to the town comprising the Igala, Kakanda, Ebira, Koto, Oworo, Bassa Nge, Bini, and Nupe among the major tribes. The conglomeration of these tribes and groups fostered inter-group relations as well as the population growth of the town (Abdullahi et al., 2015)

Materials and Methods

Data for the study were obtained from both primary and secondary sources. The primary sources include a reconnaissance survey, traffic count, and administration of the questionnaire. The questionnaire was administered to three different groups of people in the study area. These are the commuters, operators, and agencies responsible for traffic management such as vehicle Inspection officers (VIO) and officers of the Kogi State Traffic Management Authority (KOTRAMA). The secondary data were sourced from KOTRAMA, Kogi State Ministry of Lands and Survey, and relevant journals and textbooks.

The sampling technique adopted was accidental because there is no pre-determined population and the number was picked purposively based on the situation of the groups in the case of transportation studies. From a total of twelve roads comprising four (4) radial and eight (8) axial, six (6) representing 50% were purposively selected based on the volume of traffic observed during the reconnaissance survey (see Table 2a). In all, a total of 267 copies and 99 copies of the questionnaire were administered to the commuters and operators on the radial and axial roads as shown in Tables 2b and 2c respectively.

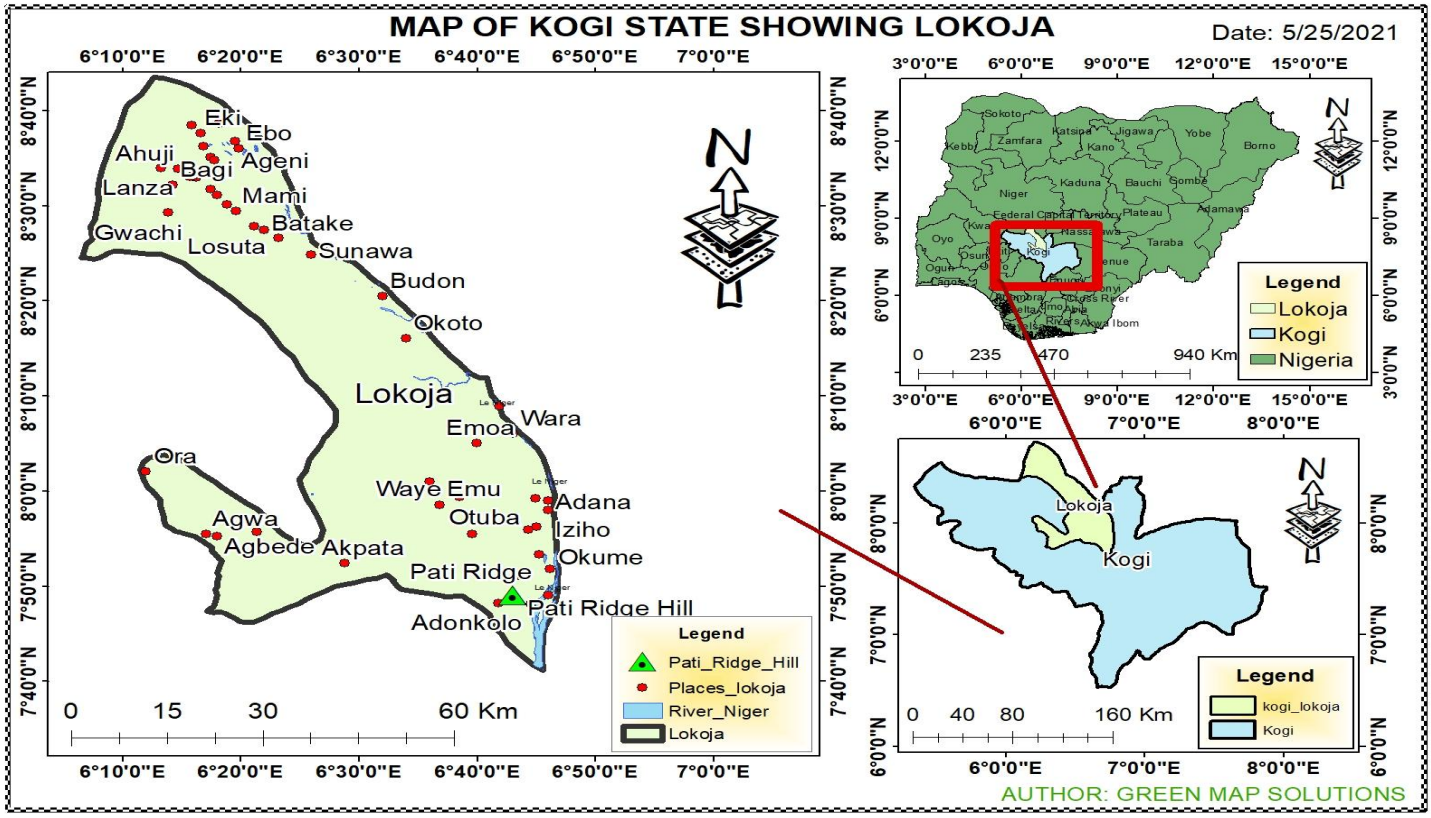

Figure 1: Lokoja within the Context of Kogi State
Source: Author's GIS work 2021.

Table 2a: Roads Selected for the Study

Radial Routes identified	Radial Roads selected	Axial Routes identified	Axial Roads selected
Ilorin Road	Felele Road	Adankolo-Ganaja Road	Adankolo Road
Anambra-Enugu Road	Ganaja Road	Barrack-Felele Road	Barrack Road
Okene-Abuja Road	Okene Road	Felele-Okene Road	Otokiti Road
KotoKarfi –Abuja Road		Post – Nataco Road	
		Ganaja-Lokogoma Road	
		Old Poly Quarters Road	
		Lokoja Model Stadium Road	
		New Layout Area Road	
Total 4	**Selected= 3**	**Total= 8**	**Selected= 3**
Total roads = 12			
Road Selected = 6 at 50%			

Source: Author's Fieldwork, 2023

Table 2b: Distribution of Questionnaire in the Radial and Axial Roads to Commuters

Radial	Quantity	Axial	Quantity	Total questionnaire administered
Felele Road	57	Adankolo Road	38	95
Ganaja Road	53	Barracks Road	33	86
Okene-Abuja Road	62	Otokiti Road	24	86
	172		**95**	**267**

Source: Author's Fieldwork, 2023

Table 2c: Distribution of Questionnaire in the Radial and Axial Routes to Operators

Radial	Quantity	Axial	Quantity	Total questionnaire administered
Felele Road	21	Adankolo Road	14	35
Ganaja Road	20	Baracks Road	12	32
Okene Abuja Road	23	Otokiti Road	9	32
	64		**35**	**99**

Source: Author's Fieldwork, 2023

Table 3: Radial Route Characteristics and Conditions of Roads in Lokoja

Route Name	Width of the road (m)	Number of lanes	Pavement with Asphalt	Number of potholes		Number of speed breaker		Land use Characteristics adjoining the road
				Left	Right	Left	Right	
Felele Road	22.62	4	Paved	20	15	1	2	Commercial, Residential, industrial, and public
Ganaja Road	20.54	4	Paved	10	8	1	-	Commercial, Residential, and public
Okene-Abuja Road	22.62	4	Paved	24	18	3	2	Commercial, Residential, and public
Total		**12**		**95**		**9**		

Source: Author's Fieldwork, 2023

Data collected were analyzed using descriptive statistical techniques including tables, cross-tabulations, percentages, and chi-square. Analysis of Variance (ANOVA) was used to test if any significant difference exists in the volumes of traffic in the radial and axial routes in the study area.

Results and Discussion

Road Infrastructure Characteristics and Conditions in Lokoja

The parameters used for the assessment of road characteristics and conditions in the Lokoja radial and axial roads include road width, number of lanes, pavement with asphalt, existence of potholes, speed breaker, and the land use characteristics of the adjoining road (see Table 3). It was observed that Felele and Okene-Abuja roads have the largest road width of 22.62m among the selected radial roads for this study, while the smallest width of 20.54m was found in Ganaja road. However, it was observed that all the radial routes studied have four (4) lanes. It was also observed that all the roads are paved. The incidence of potholes was also observed on the roads (see plate 1). The total number of potholes observed in the radial roads is ninety-five (95). It can be inferred from Table 3 that the incidence of potholes is also a major issue in most of the roads studied in the radial routes, as they exist in large numbers and constitute great threats to smooth rides for vehicle operators and pedestrians on these roads. This finding aligns with the study of Arosanyin et al. (2011) that the condition of many roads in Lokoja is poor, with potholes, erosion, and inadequate road networks contributing to the challenges faced by larger vehicles. Speed breakers (Bumps) were also found in some of the radial routes including Felele Road (3 bumps), Okene-Abuja Road (5 Bumps), and Ganaja Road (1 bump) respectively.

The largest route width in the axial roads found at the Adankolo route measured 20.34m. Also, Adankolo and Otokiti roads have two (2) lanes each, while Barrack Road has a single lane. Furthermore, all the axial roads in the study area are paved with asphalt.

Potholes were also noticed in most of the axial routes with 54, 28, and 32 potholes found in Adankolo, Barrack, and Otokito roads respectively.

Plate 1: Pothole causing Traffic Obstruction along Felele Road, Lokoja
Source: Author's Fieldwork, 2023

All the axial rods studied were provided with speed breakers, with Barrack Road having eight (8) bumps representing the highest on this route. Although, all the axial routes are paved with asphalt., the presence of potholes in large numbers still portends hindrance to smooth ride for the vehicle operators and pedestrians on these roads. These potholes also increase the possibility of traffic congestion. This is because vehicles would be forced to slow down to navigate the potholes. This is corroborated by Abdullahi et al. (2015) in their study that a significant factor affecting traffic flow in Lokoja is the poor state of the road infrastructure where many of the roads in the city are narrow and have potholes.

Table 4: Axial Route Characteristics and Conditions of Roads in Lokoja

Route Name	Width of the road (m)	Number of lanes	Pavement with Asphalt	Number of potholes		Number of speed breaker		Land use Characteristics adjoining the road
				Left	Right	Left	Right	
Adankolo Road	20.34	2	Paved	30	24	3	1	Commercial, Residential, and public
Barrack Road	10.50	1	Paved	12	16		8	Commercial, Residential, and public
Otokiti Road	16.82	2	Paved	15	17	3	3	Commercial, Residential, and public
Total		**5**		**114**		**18**		

Source: Author's Fieldwork, 2023

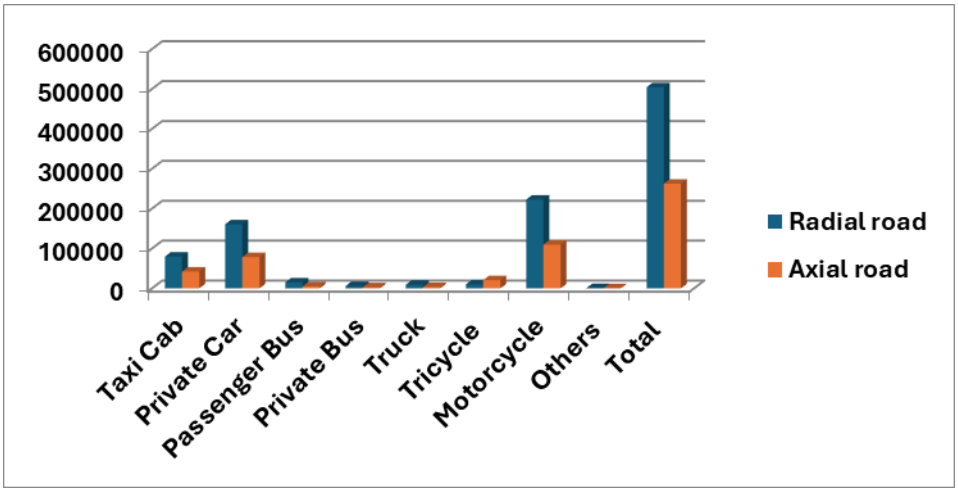

Figure 2: Summary of Traffic Counts in Radial and Axial Routes of Lokoja
Source: Author's Fieldwork, 2023

Table 5: Volume of Traffic Per Hour at Radial Routes in Lokoja

S/N	Route Name	Morning Peak (7-8 am)		Afternoon Peak (4-5 pm)	
		VPH	% of total	VPH	% of total
1	Felele Road	12207.5	42.3	11459	30.2
2	Ganaja Road	4276	14.8	12517.5	33.0
3	Okene-Abuja Road	12384	42.9	13966.5	36.8
	Total	**28867.5**	**100**	**37943**	**100**

Source: Author's Fieldwork, 2023 VPH= Volume per Hour.

Table 6: Volume of Traffic Per Hour at Axial Routes in Lokoja

S/N	Route Name	Morning Peak (7-8 am)		Afternoon Peak (4-5 pm)	
		VPH	% of total	VPH	% of total
1	Adankolo Road	6573	41.9	8170.5	33.0
2	Barrack Road	6107	39.0	10380	42.0
3	Otokiti Road	2996.5	19.1	6190.5	25.0
	Total	**15676.5**	**100**	**24741**	**100**

Source: Author's Fieldwork, 2023 VPH= Volume per Hour

Summary of Traffic Counts in Lokoja

The summary of traffic counts as shown in Figure 2 indicated that vehicles plying the radial route for four (4) days of study were higher (504, 426) than that of axial routes (262,469). As the result revealed, motorcycles were observed to be very high on both radial and axial routes. This could be attributed to the flexibility of motorcycles in avoiding traffic congestion. This is in line with the finding of Oyesiku et al. (2016) that the affordability of motorcycles, coupled with relatively low entry costs to become a commercial motorcycle operator, further explains the high prevalence of motorcycles on both axial (main roads) and radial (secondary) roads in Lokoja. However, the presence of a lot of motorcycles on these roads could have also resulted in escalating congestion or disturbance of traffic flow. Competition between motorcycles and other vehicles on the road may often result in accidents and loss of lives on the road.

Volume of Traffic Per Hour at Radial and Axial Routes in Lokoja

The results in Table 5 show that for both morning and afternoon peaks, the Okene-Abuja Road recorded the highest volume of traffic among the studied Radial roads. There are 12,384 Vehicles per Hour (VPH) representing (42.9%) and 13,966.5 VPH representing (36.8%) of total volume for morning and afternoon peaks respectively. The volume of traffic was also high in Felele with a VPH of 12,207.5 (42.3%) and the least was on the Ganaja Road with 4,276VPH (14.8%). The afternoon peak on Ganaja Road was also found to have a high VPH of 112,517.5 (33.0%). The Vehicle per Hour (11,459) was, however, observed to be the lowest at Felele Road (30.2%). These findings of this study correspond with those of Aderamo & Magaji (2010), who observed that axial roads in Lokoja, such as the Lokoja-Abuja Road and the Lokoja-Okene experienced high traffic volumes with the daily traffic volume on the Lokoja-Abuja Road recorded an estimated 40,000 to 50,000 vehicles per day, many of which are heavy-duty trucks.

Furthermore, Adankolo Road has the highest volume of traffic at the morning peak with 6,573VPH (41.9%), while Otokiti Road was found to be the lowest volume of traffic with 2,996.5VPH (19.1%) at the morning peak on the Axial routes (see Table 6)

In addition, the afternoon peak showed that Barrack Road had the highest volume of traffic with 10,380 VPH (42.0%). This is followed by Adankolo Road at 8,170.5VPH (33.0%) and the least volume of traffic occurs in Otokiti Road with (6,190.5) VPH, representing (25.0%) in the afternoon. The result implies that people ply Otokiti Road in high numbers in the morning to carry out their daily activities, but in the peak hour in the evening, fewer people were recorded plying the road. This may be attributed to the fact that many of the residents in this area may not be government workers or most of them do not engage in works that close between 4 pm – 5 pm which is the peak hour.

Difference in the Volume of Traffic in Radial and Axial Routes in Lokoja

The hypothesis tested is stated below:

H_0: There is no difference in volumes of traffic in the Radial and Axial routes of the study.

The information in Table 7 shows the results of the Analysis of Variance (ANOVA) used to examine differences in the traffic volumes on the axial and radial routes of Lokoja city. From the results, the F-value of 0.068 and P-value of 0.795($p>0.05$) for traffic volumes in Radial routes showed that there are no significant differences in the distribution of the volume of traffic flow across the three (3) selected radial routes in the study area. Considering the axial routes, F-value 0 8.168 and p-value of 0.00($p<0.05$), the results showed that there is a significant difference in the volume of traffic flow across the three selected (3) axial routes in the study area. The results of ANOVA however, have indicated that the incidence of traffic flow across the radial and axial routes in Lokoja are different. This is because, on the radial route, almost all vehicles pile on the road. After all, it is an express road, while on the axial, vehicles that pass each route differ depending on the type that the locals prefer, It should be noted that these roads are majorly used by the residents.

Generally, traffic flow scenarios across Lokoja reveal a situation that is becoming worrisome as each day passes. The level of traffic congestion is also very high on these routes. There is no doubt that the location of Lokoja city as a gateway to the Federal Capital Territory (FCT), where virtually most of the modes of transportation are in existence, coupled with the human population has greatly influenced the nature of traffic flows. The study of Onuh & Olajide (2020) also confirmed that the increasing population in Lokoja, due to its administrative importance and growing urbanization, has led to more vehicles on the road, especially private cars and motorcycles used for commuting.

Road Users' Opinion on 'Factors Affecting Traffic Flow on the Radial and Axial Routes and Differences in Lokoja

The results in Table 8 show the opinions of respondents on the causes of road traffic congestion in the study area. Likert scale was used to weigh the degree of causes. This is done by attaching values of weight to different degrees of responses as shown: strongly agreed (5) agreed (4), neutral (3), disagreed (2) strongly disagree (1).

The AWV (Agreement Weight Value) was calculated by multiplying the total number of replies for each variable by the corresponding weight assigned to each rating and then, summing up these products. For example, the AWV can be calculated as (a x 5) + (b x 4) + (c x 3) + (d x 2) + (e x 1). The mean utilized in the computation was derived by adding the Mean Weighted Value (MWV) and dividing it by the total number of variables. The results of Table 8 show that the increase in car usage has the greatest weighted value of 4.57. This implies that the study area's traffic congestion is mostly caused by a rise in car usage. The situation is followed in decreasing order by disobedience to traffic rules which has a mean weighted value of 4.49, poor transport design and planning (4.42), operators' impatience (4.16), and high volume of traffic (4.14) among others.

Table 7: Difference in the Volume of Traffic Flow in Lokoja

		Sum of Square	Df	Mean Square	F	Sig
Traffic Volume in Radial Routes	Between groups	.047	1	.047	.068	.795
	Within groups	118.807	170	.699		
	Total	118.855	171			
Traffic Volume in Axial Routes	Between groups	16.336	2	8.168	8.651	.000
	Within groups	86.864	92	.944		
	Total	**103.200**	**94**			

Source: Author's Fieldwork, 2023

Table 8: Causes of Road Traffic Congestion in Lokoja

Factor Influencing Change of Use	SD		D		N		A		SA		TWV	TOTAL	RAI (x) TWV/N	(x- ẋ)	$(x-ẋ)^2$	Rank
	$f_{(1)}$	$W_{(1)}$	$f_{(2)}$	$W_{(2)}$	$f_{(3)}$	$W_{(3)}$	$f_{(4)}$	$W_{(4)}$	$f_{(5)}$	$W_{(5)}$						
The high volume of traffic	5	5	0	0	4	12	57	228	33	165	410	99	4.14	0.22	0.0484	5th
Increase in population	4	4	19	38	68	204	8	32	0	0	278	99	2.81	-1.11	1.2321	9th
Increase in household income	12	12	0	0	29	87	54	216	4	20	335	99	3.38	-0.54	0.2916	7th
Increase in the level of car usage	0	0	0	0	0	0	43	172	56	280	452	99	4.57	0.65	0.4225	1st
Poor transport design and planning	0	0	0	0	3	9	42	168	54	270	438	99	4.42	0.5	0.25	3rd
Disobedience of traffic rules	0	0	0	0	9	27	32	128	58	290	445	99	4.49	0.57	0.3249	2nd
Operator impatience	0	0	0	0	13	39	57	228	29	145	412	99	4.16	0.24	0.0576	4th
Indiscriminate on-street parking	0	0	0	0	32	96	42	168	25	125	389	99	3.93	0.01	0.0001	6th
Street trading	0	0	24	48	34	102	22	88	19	95	333	99	3.36	-0.56	0.3136	8th
Total													35.26		2.9408	
Mean	3.92															

Source: Author's Field Work, 2023

Where TWV means Total weight value, Variance = $\Sigma (x-ẋ)2/9 = 2.94/9 = 0.33$, Standard Deviation = $\sqrt{\text{Variance}} = \sqrt{0.33} = 0.57$

Co-efficient of Variation (CV) = S.D x 100/Mean RAI = 0.57 x 100/3.92 = 14.54%, Total = Total number of respondents, RAI(X) = Resident Agreed Index, F=Frequency of different reply, W= Weighted Index, Mean = ΣRAI/N = 35.26/9=3.92

Some of these variables here that affect traffic flow in Lokoja are in line with the findings of Oni (2018) that narrow roads, poor maintenance of existing roadways, inadequate traffic management, poor enforcement of traffic rules, lack of coordinated public transportation, and the absence of dedicated lanes for different vehicle types contribute to congestion in Lokoja. Other factors that contribute to traffic congestion are the incidence of street trading and, the incidence of on-street motor and motorcycle parking.
Nevertheless, the average value of responses about the causes of traffic congestion in the study area, as reported by the participants, is 3.92. This indicates that the average replies were significantly higher than the norm, suggesting that there is high traffic congestion in the research location. This condition suggests a worrisome and highly disturbing situation.

Incidence of Street Trading

The incidence of street trading is also examined in the study area. The result in Figure 3, showed that 95.5% of respondents indicated yes, that there is an incidence of street trading. While 4.5% of the respondents agreed that there is no street trading. The highest proportion of respondents, however, was of the view that the incidence of street trading is prevalent in both the axial and radial routes of Lokoja. This supports the finding of Ogunsanya (1983) that street trading is a menace to traffic flow in Nigerian urban centres.

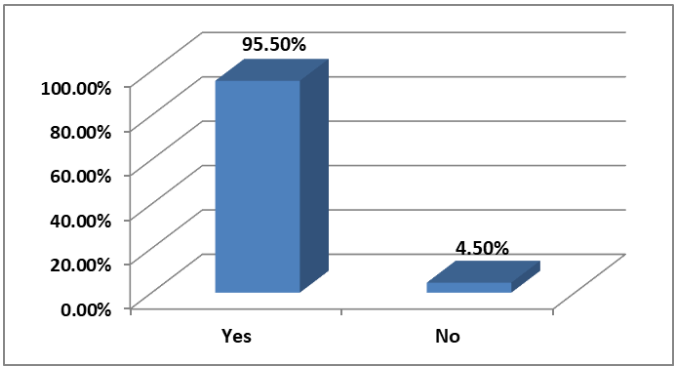

Figure 3: Incidence of Street Trading along the Road in Lokoja
Source: Author's Fieldwork, 2023

Incidence of On-Street Motor and Motorcycle Parking

The result in Figure 4 indicated that 95.5% of respondents agreed that there is an incidence of on-street motor and motorcycle parking, whereas 4.5% of respondents claimed they do not agree that this contributes to traffic congestion. It can be deduced that the majority of respondents affirmed that the situation of on-street motor parking is on the increase in the axial and radial routes of Lokoja. This aligns with the finding of Okoko (2008) which affirmed that on-street parking is becoming a problem to smooth traffic flow in Nigeria.

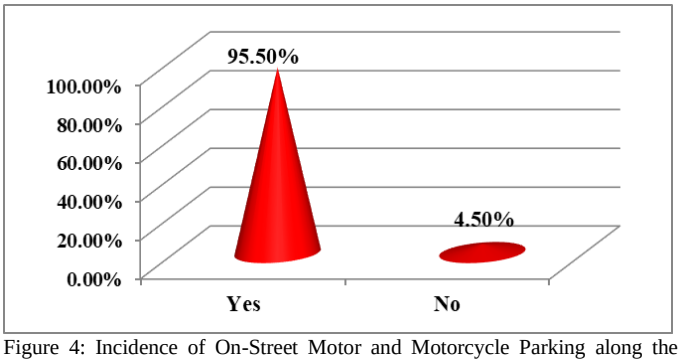

Figure 4: Incidence of On-Street Motor and Motorcycle Parking along the Road in Lokoja
Source: Author's Fieldwork, 2023

Effects of Traffic Congestion on Road Users

The results in Table 9 show the problems faced by respondents on the radial and axial routes as a result of traffic congestion. One of the main effects as claimed by the respondents was lateness to work, which accounted for 91.6% and 86.0% of the respondents on axial and radial routes respectively. In addition, 82.6% and 73.7% of the respondents on radial and axial respectively, claimed their inability to respond to emergencies due to traffic congestion (see plate 2). Another effect of traffic congestion claimed by respondents is the failure to meet appointments, which accounted for 67.4% on the axial route and 45.3% on the radial route. This finding supports the finding of Joseph and Anderson (2012), who showed that traffic congestion causes a lot of difficulties such as lateness to work, failure to meet appointments, and depreciation in economic activities in the affected area. Similarly, Kamruzzaman & Rumpa (2019) examined the impact of road traffic congestion on workers' performance in Dhaka, Bangladesh, and found that effectiveness, efficiency, career progression of workers, satisfaction, innovation, and quality of work were affected by traffic congestion.

Table 9: Effect of Road Traffic Congestion in Lokoja

	Effects of traffic congestion	**Radial**		**Axial**	
		Yes	**No**	**Yes**	**No**
1	Late to Work	86.0%	14.0%	91.6%	8.4%
2	Failure to meet the appointment	45.3%	54.7%	67.4%	32.6%
3	Unable to meet health emergency	82.6%	17.4%	73.7%	26.3%
4	Roadblock	21.5%	78.5%	42.1%	57.9%
5	Economic activities paralysed	15.1%	84.9%	23.2%	76.8%

Source: Author's Fieldwork, 2023

Plate 2: Hold-up along Ganaja Road, Lokoja
Source: Author's Fieldwork, 2023

Management Techniques for Road Traffic Flow and Congestion

The data shown in Table 10 illustrates several road traffic management measures implemented in the research area. The findings indicated that 83.3%, 80%, and 76.7% of the participants believed that implementing lane marking, traffic lights, and parking limits are necessary strategies for alleviating traffic congestion and enhancing traffic flow. Additional measures encompass public awareness campaigns and the deployment of traffic personnel to mitigate the impact of traffic congestion.

Table 10: Traffic Management Techniques

	Traffic Management Technique	**Percentage (%)**		
		Yes	**No**	**No Response**
1	Use of traffic law enforcement agency (warden)	73.3	26.7	0.0
2	Use of traffic light	80.0	20.0	0.0
3	Lane marking	83.3	16.7	0.0
4	Parking restriction	76.7	23.3	0.0
5	Public enlightenment campaign	46.7	53.3	0.0

Source: Author's Fieldwork, 2023

Conclusions and Recommendations

The volume of traffic on Lokoja's axial and radial roads is influenced by its geographic location as a transportation hub and its role as the capital of the Kogi State. The combination of local commuter traffic, inter-regional commercial traffic, and insufficient road infrastructure contribute to significant congestion, especially on key routes such as the Lokoja-Abuja Road, Lokoja-Okene Road, and Ganaja Road. Hence, it is crucial to devise more effective methods for controlling traffic in the city. As the population grows and individuals' wealth increases, the issue of transportation congestion worsens. Given the rapid growth of Lokoja, it is imperative to address the traffic challenge before it reaches the same level of severity as other urban areas in Nigeria. Therefore, our study recommends that the relevant agencies should take prompt action to address the issue of traffic congestion. The government should increase the number of traffic wardens and rigorously enforce traffic laws and regulations. They should also install more traffic lights and widen main roads to accommodate at least three lanes. Additionally, parking on the streets should be restricted and all roads with potholes should be repaired.

Acknowledgment
The contributions of research assistants who helped in the collection of data and various agencies of government like the Kogi State Traffic Management Authority (KOTRAMA), and officers of the Kogi State Ministry of Lands and Survey, who provided the researchers with secondary data are greatly acknowledged.

Conflict of interests
The authors declare that no conflict of interest exists for this research work.

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