

Assessment of Freight Vehicles' Effects on Urban Traffic in Lagos State, Nigeria

Tolu I. Atomode

Department of Geography, Federal University Lokoja, Kogi State, Nigeria
toluwaseisaac@gmail.com

Abstract

Freight vehicles possess distinguishing characteristics from those of the passenger vehicles that often predispose them to diverse traffic challenges in the urban transport systems. This study examined the contribution of freight vehicles to urban traffic problems in Lagos State, Nigeria. Major traffic bottlenecks along selected roads served as data collection stations for this study. Classified traffic counts conducted at each station was obtained from Lagos Metropolitan Area Transport Authority (LAMATA). The opinions of sampled 1,500 stakeholders (commuters, freight and passenger vehicle drivers, and traffic management officers) in the transport sector were sought through questionnaire administration on the perceived share of freight vehicles in urban traffic problems. Simple percentages, tables and charts were used to summarise the data while Simple Linear Regression Analysis was used for testing hypothesis and drawing valid conclusions. Findings showed that, although freight vehicles make up 8% of the total vehicular traffic; they constitute 40% of urban traffic problems in the study area. In addition, the proportion of freight vehicles in traffic was also found to significantly predict their share in urban traffic problems, $F(198) = 315.107, P < .001, R^2 = .614$. The R^2 value of .614 revealed that the volume of freight vehicles explained 61.4% of the variability in traffic problems associated with freight vehicles in the study area. Attempts at solving urban traffic problems should therefore accord greater priority to reducing the pressure on the urban roads by encouraging the efficient development and utilization of other transport modes.

Key Words: Freight Vehicles; Traffic Problems; Transport Stakeholders; Urban Traffic; Lagos State.

Introduction

Nigeria witnessed a dramatic increase in the use of freight vehicles during the post-war port development efforts and the economy booming years of early 1970s. During that period, there were lots of incoming goods into the country because of the discovery of crude oil, the reconstruction of the devastated effects of the civil war, increase in the purchasing power of the people in the country coupled with the relaxation of foreign exchange control and the lifting of embargo on imports. The period witnessed a lot of importation of reconstruction machinery including heavy structures for some basic industries, construction materials (especially cement) and consumer goods into the country, so much that hundreds of vessels had to queue for berthing space for months. So much money was wasted on payment of demurrage for these vessels, a development that created unpleasant consequences for the Nigeria economy (Oyatoye *et al.* 2011). Consequently, the demand for haulage trucks increased to evacuate and/or trans-load the freight from the vessels.

Rapid urbanisation and ever-increasing industrialisation with the resultant increase in the demand to move goods from one location to another in Nigeria also contributed to the increase in the number of freight vehicles in the country. Urban activities are accompanied by large movements of freight, since cities are dominant centres of production and consumption. For instance, raw materials are moved from their sources to industries for processing. Processed goods are transported to consumers in various locations within and outside urban centres. These movements are characterised by freight vehicles moving between industries, distribution centres, warehouses and retail activities as well as from major terminals such as ports and also intercity movements.

The increase in the volume of freight vehicles in urban traffic could be explained by the concept of spatial interactions. Spatial interaction is a broad term encompassing any movement over space that results from a human process in response to localized supply and demand. It is a transport demand and supply relationship expressed over a geographical space. Edward Ullman addressed spatial interaction as a function of 'complementarity', 'intervening opportunity', and 'transferability'. The term 'complementarity' refers to the basic relationship between supply and demand locations and the movement which this generates. Transport will take place between different areas if complementarity exists between the areas. This means that there must be a supply and a demand between the interacting locations. In other words, complementarity is the presence of a surplus or supply in one area and unsatisfied or excess demand in the other area. Both have to be present and not just one. Where a demand could be satisfied by more than one source of supply then 'intervening opportunity' is created. Intervening opportunity thus means that, there must not be another location that may offer a better alternative as a point of origin or as a point of destination. For instance, in order to have an interaction between a customer and a store, there must not be another closer store that offers a similar array of goods. In Atoyebi *et al.* (2015) explanations, complementarity will only generate a flow if there is no intervening or closer alternative location. The term transferability describes the cost involved in transportation between locations of demand and supply. Freight, persons or information being transferred must be supported by transport infrastructures, implying that the origin and the destination must be linked. Costs to overcome distance must not be higher than the benefits of related interaction, even if there is complementarity and no alternative opportunity. Summarily put, the amount of interaction between two places depends upon; the distance between the two places, the availability of intervening opportunities, and the attractiveness of each place.

Edward Ullman, in his explanation on the bases for interaction between places approached the subject from a geographic perspective of uneven distribution of markets and raw materials. It is certainly true that in the absence of geographical variation there would be no need for transport. It means that if all areas were the same in terms of economic activities and resources, there would be no need to interact or trade with other areas. So, it is essentially the variation of resources that gives rise to interaction. Writing on the basis of how the environment works, Filani (2000) noted that the environment consist of different land uses which creates spatial imbalance between areas of desires and fulfilments. According to Ogunsanya (2002), urban land use constitutes the origin and destination of different types of movement. The land use activities within the city create room for demand and supply or desires and fulfilments and thus create spatial imbalance. The objective of transportation is therefore to eliminate this spatial imbalance. Transport is the means by which products are brought from supply areas to areas where they are needed. Therefore, spatial interaction in the urban transport system provides the means for the satisfaction of certain needs arising from the locational separation of producers and consumers. It depends on reciprocal relations between different places on the earth's surface and it is based on the Ullman's principles of complementarity, intervening opportunities and transferability. The concept of spatial interactions therefore forms the basis for the proliferation of freight vehicles in urban areas and in turn, compounds traffic problems which are the focus of this research.

The ability to provide easy accessibility further earned freight vehicles the preference for the movements of goods in Nigeria. According to Olagunju (2011), Nigeria has an average of about 5,000 tankers involved in wet cargo haulage, and 2,500 trailers in dry cargoes plying Nigeria's roads daily. The consequence of the large numbers of freight vehicles is protracted urban transport problems of which Lagos State is the worst hit considering the astronomical increase in the numbers of both passengers and freight vehicles in the city (Olagunju, 2011). In a study on the contribution of freight vehicles to urban traffic delay in Lagos, Ogunsanya (1983) observed that on the average, 1% of freight vehicles is responsible for about 2% of the delay problems. In an investigation into the effects of heavy vehicles on traffic flow during congestion, Al-Kaisy and Jung (2005) observed that heavy vehicles are known for their significant effect on traffic due to their larger dimensions (in general) and inferior performance compared with an average automobile. The research involved an investigation of several important factors on the effects of

heavy vehicles during congestion using empirical data and traffic simulation. These factors include grade, grade length, heavy vehicles' percentage, lane-use restriction by vehicle type, and the location of bottleneck with respect to grade. Also, Federal Highway Administration (2004) reported that trucks contribute significantly to congestion in urban areas, accounting for at least one-fifth of the delay for all vehicles in the fifty worst urban bottlenecks in the USA. It was also observed by Victoria Transport Policy Institute (2016) that freight vehicles form a small portion of total urban-peak traffic but imposes more congestion per unit of travel than lighter vehicles because of their large size and slower acceleration.

According to Rodrigue *et al.* (2013), congestion and parking are interrelated since looking for a parking space creates additional delay and impairs local circulation. Many delivery vehicles will therefore simply double-park at the closest possible spot to unload their cargo. When freight vehicles park to make collections or deliveries outside designated parking spaces, they can reduce road capacity and contribute to congestion. On this note, Ojekunle (2004) observed that one major problem associated with managing and controlling freight traffic in urban areas is the absence/inadequacy of terminal facilities for loading and offloading of goods. Therefore, lorries/trucks, trailers, tankers are usually parked along roadsides thereby obstructing traffic flow. Road traffic accident has also been identified as a major consequence of freight vehicles in urban transportation. Forkenbrock (2001) observed that, although crash rates for heavy trucks are relatively low, they can cause significant damage to other road users when a crash does occur, resulting in relatively high costs per vehicle-mile. The National Highway Traffic Safety Administration (2005) found that truck occupants accounting for only 15% of those who died in crashes involving a large truck in the United States. The majority of the fatalities in these crashes were occupants of another vehicle (77%). The remaining 8% were pedestrians or bicyclists. Truck tractors pulling semi-trailers accounted for 74% of the trucks involved in fatal crashes and approximately 52% of the trucks involved in nonfatal crashes.

Furthermore, Browne *et al.* (2007) observed that road freight vehicles operating in an urban environment generally emit a greater proportion of certain pollutants per kilometre travelled than other motor vehicles such as cars and motorcycles. This is due to their higher fuel consumption per unit of distance travelled and the fact that many of them use diesel as a fuel. Freight transport consumes 30% to 40% of total transportation energy. Heavy diesel trucks consume about 22% of total roadway fuel, and produce high levels of particulate air pollutants, which are particularly harmful to human health. In general, the share of traffic emissions from freight vehicles is about 20% to 30%, depending on the local context (Victoria Transport Policy Institute, 2016). Moreover, Hatzopoulou *et al.* (2013) studied the impact of traffic volume, composition, and road geometry on personal air pollution exposures among cyclists in Montreal, Canada. Personal air pollution exposure data were collected over 64 cycling routes during morning and evening commutes in Montreal, Canada, over 32 days during the summer of 2011. Measured pollutants included ultrafine particles (UFPs), fine particles (PM (2.5)), black carbon (BC), and carbon monoxide (CO). Counts of diesel vehicles were important predictors of personal exposures to BC, with each 10 vehicle/h increase associated with a 15.0% (95% confidence interval (CI): 5.7%, 24.0%) increase in exposure. Use of separated cycling lanes had less impact on personal exposures with a 12% (95% CI: -43%, 14%) decrease observed for BC and smaller decreases observed for UFPs (mean: -1.3%, 95% CI: -20%, 17%) and CO (mean: -5.6%, 95% CI: -17%, 4%) after adjusting for meteorological factors and traffic counts. On average, PM (2.5) exposure increased 7.8% (95% CI: -17%, 35%) with separate cycling lane use, but this estimate was imprecise and not statistically significant. In general, the findings suggest that diesel vehicle traffic is an important contributor to personal BC exposures and that separate cycling lanes may have a modest impact on personal exposure to some air pollutants. Similarly, Agata *et al.* (2014) studied the impact of traffic volume and composition on the air quality and pedestrian exposure in urban street canyon in Hong Kong. Mobile measurement techniques were deployed to monitor both on-road and roadside pollutants concentrations at different times of the day and on different days of a week. Multiple traffic counting points were also established to concurrently collect data on traffic volume and fleet composition on individual streets. Street canyon effects were evident

with elevated on-road pollutants concentrations. Diesel vehicles were found to be associated with observed pollutant levels.

Again, Rodrigue *et al.* (2013) noted that in larger European urban areas, freight vehicles are responsible for 21% of CO_2 emissions, half of particulate matter (PM) and a third of transport-related Nitrogen Oxides (NO_x) emissions. Urban freight is more polluting than long-distance freight transport owing to an older vehicle fleet and the frequency of short trips and stops. Fuel consumption increases if the vehicle has to stop frequently with five stops in 10km, fuel consumption increases by 140%. Heavy trucks tend to be much noisier than most other vehicles. Noise pollution generated by freight vehicles while they make deliveries in urban areas during the night is regarded as a nuisance by residents because it disturbs their sleep. In fact, the transportation of goods accounts for 40% of air pollution and noise emissions (European Commission, 2006). Road failure, as one of the major problems of urban transport operations and planning, has become an issue of national concern over the years. This omen has caused severe loss of man-hours, financial resources, loss of lives, transit discomfort, to mention but a few (Nwoye and Oni, 2016). An assessment of the carrying capacity of Lagos Metropolitan roads: a case study of Mile 2-Apapa and Lekki-Epe corridors was conducted by Nwoye and Oni (2016). The study aimed at exploring and analysing the carrying capacities of Lagos roads with a view to evaluating the legally permissible load tonnage as well as the damage effect of overloading on the corridors. The focus was to critically examine pavement classifications, with respect to the design traffic of the corridors chosen as the case study. The study paid attention to the composition of the traffic volumes, existence and effectiveness of load tonnage standards as well as the damage effects of overloading on the life span of the roads. Traffic count data was used to calculate average daily traffic for the two corridors and also to determine the volume of traffic on the corridors and the composition of HDV thereof. A pavement classification standard was adopted to benchmark the traffic characteristics of the corridors considered. Interview sessions were conducted for top officials of government agencies on load tonnage standards and the effectiveness of such laws if they are in existence. Questionnaires were used to elicit information on compliance and enforcement of load tonnage standards, if any from road users. The findings revealed that the corridors examined had exceeded their design carrying capacities even though the composition of the volume of traffic for both corridors was not the same. Lekki-Epe corridor had a very insignificant proportion of high density vehicles (HDV), which are the major cause of road overload and resultant breakdown. On the contrary, Mile 2-Apapa corridor had a significantly high proportion of its traffic volume being in the category of the HDVs (20% or 1 in every 5 vehicles being a HDV). The implication of this is that, as compared to the case of Lekki-Epe corridor (1% over a 24-hour count), the latter is subjected to a higher tonnage stress (1 out of every 5 vehicles being a HDV) and therefore is more susceptible to wear and tear and overall resultant breakdown of the road.

The overall implication of the various studies is that urban freight transportation together with the vehicles used possesses distinguishing characteristics from those of the passenger transportation. Emphasis is also on the fact that these characteristics predispose the freight vehicles to diverse traffic challenges in the urban transport systems. Since, cohabitation of several operating modes and types is a major characteristic of urban traffic. Therefore, to find adequate and efficient solutions to the problems associated with transportation in urban areas, it is necessary to differentiate between the various types of vehicles and their effects in urban traffic. Going through the literatures, it can be observed that the issue of urban transport problems has received considerable attention over the years. However, most of the works on the effects of freight vehicles are carried out in developed countries of the world with relatively little studies in developing countries. For example, apart from the work of Ogunsanya (1983) which studied the contribution of freight vehicles to urban traffic delays in Lagos, significant attention has not been given to the effects of freight vehicles on urban transportation in Nigeria. Therefore, it suffices to state that those studies in developed countries reflected social, cultural, economic and political situations different from the Nigerian situation. Their adoption for use in the Nigerian situation may not provide perfect explanations but will be useful as guides. This study will thus contribute

to knowledge in this direction and fill the gap found in respect of the dearth of research geared towards examination of share of freight vehicles in urban traffic problems the study area. In addition, efforts were made at examining the relationship between the proportion of freight vehicles in traffic and their share in urban traffic problems.

The Study Area

The study focused on the urban areas across the 20 Local Government Areas (LGAs) of Lagos State. Lagos State is located in the South-Western part of Nigeria. It is situated within Latitudes $6^{\circ} 22'N$ and $6^{\circ}45'N$ and Longitudes $2^{\circ} 42'E$ and $4^{\circ}22'E$ (Figure 1). It is the smallest State in the Federation and occupies an area of 3,577 square kilometres. About 22% or 787 square kilometre of the State is made up of Lagoons and Creeks (Bashiru and Waziri, 2008; Akanni, 2010; Osoba, 2012; LSG, 2015). Commerce and industry is the mainstay of the Lagos economy. Lagos is Nigeria's most industrialized State. It accounts for over 60% of the Federation's total industrial investment (Lagos State Government, 2015). Also, Lagos is an important commercial centre in West Africa with a high number of both organized and unorganized markets (Olokesusi, 2011). The concentration of industries and socio-economic activities in Lagos State creates needs for the services of freight vehicles. In Lagos State, like many other states in Nigeria, greater percentage of freight and passenger vehicles still share the road as their common and major mode of movements. In other words, road freight remains the outstanding transport mode over short, medium and even long distances in the city. This sharing of road infrastructure by both freight and passenger traffic has made the mobility of freight in Nigeria's urban areas increasingly problematic. Freight vehicles pose great dangers to other road users and constitute in no small measure problems to urban transportation system as a whole.

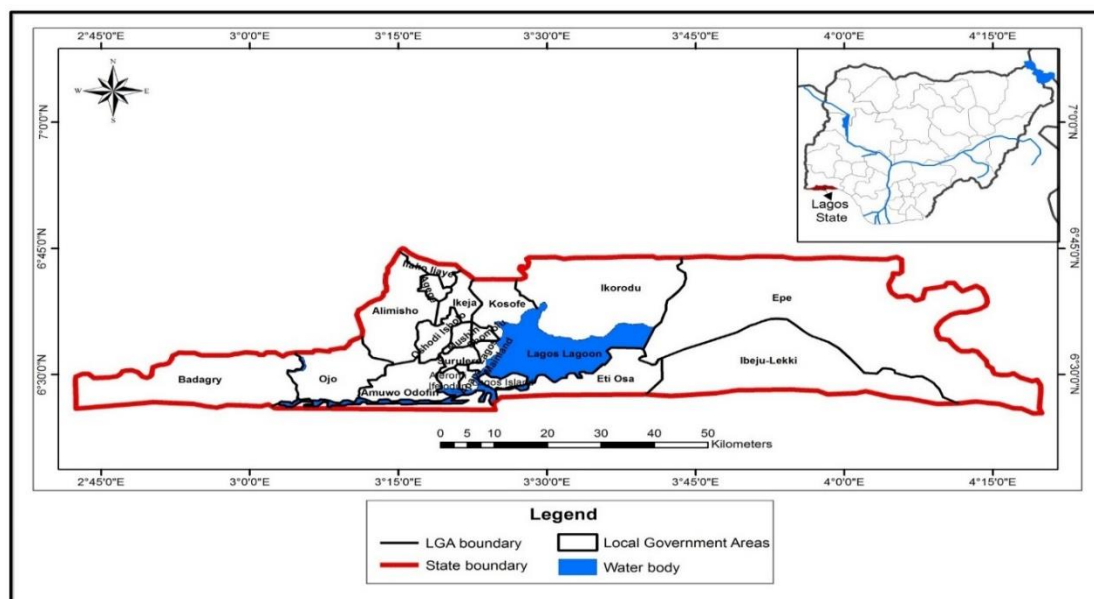


Figure 1: The Administrative Map of Lagos State

Source: Adapted and Modified from LAMATA, 2015

Research Methods

Through the opinions of stakeholders in the transport sector, data was obtained on the percentage contribution of freight vehicles to the selected urban traffic problems in the study area. In addition, classified traffic volume counts were obtained from Lagos Metropolitan Area Transport Authority (LAMATA) to determine the proportion of freight vehicles in the total traffic. From a reconnaissance survey conducted, traffic accident, air pollution, noise pollution, road damage, road traffic congestion/delay and indiscriminate parking were identified as significant traffic problems associated with freight vehicles in the study area. The drivers of freight vehicles, drivers of passenger vehicles, commuters, and traffic management officers who are stakeholders in the transport sector formed the population for this study. These groups of people were targeted with the view that they possess first-hand knowledge of the traffic situation in the study area

(Atomode, 2017). Twenty (20) traffic bottlenecks (one from each of the twenty Local Government Areas) selected from major roads in the study area served as survey/data collection station for traffic count and questionnaire administration. At each survey station; 45 sets of questionnaire were administered to drivers of passenger vehicles, 20 to commuters, 5 to drivers of freight vehicles and 5 to traffic management officers. The traffic management officers comprised of officials from the Traffic Control Unit of the Nigerian Police (known as Traffic Warden), Federal Road Safety Corps, Lagos State Transport Management Authority (LATSMA), and Vehicle Inspection Services (VIS). The same process was done in all the traffic count locations across the study area. Systematic random sampling was thereafter used to select the respondents from each category based on every fifth driver and commuters and every third traffic management officers who was ready to respond to the questionnaire. In all, a total of one thousand and five hundred (1500) respondents were sampled comprising of one thousand (1000) drivers of freight and passenger vehicles and five hundred (500) commuters and traffic officers. The drivers were given higher quota than the commuters and traffic officers due to the technicality of the information on the research questions which was believed could be best provided by them (Harriet, Poku and Anin, 2013).

In order to have the time of the drivers to answer the questions, the field assistants were advised to focus on those who at the period of this survey are either loading or offloading within a 300 metres radius of the traffic stations. Likewise, more attention was given to commuters who have shop or business stand within 300 metres radius and those who are waiting at the bus stations for vehicles to get filled up. Generally, except for traffic management officers who are mostly on weekly posting/transfer, the various groups of respondents were selected on the condition that they have spent a minimum of three years living or working within 300 metres radius of the sampled locations. It was believed that the three years period would have earned them a good knowledge of the traffic situations around the traffic locations. Simple percentages, averages, frequency distribution tables and charts are some of the descriptive statistical techniques employed to measure the spread of observations. Simple Linear Regression Analysis was employed to test the null hypothesis which states that “there is no significant relationship between the proportion of freight vehicles in total traffic and their share in traffic problems within Lagos State. The first step consists of defining the variables of interest. In this hypothesis, volume of freight vehicles was regressed along traffic problems. The regression analysis is relevant to this study as it assists in predicting, making inferences, testing the hypothesis, and modelling the relationships between the variables. The volume of freight vehicles in this case is the independent variable (X) and traffic problems represent the dependent variable (Y).

The regression model is given as:

$$Y = a + bX + e \quad (1)$$

where, Y – dependent variable (Traffic Problems), A – constant, B – the regression coefficients which determines the contribution of the independent variables, X – independent variable (Volume of Freight Vehicles), e – residual or stochastic error (which reveals the strength of bX)

The application of Regression Analysis to this study was faced with challenges or limitations. While the independent variable was measured directly, the dependent variable (traffic problem) was not but was measured through a combination of identified observable parameters (traffic accident, air pollution, noise pollution, road damage, traffic congestion and indiscriminate parking). The direct application of Regression Analysis was therefore difficult. As a result, the data obtained was first subjected to Exploratory Factor Analysis (EFA) to determine the dimensional structure for traffic problems. According to Klinke, *et al.* (2010), the idea of EFA is to model a set of variables by latent factors. EFA is usually specified such that the measured indicators (items used to measure the unobserved latent variables) are expressed as linear combinations of both the underlying common and unique factors (Bartholomew, 2007; Adam *et al.*, 2015). A simplified mathematical model denoting the Factor Analysis for the vectors of

observed variables (traffic accident, air pollution, noise pollution, road damage, traffic congestion and indiscriminate parking) and the underlying common factor (traffic problems) was presented thus;

$$X = \lambda F + E \quad (2)$$

where, X – matrix of the measured items/variables, F – matrix of underlying structure (common factor), λ – matrix of factor loadings, E – matrix of error variance (unique factors).

In the specific application of this study therefore, X denotes all the six (6) individual indicators of traffic problems while F represents traffic problem which is the underlying common factor (Adam *et al.*, 2015).

Results and Discussion

Contribution of Freight Vehicles to Urban Traffic Problems in Lagos State

The study revealed that on the average, freight vehicles constitute 40% of all the associated traffic problems in the study area. Analysis in figure 2 shows that the share of freight vehicles in the traffic problems varies with problem types. For instance, freight vehicles account for an average of 61% of road damage in Lagos State. Due to the heavy weight of freight vehicles and the typical overloading of these vehicles by the operators, their activities cause a lot of damage to the roads. This is mostly associated with the heavy duty freight vehicles whose movements induce intense vibration on the road and damaging them. Over the years there has been rapid deterioration of the highways directly or remotely caused by the excessive use by overloaded freight vehicles.

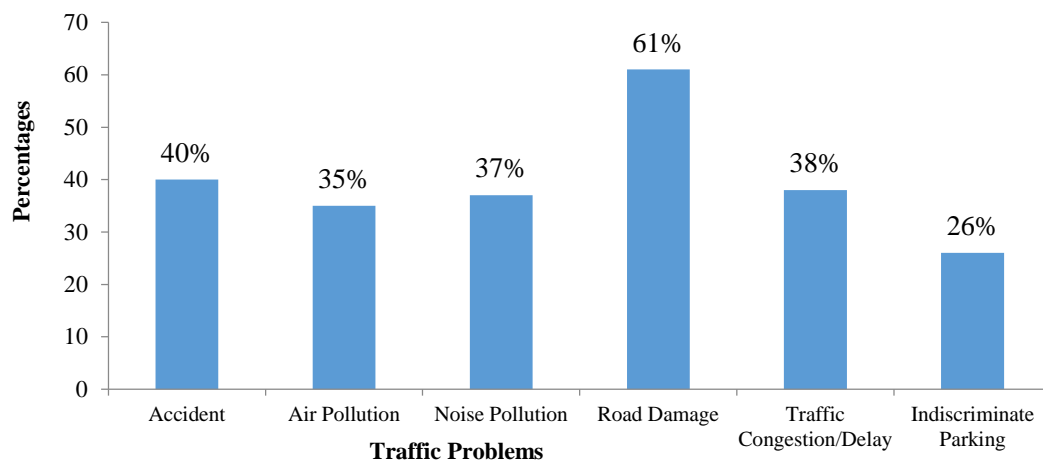


Figure 2: Percentage Contribution of Freight Vehicles to Traffic Problems in Lagos State

Source: Author's Field Work

Furthermore, findings from the respondents view showed that an average of 40% of traffic accident in Lagos State is attributed to freight vehicles. The secondary data on reported cases of traffic accident obtained from the Lagos State Traffic Management Agency (LASTMA) is presented in table 1. The analysis revealed that on the average, freight vehicles contributed 29% and 34% to traffic accident in Lagos State for the year 2013 and 2014 respectively. This gave an annual average of 32%. The difference of 8% between the annual average of reported cases of accident and the respondents view could be attributed to the fact that not all occurrences of traffic accidents are reported to the appropriate authority. It is indisputably a common knowledge that many of road accidents are caused by freight vehicles resulting in the colossal loss of human lives and properties. The unorganized ways in which the heavy-duty vehicles are operated in Nigeria have no doubt made the situation worse. Their operation has been left in the hands of private individuals or groups without adequate control or supervision from the government. As a result, many of the vehicles do not meet the minimum safety standards requirements and most of them

are not in any way road worthy, thereby constituting danger to themselves as well as other road users.

For air pollution, analysis revealed that freight vehicles constitute 35% of the transport related pollutants into the environment. Most freight vehicles are powered by diesel fuel. The combustion of diesel fuel by freight vehicles emits particulate matter, oxides of nitrogen, and sulphur dioxide, all of which contribute to air pollution problems. This is more pronounced in freight generating and attracting zones of the urban areas. Freight vehicles are significant source of greenhouse gas (GHG) emissions, especially in developing countries where most of the vehicles are old and in no way road worthy. Analysis also revealed that about 37% of road traffic noise is attributed to freight vehicles. This may be due to the very loud type of horns mostly used by these categories of vehicles. Due to their size, freight vehicles, make use of loud sound horns which emit intensive noises exceeding the recommended and acceptable levels by World Health Organisation and Environmental Protection Agencies. Again, the incessant blaring of horn by freight vehicles especially in traffic congested areas increases the noise levels in such areas. In addition, about 38% of traffic congestion is attributed to freight vehicles in Lagos State. Considering the weight, length, size and height characteristics of freight vehicles manoeuvring in traffic is a difficulty. They therefore constitute in no small measure to traffic congestion and delay problems in Lagos State. In recent times, serious concerns are being raised about the presence of freight vehicles. The concern is more worrisome in freight attracting and generating zones such as Apapa where the two prominent Nigerian Ports (Apapa Warf and Tin Can Island) are sited.

Table 1: Recorded Cases of Accident by Vehicle Types in Lagos State

LGAs	Year				Total		Average	
	2013		2014		Passenger Vehicles	Freight Vehicles	Passenger Vehicles	Freight Vehicles
	Passenger Vehicles	Freight Vehicles	Passenger Vehicles	Freight Vehicles				
Agege	49	16	146	30	195	46	98	23
Ajeromi Ifelodun	7	7	8	8	15	15	8	8
Alimosho	44	11	22	10	66	21	33	11
Amuwo Odofin	35	35	20	16	55	51	28	26
Apapa	9	23	1	5	10	28	5	14
Badagry	10	1	8	5	18	6	9	3
Epe	8	11	2	0	10	11	5	6
Eti Osa	82	15	93	21	175	36	88	18
Ibeju Lekki	11	6	0	3	11	9	6	5
Ifako Ijaye	70	20	24	10	94	30	47	15
Ikeja	406	119	496	112	902	231	451	116
Ikorodu	26	9	38	8	64	17	32	9
Kosofe	270	75	374	91	644	166	322	83
Lagos Island	232	16	334	21	566	37	283	19
Lagos Mainland	98	28	78	25	176	53	88	27
Mushin	22	8	27	12	49	20	25	10
Ojo	7	1	2	3	9	4	5	2
Oshodi Isolo	119	46	160	59	279	105	140	53
Shomolu	63	13	80	16	143	29	72	15
Surulere	50	14	2	2	52	16	26	8
Total	1618	474	1915	457	3533	931	1767	466
Average	81	24	96	23	177	88	47	23

Source: LAT SMA, 2015

Closely related to the problem of traffic congestion and delay is indiscriminate parking (Rodrigue, Comtois and Slack, 2009). The study shows that freight vehicles contribute an average of 26% to indiscriminate parking in Lagos State. This seems to be the least problems caused by freight vehicles in traffic as perceived by the respondents. The enforcement of traffic related offences especially indiscriminate parking in the State could have been responsible for the low share recorded for freight vehicles. Although, in freight active zones the situation could be more serious. In Apapa for instance, freight vehicles drivers are notorious for indiscriminate parking on the roads waiting for loading and offloading of goods from and to the Ports. In this way they reduce the road capacity by impairing movement and creating additional delays. Those who cannot find space flow into adjoining streets and lanes to the discomfort of residents and other road users. By this act, a new dimension is added to a very bad traffic congestion situation. Researches all over the world have shown that freight vehicles contribute significantly to all urban traffic problems. For example, European commission (2006) observed that freight vehicles account for about 40% of air pollution and noise emissions in European urban areas. Similarly, in a study on the carrying capacity of Lagos Metropolitan roads, Nwoye and Oni (2016) observed that, high freight traffic subject roads to higher tonnage stress. Such roads are therefore more susceptible to wear and tear and overall resultant breakdown. Freight vehicles have also been found to impose more congestion than lighter vehicles due their large size and slow acceleration rate (Victoria Transport Institute, 2016).

Relationship between Freight Vehicles' Volume and Freight Traffic Problems

Simple Linear Regression was used to test the hypothesis that 'there is no significant relationship between the proportion (volume) of freight vehicles in total traffic and their share in traffic problems within Lagos State'. The proportion of freight vehicles in traffic represents the independent variable while the traffic problems represent the dependent variable. The dependent variable (traffic problems) being a latent variable could not be directly measured and thus cannot be directly analysed using a linear regression analysis technique. As a result some measured indicators (traffic accidents, air pollution, noise pollution, road damage, traffic congestion and indiscriminate parking) were used to measure traffic problems. The measured indicators were subjected to Exploratory Factor Analysis using Principal component Analysis method in order to determine if they are good measures of traffic problems. All Kaiser-Meyer-Okin Measure (KMO) values for the individual items ($>.80$) were all above the $.50$ and the KMO for overall item is 0.86 indicating the data were sufficient for EFA. The Bartlett's Test of sphericity $\chi^2(15) = 551.37$, $P = .001$ showed that there were patterned relationships between the items. Using an Eigen value cut-off of 1.0 , there was only one factor that explains a variance of 60.67% . The finding of only one factor was also confirmed by the scree plot. The extraction of a single factor implies that all the variables load jointly to explain a latent variable which in this study is traffic problems. Therefore, the aggregate score was derived and the average was used in a linear regression analysis to test if the proportion of freight vehicles in traffic significantly predicts the associated traffic problems. The proportion of freight vehicles in traffic and their share in urban traffic problems across Lagos State are presented in table 2.

The summary statistics of the model is presented in Table 3. A good level of prediction of the dependent variable (traffic problems) was indicated by the value of the correlation coefficient (R), 0.784 . The coefficient of determination (R^2) value of 0.614 indicated the model as fitted explained 61.4% of the variability in the traffic problems.

Table 2: The Share of Freight Vehicles in Traffic and Percentage Contribution to Traffic Problems

LGAs	% in Total Traffic	% in Traffic Problems
Agege	5	35
Ajeromi Ifelodun	2	29
Alimosho	6	33
Amuwo Odofin	15	50
Apapa	26	94
Badagry	4	31
Epe	19	50
Eti Osa	4	32
Ibeju Lekki	16	52
Ifako Ijaye	4	32
Ikeja	4	34
Ikorodu	2	26
Kosofe	11	38
Lagos Island	5	32
Lagos Mainland	4	29
Mushin	6	45
Ojo	7	40
Oshodi Isolo	6	36
Shomolu	9	39
Surulere	6	36
Average	8	40

Source: LAMATA and Author's Field Work

Table 3: Summary Statistics of Regression of Freight Volume and Associated Traffic Problems

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.784 ^a	.614	.612	9.465

a. Predictors: (Constant), Freight Volume

Source: SPSS Output of Author's Analysis

The F-ratio in the ANOVA table was used to test whether the overall regression model was good fit for the data (Table 4). The table reveals that the independent variable (proportion of freight vehicles in total traffic) significantly predict the dependent variable (traffic problems), $F(1,198)=315.107$, $P < .001$. Since the P-value is less than .05, the regression model is a good fit of the data. The null hypothesis that there is no significant relationship between the proportion (volume) of freight vehicles in total traffic and their share in traffic problems within Lagos State is hereby rejected. This implies that there is a significant relationship between the proportion of freight vehicles in traffic and the associated traffic problems

Table 4: ANOVA of Relationship between Freight Volume and Associated Traffic Problems

ANOVA ^a						
Model	Sum of Squares	Df	Mean Square	F	Sig.	
1	Regression	28230.814	1	28230.814	315.107	.000 ^b
	Residual	17739.061	198	89.591		
	Total	45969.875	199			

a. Dependent Variable: Traffic Problems

b. Predictors: (Constant), Freight volume

Source: SPSS Output of Author's Analysis

The unstandardized coefficients in the coefficient table indicate how far traffic problems vary with the volume of freight vehicles when all other variables are held constant (Table 5). Therefore, for each 1% increase in traffic volume, there is an increase in 170.8% in traffic problems. The equation to predict traffic problems from freight volume becomes:

$$\text{Traffic Problems} = 25.972 + 1.708 (\text{volume of freight vehicles}) \quad (3)$$

Table 5: Regression Coefficients of Relationship between Freight Volume and Associated Traffic Problems

Model	Coefficients ^a							
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		
	B	Std. Error	Beta			Lower Bound	Upper Bound	
1	(Constant)	25.972	1.024		25.367	.000	23.953	27.991
	Freight Volume	1.708	.096	.784	17.751	.000	1.519	1.898

a. Dependent Variable: Traffic Problems

Source: SPSS Output of Author's Analysis

It therefore implies that although, freight vehicles form a small proportion of the total urban traffic, their effects outweighed their volume in traffic. This may be due to their operational characteristics which have a detrimental effect on traffic flow rates. For example, according to World Road Association (2005), the size of freight vehicles together with the driving behaviour can have a negative effect on the environment, society and the economy.

Conclusion and Recommendations

The study particularly revealed urban traffic problems that manifest from over reliance on single transport mode. Through the opinions of stakeholders in the transport sector, urban traffic problems were disaggregated into passenger and freight vehicles categories. The relationship between the proportion of freight vehicles in traffic and their share in urban traffic problems was equally examined. The proportion of freight vehicles in urban traffic though seemingly inconsequential, their effects in traffic are quite significant. Freight vehicles constitute high proportion of the road traffic problems in the study area especially road damage, traffic accident and traffic congestion/delay. Some of these problems obviously result from the cohabitation of freight traffic and passenger traffic on the only viable mode of transport (road). In essence, urban traffic problems in the study area could have been minimised if not for the over dependency on a uni-modal means of transport. Attempts at solving urban traffic problems should therefore accord more/greater priority to reducing the pressure on the urban roads. The findings of this study will be of great assistance to Lagos State Government and the country at large. It will undoubtedly help in the formulation and implementation of policies and measures that will effectively and efficiently enhanced freight movement. It will also encourage the efficient development and utilization of other transport modes.

From this study, opportunity for further research lies in empirically measuring the traffic problems and segregating the data using vehicle categories rather than relying on the opinions. In other words, there is the need by relevant transport agencies in the study area such as Lagos State Traffic Management Agency (LASTMA) and Lagos Metropolitan Area Transport Authority (LAMATA) to keep records of traffic problems by vehicle categories. This will improve the objectivity of examining the contribution of various vehicle categories to traffic problems. More researches are therefore needed in this field for better traffic management in the study area and Nigeria at large.

References

- Adam, S.U., Shamsudin, M.N., Sidique, S.F., Rahim, K.A., and Radam, A. (2015). Solid waste pollution concern in economic value assessment: is it uni-dimensional or multi-dimensional? *Resources, Conservation and Recycling*, 104, 49 – 60.
- Agata, R., Ka-Chun, W., Thomas, T., Ka-Lok, C., Dane, W., Simon, N., Griša, M., Luka, D., and Zhi, N. (2014). Impact of traffic volume and composition on the air quality and pedestrian exposure in urban street canyon. *Atmospheric Environment*, 98, 260-270.
- Akanni, C.O. (2010). Spatial and seasonal analyses of traffic related pollutant concentrations in lagos metropolis, Nigeria. *African Journal of Agricultural Research*, 5 (11), 1264 - 1272.
- Al-Kaisy, A., and Jung, Y. (2005, August 8-10). Examining the effects of heavy vehicles on traffic flow during congestion. Compendium of Technical Papers of the Institute of Transport Engineers Annual Meeting and Exhibit Australia.
- Atomode, T.I. (2017). Analysis of freight vehicle factor in urban traffic of lagos state, Nigeria. *Unpublished Ph.D. Thesis*, Department of Geography and Natural Resources Management, Faculty of Social Sciences, University of Uyo, Uyo, Akwa Ibom State, Nigeria.

- Atoyebi, A.O., Gbadamosi, T.K., Nwokoro, I.I.C., and Omole, F.K. (2015). Analysis of intra-city public transport system of ojulegba park, lagos state, Nigeria. *Mediterranean Journal of Social Sciences*, 6 (2), 624 - 635.
- Bartholomew, D.J. (2007). Three faces of factor analysis in: Cudeck, R., MacCallum, R.C., (Ed.), *Factor Analysis at 100 Historical Developments and Future Directions*. New Jersey/London: Lawrence Erlbaum Associates, 9 - 45.
- Bashiru, A.R., and Waziri, O.O. (2008). Analysis of intra-urban traffic problems in Nigeria: a study of lagos metropolis. *Indonesian Journal of Geography*, 40 (1), 41 - 51.
- Browne, M., Piotrowska, M., Woodburn, A., and Allen, J. (2007). Literature review WM9: urban freight transport. Transport Studies Group, University of Westminster.
- European Commission. (2006). Urban freight transport and logistics: an overview of european research and policy. Schoemaker, J., Llen, J.A., Huschebeck, M., and Monigl, J. (Ed.), Belgium: European Commission.
- Federal Highway Administration. (2004). Traffic congestion and reliability: linking solutions to problems. Cambridge, Massachusetts: Cambridge Systematics, Inc.
- Filani, M.O. (2000). Transport and the environment. *The Nigerian Geographical Journal, New Series*, 3 and 4, 15 - 28.
- Forkenbrock, D. (2001). Comparison of external costs of rail and truck freight transport. *Transportation Research, Part A*, 35, 321 - 337.
- Harriet, T., Poku, K., and Anin, E.K. (2013). An assessment of traffic congestion and its effect on productivity in urban Ghana. *International Journal of Business and Social Science*, 4 (3), 225 - 234.
- Hatzopoulou, M., Weichenthal, S., Dugum, H., Pickett, G., Miranda-Moreno, L., Kulka, R., Andersen, R., and Goldberg, M. (2013). The impact of traffic volume, composition, and road geometry on personal air pollution exposures among cyclists in Montreal, Canada. *J Expo Sci Environ Epidemiol*, 23(1): 46 - 51.
- Klinke, S., Mihoci, A., and Härdle, W. (2010). Exploratory factor analysis in MPLUS, R and SPSS. in: reading, C. (Ed.), data and context in statistics education: towards an evidence-based society. Paper Presented at the Eighth International Conference on Teaching Statistics (ICOTS8), Slovenia, Netherlands, July 2010.
- Lagos State Government. (2015). Information for Visitors. Lagos State Government, (www.lagosstate.gov.ng/information_for_visitors), Accessed on 07-07-14.
- National Highway Traffic Safety Administration. (2005). Traffic safety facts 2004. Washington, DC: National Centre for Statistics and Analysis of the National Highway Traffic Safety Administration, U.S. Department of Transportation, (<https://crashstats.nhtsa.dot.gov/Api/Public/Publication/809919>), Accessed on 16-04-15.
- Nwoye, C.F., and Oni, S.I. (2016). An Assessment of the carrying capacity of lagos metropolitan roads: a case study of mile 2-apapa and lekki-epe corridors. *Arts and Social Sciences Journal*, 7 (1), 1 - 8.
- Ogunsanya, A.A. (1983). Contribution of freight vehicles to urban traffic delays in a developing economy: The Case of Lagos, Nigeria. *Nigerian Geographical Journal*, 26 (1 & 2): 125 - 137.
- Ogunsanya, A.A. (2002). Maker and breaker of cities. The Fifty-Ninth Inaugural Lecture. University of Ilorin, Ilorin, Nigeria: Library and Publication Committee, 63.
- Ojekunle, J. A. (2004). Urban freight transport in: Vandu-Chikilo, I; Ogunsanya, A. A; and Sumaila, A. G., (Ed.), *Perspectives on Urban Transportation in Nigeria*. Nigerian Institute of Transport Technology (NITT), Zaria, pp. 224 - 241.
- Olagunju, K. (2011). Articulated lorries management in nigeria: road safety perspective. Paper Presented at the Road Safety Forum Organised by the International Road Safety Organisation at Ladi Kwali Hall, Sheraton Hotel and Towers, Abuja, 6 May.
- Olokesusi, F. (2011, July 5). Lagos: the challenges and opportunities of an emergent african mega city. Paper Presented at the NISER Seminar Series.
- Osoba, S.B. (2012). Appraisal of parking problems and traffic management measures in central business district in Lagos, Nigeria. *Journal of Sustainable Development*, 5 (8), 105 - 115.
- Oyatoye, E.O., Adebisi, S.O., Okoye, J.C., and Amole, B.B. (2011). Application of queuing theory to port congestion problem in Nigeria. *European Journal of Business and Management*, 83 (8), 24 - 36.
- Rodrigue, J.P., Comtois, C., and Slack, B. (2013). The geography of transport systems. 3rd ed., New York: Routledge, p. 411.
- Victoria Transport Policy Institute. (2016). Freight transport management: increasing commercial vehicle transport efficiency. Transport Demand Management (TDM) Encyclopedia, Canada: Victoria Transport Policy Institute, (<http://www.vtpi.org/tdm/tdm16.htm>), Accessed on 13-10-16.
- World Road Association. (2005). Freight modal split. Permanent International Association of Road Congresses (PIARC) Technical Committee on Freight Transport (C19).