PERCEPTIONS OF TEMPORAL VARIATIONS IN URBAN FREIGHT TRAFFIC PROBLEMS IN LAGOS STATE, NIGERIA

BY

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ABSTRACT

This study examined the perceptions of transport stakeholders on the temporal variations of urban freight traffic problems in Lagos State. Their opinions formed the data for this study. The data were collected at major traffic bottlenecks along major roads in the study area. A total of 1,500 sets of questionnaire were administered to sampled commuters, freight and passenger vehicle drivers, and traffic management officials who are stakeholders in the transport sector. Data obtained were summarised using simple percentages, frequency distribution tables, averages and charts, while Two-Way Analysis of Variance (ANOVA), was used for testing hypotheses and drawing valid conclusions. Findings showed that there was a significant main effect of period of the day on the prevalence of freight traffic problems, $F(3, 456) = 114.980$, $P < .001$. This means that variations exist in the occurrence of freight traffic problems over different periods of the day. For example, noise pollution, indiscriminate parking, and traffic accidents from freight traffic are perceived to be more pronounced in the night (10:00pm to 4:59am) than other periods of the day, while air pollution is predominant in the afternoon (12 noon to 3:59pm). In addition, freight traffic is viewed to contribute more to traffic accident, road breakdown and traffic congestion during the rainy season (April to October) than the dry season (November to March). On the other hand, indiscriminate parking, air and noise pollution associated with freight vehicles are believed to be more pronounced in the dry season than in the rainy season. Attempts at solving urban traffic problems should therefore give consideration to the temporal variations in the prevalence of each problem.

Key Words: Diurnal, Freight, Problems, Prevalence, Seasonal, Traffic, Urban, Variation.

INTRODUCTION

Urban centres can only function efficiently when transportation enables free movement of people and goods into, outside and within cities without much hindrance. In other words, the full complementarity between areas of supply and areas of demand are fully supported by the transportation system. Thus, efficient urban system requires an efficient coordination of the transport systems to enable all modes work in synergy for the delivery of the services of movements of people and goods from one location to another (Atomode, 2017a).

In developed countries, transport infrastructure is developed in such a way that each mode is allowed to render services for which it possesses key operational and commercial advantages. In Nigeria, on the other hand, road remain the most efficient mode of transport for the movement of both passengers and goods. The restrictive nature of the water ways, coupled with the near collapse of the rail system, and the high cost of air travels which could have eased the tense of the competition have made road the dominant mode over others. Consequently, goods that ought to have passed through the railways, waterways and airways are now being forced on the overstressed road network.

Urban traffic problems are compounded where freight and people's traffic cohabit (Rodrigue, Comtois and Slack, 2013). In other words, the sharing by freight and passengers of the road infrastructure is not without difficulties and indeed some of the problems confronting transportation occur where the two seek to cohabit. The most obvious is that, goods traffic will tend to contest with the already densely congested passenger traffic on the available mode since the movements of both goods and passengers are required for the sustenance of the city system. In Nigeria, current road transport operations are therefore characterised by large-scale movements of goods and passengers that could have been moved more cost effectively by other modes. As observed by Atomode (2017b), the movements of freight in Lagos State (though critical to the economy) are increasingly becoming problematic owing to the detrimental characteristics of freight vehicles, the unorganised ways in which they operate, the wrong attitude of most of their drivers coupled with the poor condition of most of the vehicles.

All over the world, researches have shown that among the road transport vehicles, freight vehicles have the greatest impact on urban traffic. As observed by Ezquerro et al. (2018), freight transport in the urban environment has a great impact on the city, in terms of increase in congestion, pollution, costs, and so on. For instance, Lebeau and Macharis (2014) examined freight transport in Brussels and its impact on road traffic. It was observed that freight vehicles account for an average of 14% of road traffic but are responsible for 25% of carbon dioxide (CO_2) emissions, 31% of nitrogen oxides (NO_x) *(i.e.,* nitric oxide (NO) and nitrogen dioxide (NO_2)) emissions, 33% of particulate matters (PM) 2.5 emissions and 32% PM 10 emissions. Similarly, the impacts of urban freight traffic was evaluated by Aditjandra et al. (2016) using micro-simulation at a larger establishment in Newcastle. The simulation results of the Base Case showed that, although the percentages of 10% and 7% of freight vehicles in total traffic for the morning and afternoon peaks respectively appear quite low, the nature of the activities and the vehicle types used for freight transportation were found to emit more pollution than cars, resulting in a greater impact in terms of CO_2 and even more for toxic pollutants (PM, NO) emissions.

Moreover, the impacts of freight vehicles on cars' travel times was examined by Beziat, Dablanc and Koning (2015). It was observed that for a given level of small vehicles traffic (650 veh/h/km for instance), the mean travel time is equal to 50 minutes approximately if trucks represent 2% of total traffic. Travel duration will rise to 80 minutes if the share of trucks increases to 3% of total traffic. Besides, Ojekunle (2004) noted that the absence/inadequacy of terminal facilities for loading and offloading of goods is one of the problems associated with managing and controlling freight traffic in urban areas. Consequently, freight vehicle drivers resort to indiscriminate parking of vehicles along roadsides thereby reducing road capacity, obstructing traffic flow and contributing to traffic congestion (Rodrigue, Comtois and Slack, 2013).

Furthermore, urban freight transport accounts for a significant part of ambient noise that causes discomfort to people in cities especially during the night. According to Schoemaker et al. (2006), urban freight deliveries produce a significant amount of noise in a city, not only from the engine and tyre noise, but also the sound of loading and off-loading of goods. Depending on different traffic conditions and type of roads, on average the emissions of LGV and HGV are 2-10 times higher than passenger cars (a weight of 2 indicates +3 decibel (dB) on average levels.

Studies have also shown that, while freight vehicles represent a small proportion of the traffic, they are involved in a majority of accidents involving vulnerable road users. The share of fatalities involving goods vehicles differs by country. For example, the share of heavy urban freight vehicles (more than 3.5t) ranges from 2.5% in Finland to 15% in Austria, while most of the countries have a share between the 10 and 15%. (Schoemaker et al., 2006). However, the accident risk is influenced by several factors such as road lighting conditions, weather conditions, road surface conditions, drivers' fatigue, location (urban and rural roads, intersections, section of roads), vehicles' conditions, among others (Elvik et al., 2009; Wanvik, 2009; Johansson, Wanvik and Elvik, 2009). A study of traffic accidents' risk during visibility restrictions in darkness on Polish network of national and regional roads revealed that the risk of road fatalities at night-time is greater than daylight throughout the year (Gaca and Kiec, 2013). Also, Atubi (2010) noted that the rates of accidents are higher during the rainy season than dry season due to the wetness and slippery nature as well as poor conditions of roads.

In another study, Nwoye and Oni (2016) examined the carrying capacity and 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 Mile 2- Apapa and Lekki-Epe roads. The findings revealed that Mile2-Apapa corridor had a higher proportion of its traffic volume being in the category of the HGVs (20%) than the Lekki-Epe corridor (1%). Mile2-Apapa corridor is therefore subjected to a higher tonnage stress and also more susceptible to wear and tear and overall resultant breakdown of the road.

The reviewed studies revealed the damaging effects of freight vehicles both on the road and people, but were not explicit on the issue of temporal variation. In other words, the studies focused more on the incidence of problems associated with freight traffic from one location of urban centres to another. However, freight traffic problems also vary by time of day and season of the year based on complex meteorological conditions and human factors (Kendrick, Koonce, and George, 2015; Yao et al., 2015). Hence, the temporal pattern of traffic problems can be used as a convenient basis for urban traffic planning and management. As observed by Batterman, Cook, and Justin (2015), the temporal pattern and variation of traffic activity has major influence on congestion, safety issues, emissions and concentrations of traffic-related air pollutants. A study of freight traffic problems is therefore crucial in urban transportation planning and management.

One approach adopted by the Lagos State Government at reducing problems associated with freight traffic, is the regulation of freight vehicles' movement. For instance, the State has experimented restrictions on time of delivery as well as route taken by heavy-duty trucks but the approaches have failed to substantially tackle the problem. It is on this note that this study was carried out to investigate the existence or otherwise of any form of diurnal and seasonal variations in the occurrence of problems associated with freight traffic in the study area. The specific objectives of this study are to: examine the perceptions of transport stakeholders on the

diurnal variation of traffic accident, air pollution, noise pollution, road breakdown, traffic congestion/delay and indiscriminate parking associated with freight traffic; and describe the seasonal pattern of the selected freight traffic problems in in the study area. The hypothesis that "there is no significant diurnal variation in the prevalence of selected freight traffic problems in Lagos State" was thereafter tested.

THE STUDY AREA

The study focused on urban areas across the 20 Local Government Areas (LGAs) of the State. Lagos State is the smallest State in Nigeria with a total area coverage of 3,577.28 square kilometre, out of which about 22% or 779.56 square kilometre is made up of Lagoons and Creeks (Osoba, 2012; Lagos State Government [LSG], 2017). The State lies within Latitudes 6º 22′N and 6º45′N and Longitudes 2º 42′E and 4º22′E (Figure 1). Lagos State had an estimated total population of 24,821,418 people in the year 2017 with a population density of 6,939 persons per square kilometre (LSG, 2017). The high population of Lagos State requires efficient movement of large volume of freight to meet the needs of the inhabitants. Lagos State is the industrial and the commercial hub of Nigeria [LSG], 2019). The State therefore generates and attracts large volume of freight traffic which share the congested roads with passenger traffic. Road remain the dominant mode of transportation in Lagos State although rail, air and waterway transportation exist. Road account for over 90% of intra-urban movement of passengers and goods in the State (Oni, 2004; Osoba, 2012).

Lagos State has a wet equatorial climate with mean annual rainfall above 1800mm (Soladoye and Ajibade, 2014). Generally, the State has two climatic seasons: dry and wet, but there is hardly a month without precipitation in any part of the state. The rainy season lasts from April to October, while dry season lasts from November to March (LSG, 2019). A double maxima of rainfall regime are recognizable from April to early July and the other from September to late October with a break in late July and August. The maximum temperature ranges between 29ºC and 34ºC, the lowest being in the month of July and the highest in February. The minimum temperature varies between 24ºC and 28ºC. The relative humidity is generally high and rarely below 70% throughout the year (Soladoye and Ajibade, 2014; Ayanlade, 2016). According to Akanni (2010), the microclimate of Lagos metropolis is characterised by relatively high air temperature, low wind speed and air pollution that varied according to traffic density and land-use. Thus, the climatic conditions of the State will undoubtedly have effects on the traffic activities and associated problems. For instance, according to Wang, Su and Zhai (2014), diurnal and seasonal variations of solar radiation, humidity, wind speed and atmospheric temperature have effects on asphalt and concrete road pavements.

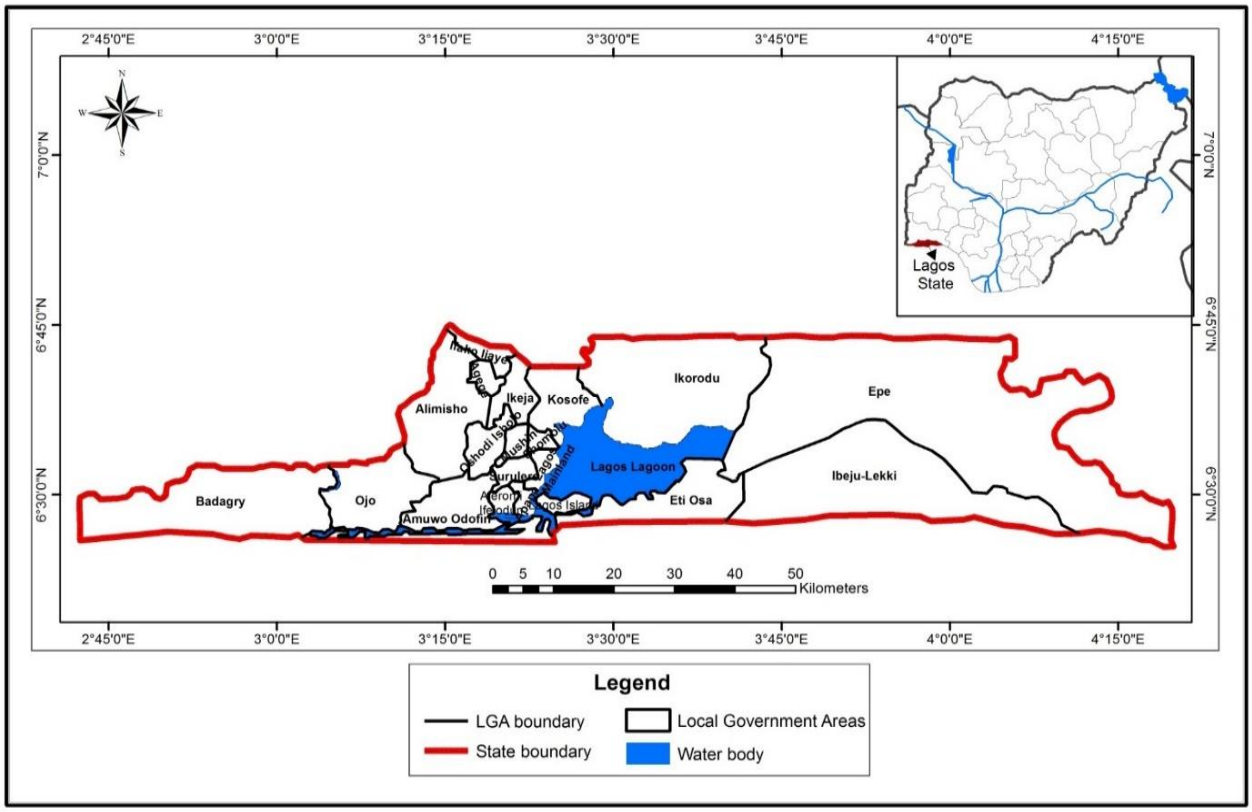

Figure 1: The Administrative Map of Lagos State
Source: Adapted from Atomode, 2017b

MATERIALS AND METHODS

The study evaluated the perception and opinions of relevant stakeholders in transport sector on the diurnal and monthly variations in the prevalence of urban freight traffic problems in Lagos State. The transport stakeholders for this study are made up of drivers of freight vehicles, drivers of passenger vehicles, commuters, and traffic management officials. Through reconnaissance survey, traffic accident, air pollution, noise pollution, road breakdown, road traffic congestion/delay and indiscriminate parking were identified as significant traffic problems associated with freight traffic in the study area. Freight traffic in this study comprised of all categorises of freight vehicles which are generally classified as light-(small trucks, pickup, and small van), medium-(tippers and Lorries), or heavy-duty (Trailers, tankers and containers) trucks according to gross vehicle weight.

Through questionnaire administration, the respondents (transport stakeholders) were asked to indicate which period of the day and season of the year are the selected freight traffic problems most pronounced in the study area. In this study, the day was categorized into morning (4: 00 am to 11:59 am), afternoon (12: noon to 3: 59 pm), evening (4:00 pm to 9:00 pm) and night (10:00 pm to 3:59 am) periods. Similarly, the rainy or wet season represents periods of reasonably high rainfall in the State, from April to October, while dry season lasts from November to March. The frequencies of the responses were thereafter used for analysis. The questionnaire administration

was carried out for the period of twenty (20) days. This lasted from 17 August to 11 September, 2015 with the exemption of weekends (Saturdays and Sundays).

A total of 1,500 respondents were selected from 20 survey stations in the State. The 20 Local Government Areas (LGAs) served as the Traffic Analysis Zones (TAZs). One major traffic bottleneck on a major route in each LGA was used as survey station where data was collected for this study (Table 1). It was difficult to construct a sampling frame for drivers of passenger and freight vehicles, since they are largely a mobile population. Therefore, the study adopted a sampling technique by Harriet, Poku and Anin (2013) which suggested the use of the average number of each category of vehicles per minute in the State traffic. The average traffic volume at the selected traffic bottlenecks based on data obtained from the office of the Lagos Metropolitan Area Transport Authority (LAMATA) was 3.2 and 44.2 vehicles per minute for freight and passenger vehicles respectively. It was on this basis that approximately 5 drivers of freight vehicles and 45 drivers of passenger vehicles were selected from each traffic bottleneck.

At each survey station; 50 sets of questionnaire were administered to drivers (45 to drivers of passenger vehicles and 5 to drivers of freight vehicles), 20 to commuters and 5 to traffic management officials. Systematic random sampling was used to select the respondents from each category based on every fifth driver and commuters and every third traffic management officials who was ready to respond to the questionnaire.

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 were 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, the various groups of respondents were selected on the condition that they have good knowledge of the traffic situation at the traffic bottlenecks.

Data obtained were summarised using simple percentages, frequency distribution tables, averages and charts. Two-Way Analysis of Variance (ANOVA) was used to test the hypothesis that "there is no significant diurnal variation in the prevalence of selected freight traffic problems in Lagos State". The Two-Way ANOVA compares the mean differences between groups that have been split on two independent variables (called factors). The primary purpose of a two-way ANOVA is to understand if there is an interaction between the two independent variables on the dependent variable. The interaction term in a Two-Way ANOVA informs researchers whether the effect of one of independent variables on the dependent variable is the same for all values of other independent variable and vice versa (Laerd Statistics, 2018). In this study therefore, traffic problem types (traffic accidents, air pollution, noise pollution, road breakdown, traffic congestion and indiscriminate parking) and the periods of the day (morning, afternoon, evening and night) represent the independent variables, while the occurrence of freight traffic problems is the dependent variable.

Table 1: Selected Traffic Bottlenecks in Lagos State

S/N	LGAs	Road Name and Traffic Bottleneck Stations
1	Agege	Agege Motor Road - At Oba Ogunji Road
2	Ajeromi Ifelodun	Lagos Badagry Expressway - By Ojo Road
3	Alimosho	Ipaja Rd/Idimu Road/Ikotun Road Roundabout - On Ipaja Road
4	Amuwo Odofin	Lagos badagry Expressway, Apapa Oshodi expressway and Apapa Oworonshoki Express Way Interchange – Before Bridge Towards Apapa
5	Apapa	Creek Road - After Burma Road Junction
6	Badagry	Lagos Badagry Express Way –By Agbara Junction
7	Epe	Ikorodu Road-Before Iki Junction
8	Eti Osa	Ahmadu Bello Way - Silverbird Galleria
9	Ibeju Lekki	Lekki-Epe Expressway - Eleko Beach/Sangotedo Area
10	Ifako Ijaye	Lagos Abeokuta Expressway - Abule Egba Bus-Stop
11	Ikeja	Mobolaji Bank Anthony way- After Eko Hospital
12	Ikorodu	Ayangbunren Road, Ikorodu - Before Obafemi Awolowo Junction
13	Kosofe	Apapa Oworonshoki Express Way and Lagos Ibadan Interchange (LGA Boundary) - Gbagada Under Bridge Before Access to Bariga and Third Mainland Bridge
14	Lagos Island	Eko Bridge (Towards Lagos Island) - Apongbon Bridge
15	Lagos Mainland	Third Axial Road (Lagos Mainland) - Ebute Meta Axis
16	Mushin	Agege Motor way (Mushin LGA) - Mosalasi Bus-Stop Mushin
17	Ojo	Isheri-LASU Expressway - (The Bend After Oduduwa Street)
18	Oshodi Isolo	Agege Motor way (LGA Boundary) - Bolade Bus-Stop
19	Shomolu	Ikorodu Road - Onipanu Bus-Stop
20	Surulere	Western Avenue - Stadium Bus-stop

Source: Author's Field Survey

RESULTS AND DISCUSSION

Perception of Diurnal Variation in Freight Traffic Problems

The perception of diurnal variation of traffic accident involving freight vehicles is shown in Figure 2. The result of the analysis shows that freight vehicles are perceived to be mostly involved in traffic accident in the night and morning as indicated by 35% and 30% of the respondents respectively. About 20% of the respondents also believed that traffic accident involving freight vehicles are common in the evening. It can be deduced from the respondents' view that freight vehicles are mostly involved in traffic accident in the night period of the day. Poor visibility, fatigue and sleepiness could be a contributing factor to the high occurrence of traffic accident involving freight vehicles in the night. This finding agrees with the work of Gaca and Kiec (2013) on traffic accidents in Poland which indicated that the risk of road fatalities at night-time is greater than daylight throughout the year. Similarly, the rush to meet up with the delivery and or loading time by the drivers could also be attributed to the high incidence of freight vehicles accident in the morning and evening periods of the day.

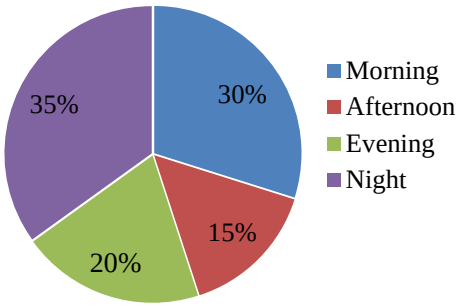

Figure 2: Perception of Diurnal Variation of Freight Vehicles Traffic Accident in Lagos State
Source: Author's Analysis

The examination of respondents' perception on air pollution from freight vehicles reveals that 40% of the respondents indicated afternoon as the most prevalent time of the day, while 31% believed the problem is high in the evening (Figure 3). The responses could be informed by the influence of temperature increase in the afternoon than other periods of the day. The rise in the temperature will likely increase the rate of combustion of diesel fuel and also increase the rate of dispersal of the pollutants into the atmosphere. This is because the mass of some pollutants from freight vehicles is more tied to regional sources and meteorological conditions than with traffic volume (Kendrick , Koonce, and George, 2015).

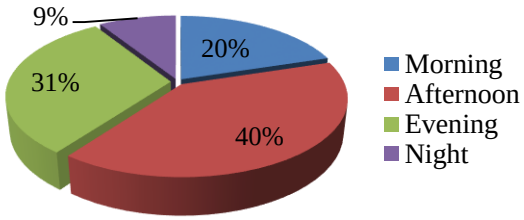

Figure 3: Perception of Diurnal Variation of Air Pollution from Freight Traffic in Lagos State
Source: Author's Analysis

The perception of the respondents on the diurnal variation in traffic noise associated with freight traffic in the study area is presented in Figure 4. The analysis shows that majority (53%) of the respondents believed that freight vehicles make the highest contribution to traffic noise in the night, while about 21% of the respondents felt that traffic noise from freight vehicles is high in the morning. The fact that sounds travel farther when human activities are at low ebb could be responsible for the high percentage of the respondents that indicated night as the period freight vehicles contribute most to traffic noise. This is why Schoemaker et al. (2006), observed that, urban freight traffic accounts for a significant part of ambient noise that causes discomfort to people in cities especially during the night.

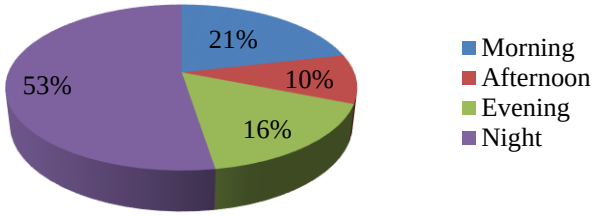

Figure 4: Perception of Diurnal Variation of Freight Traffic Noise in Lagos State
Source: Author's Analysis

Analysis again reveals that, 40% of the respondents believed freight vehicles inflict more damage to the road in the evening than any other time of the day, while 23% indicated that the problem is more pronounced in the morning (Figure 5). The decisions of the respondents could be informed by the high volume of freight traffic in the study area during the evenings. Moreover, it was shown by the analysis in Figure 6 that 47% of the respondents believed congestion associated with freight traffic occur mostly in the evening. About 40% of the respondents also believed the problem of freight traffic congestion manifest in the morning (Figure 6). The morning and evening periods coincide with the peak periods of the day and may therefore explain the reason behind the high responses recorded for the contribution of freight traffic to congestion during these periods. This supports the observation of Beziat, Dablanc and Koning (2015) that an increase in the share of freight vehicles in total traffic will results in an increase in travel duration.

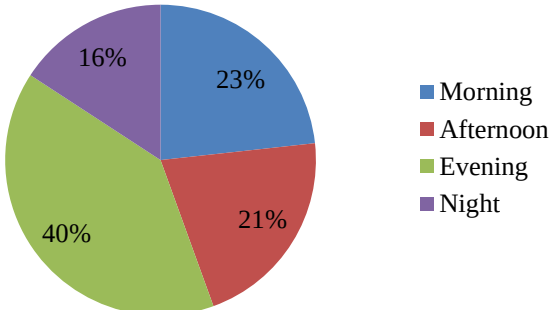

Figure 5: Perception of Diurnal Variation of Freight Vehicles' Contribution to Road Breakdown in Lagos State
Source: Author's Analysis

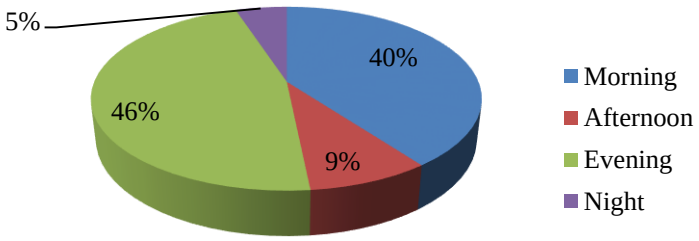

Figure 6: Perception of Diurnal Variation of Freight Traffic Contribution to Congestion in Lagos State
Source: Author's Analysis

The respondents' perception on the variation in indiscriminate parking by freight vehicle drivers in the study area is presented in Figure 7. The analysis reveals that 49% and 24% of the respondents indicated the night and evening respectively as the periods when drivers of freight vehicles park indiscriminately (Figure 7). Indiscriminate parking of freight vehicles is more pronounced when the law enforcement officers have closed from work or when they are yet to resume work. This is responsible for high responses recorded for the night and evening periods.

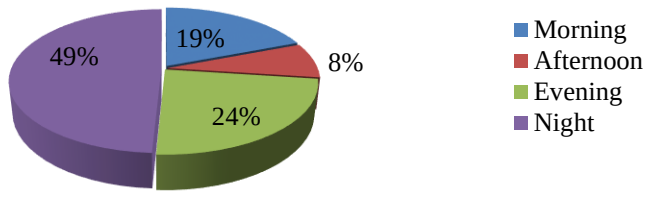

Figure 7: Perception of Diurnal Variation of Indiscriminate Parking of Freight Vehicles in Lagos State
Source: Author's Analysis

A Two-Way ANOVA was conducted that examined the effect of traffic problems types and periods of the day on perceived prevalence of freight traffic problems. There was a significant interaction between the effects of problems types and periods of the day on prevalence of freight traffic problems, F (15, 456) = 161.889, P < .001 at 0.05 alpha level. There was a non-significant main effect of the traffic problem types on the occurrences of freight traffic problems, F (5, 456) =.00, P = 1.00. This effect means that when we ignore the time of the day, the problem types did not influence the occurrence. In other words, other things being equal, traffic problem types (traffic accident, air pollution, noise pollution, road damage, traffic congestion, and indiscriminate parking) occurred unvaryingly. Furthermore, there is a significant main effect of time of the day on the occurrence of freight traffic problems, F (3, 456) = 114.980, P < .001 (Table 2). Therefore, the null hypothesis that "there is no significant diurnal variation in the prevalence of freight traffic problems in Lagos State" is hereby rejected. This means that variations exist in the prevalence of urban freight traffic problems over different periods of the day.

Table 2: Two-Way Analysis of Variance Result for Diurnal Variation of Traffic Problems Associated with Freight Vehicles

Tests of Between-Subjects Effects

Dependent Variable: Responses on Occurrences_of_Traffic Problems

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	49981.700[a]	23	2173.117	120.577	.000
Intercept	168750.000	1	168750.000	9363.250	.000
Freight_Traffic_Problems	.000	5	.000	.000	1.000
Periods_of_the_Day	6216.717	3	2072.239	114.980	.000
Freight_Traffic_Problems * Periods_of_the_Day	43764.983	15	2917.666	161.889	.000
Error	8218.300	456	18.023		
Total	226950.000	480			
Corrected Total	58200.000	479			

a. R Squared = .859 (Adjusted R Squared = .852)

Source: SPSS Output of Author's Analysis

Perception of Seasonal Variation in Freight Traffic Problems

The analysis of respondents' opinion revealed that the prevalence of the freight traffic problems vary between the dry and wet seasons. For example, 55% of the respondents believed that freight vehicles are commonly involved in traffic accident during the wet/rainy seasons than during the dry seasons. Whereas, about 45% of the respondents believed that freight vehicles are also prone to traffic accidents during the dry season (Figure 8). During the rainy seasons, the roads become slippery due to wetness from rain. Visibility is also very poor especially when it is raining. These factors account for the high occurrence of traffic accident involving freight vehicles during the rainy seasons. This is in agreement with the study by Atubi (2010) that most of the accidents occurred in the rainy season, from June to October.

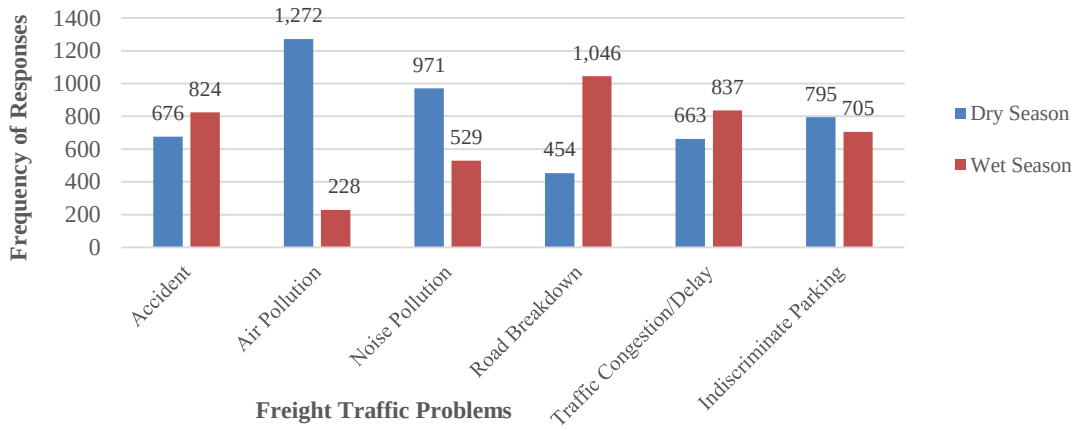

Figure 8: Perception of Seasonal Variation of Freight Traffic Problems
Source: Author's Analysis

The respondents also believed that freight traffic contributes more to road breakdown and traffic congestion during the rainy seasons than in the dry seasons. About 70% and 56% of the respondents believed freight traffic contributes more to road breakdown and traffic congestion respectively during the wet seasons than in the dry seasons. The condition of most of the urban roads gets worse during the rainy seasons due to poor drainage system. The high amount of rainfall makes the roads susceptible to flood and consequent breakdown from increasing freight traffic pressure. The already congested traffic is in turn worsened by the breakdown of the roads which has caused severe loss of man-hours, financial resources, loss of lives, transit discomfort, to mention but a few (Nwoye and Oni, 2016).

In contrast, air pollution and noise pollution from freight vehicles are perceived to be more pronounced during the dry seasons than the wet seasons. This is indicated by 85% and 65% of the respondents respectively. The reason for the responses could be for the fact that dry season is associated with high temperature and lower relative humidity conditions which may likely intensify the production and dispersal of pollutants from heavy duty freight vehicles (Kendrick, Koonce and George, 2015). Similarly, about 65% of the respondents perceived that noise pollution from freight traffic is worse in the dry season as opposed to about 35% who indicated rainy season. The respondents' view could be attributed to the large volume of freight traffic generated and attracted by several festivals in Lagos State during the dry season. It is significant

to note that an increase in freight traffic volume will possibly lead to an increase in noise level, because freight vehicles (depending on the types) emit 2-10 times higher noise in traffic than passenger cars (Schoemaker et al., 2006). Also, the contribution of freight vehicles to indiscriminate parking is perceived to be more prevalent during the dry seasons than the wet seasons as indicated by 53% of the respondents as against 47% who believed otherwise. This decision of the respondents could again be informed by the large volume of freight traffic in the dry season months.

CONCLUSION

The study examined the perception of transport stakeholders on the diurnal and seasonal variations of selected urban freight traffic problems in Lagos State. Analysis of the respondents' perception revealed that variations exist in the occurrence of freight traffic problems over different periods of the day. Noise pollution, indiscriminate parking, and traffic accidents are believed to be more pronounced in the night than other periods of the day, while air pollution from freight traffic is viewed to be predominant in the afternoon than other periods of the day. In addition, freight traffic is perceived to contribute more to traffic congestion and road breakdown in the evening than other periods of the day. The respondents also believed that seasonal variation exists in the prevalence of freight traffic problems. The contribution of freight traffic to accident, road breakdown and traffic congestion is perceived to be more pronounced during the rainy season than the dry season. Air pollution and noise pollution from freight vehicles as well as indiscriminate parking of freight vehicles on the other hand, are believed to be more pronounced in the dry season than in the rainy season.

The study showed that the diurnal and seasonal variations in the incidences of urban freight traffic is very significant and must be considered in the traffic management efforts of the Lagos State. In other words, different periods of the day and seasons of the year are characterised with varying levels of urban traffic problems. Therefore, attempts at solving urban traffic problems should therefore give consideration to the temporal variations in the prevalence of each problem. Moreover, since road freight traffic contribute significantly to urban traffic problems, policies are required to encourage the use of less environmentally destructive means (such as rail, pipeline and waterways) for transporting freight. This becomes necessary because, the use of road for freight transport has greater detrimental environmental and social impacts.

REFERENCES

Aditjandra, P.T., Galatioto, F., Bell, M.C., and Zunder, T.H. (2016). Evaluating the Impacts of Urban Freight Traffic: Application of Micro-Simulation at a Large Establishment. *European Journal of Transport and Infrastructure Research*, 16(1), 4-22.

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.

Atomode, T.I. (2017a). *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.

Atomode, T.I. (2017b). Analysis of Urban Freight Traffic Problem in Lagos State, Nigeria: An Exploratory Approach. *Journal of Research and Developments in Arts and Social Sciences,* 1, 239-259.

Atubi, A.O. (2010). Road Traffic Accident Variations in Lagos State, Nigeria: A Synopsis of Variance Spectra. *African Research Review: An International Multi-Disciplinary Journal, Ethiopia*, 4(2), 197-218.

Ayanlade, A. (2016). Variation in Diurnal and Seasonal Urban Land Surface Temperature: Landuse Change Impacts Assessment over Lagos Metropolitan City. *Model. Earth Syst. Environ.*, 2(1), 1–8.

Batterman, S., Cook, R., and Justin, T. (2015). Temporal Variation of Traffic on Highways and the Development of Accurate Temporal Allocation Factors for Air Pollution Analyses. *Atmospheric environment (Oxford, England: 1994)*, 107, 351-363.

Beziat, A., Dablanc, L., and Koning, M. (2015). Reciprocal Congestion: The Impacts of Freight Vehicles on Cars' Travel Times, and Vice-Versa. Florence Toilier (Laboratory of Planning and Transport Economics), MetroFreight Center of Excellence, IFSTTAR – 14 Bd Newton 77445 Marne la Vallee France.

Elvik, R., Hoye, A., Vaa, T., and Sorensen, M. (2009). *The Handbook of Road Safety Measures*. Emerald Group Publishing, Second Edition.

Ezquerro, S., Romero, J.P., Moura, J.L., Benavente, J., and Ibeas, Á. (2018). Minimizing the Impact of Large Freight Vehicles in the City: A Multicriteria Vision for Route Planning and Type of Vehicles. *Journal of Advanced Transportation*, 1-8.

Gaca, S., and Kiec, M. (2013). Risk of Accidents during Darkness on Roads with Different Technical Standards. A Conference Paper Presented at the 16th Road Safety on Four Continents Conference, Beijing, China on 15-17 May, 2013.

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.

Johansson, Ö., Wanvik, P.O., and Elvik, R. (2009). A New Method for Assessing the Risk of Accident Associated with Darkness. *Accident Analysis and Prevention,* 41, 809-815.

Kendrick, C.M., Koonce, P., and George, L.A. (2015). Diurnal and Seasonal Variations of NO, NO2, and PM2.5 Mass as a Function of Traffic Volumes alongside an Urban Arterial. *Atmospheric Environment,* 122, 133-141.

Lagos State Government (2017). *Abstract of Local Government Statistics*. Lagos Bureau of Statistics Ministry of Economic Planning and Budget, Secretariat, Alausa, Ikeja, (https://mepb.lagosstate.gov.ng/lbs-publication/), Accessed on 07-02-19.

Lagos State Government (2019). *About Lagos.* (https://lagosstate.gov.ng/about-lagos/),

Accessed on 07-02-19.

Laerd Statistics (2018). *Two-Way ANOVA in SPSS Statistics*. Lund Research Ltd, (https://statistics.laerd.com/spss-tutorials/two-way-anova-using-spss-statistics.php), Accessed on 10-02-18.

Lebeau, P., and Macharis, C. (2014). Freight Transport in Brussels and Its Impact on Road Traffic. *Brussels Studies*, 80, 1–13, (https://journals.openedition.org/brussels/1239), Accessed on 24-12-18.

Nwoye, C.F., and Oni, S.I. (2016). An Assessment of the Carrying Capacity of Lagos Metropolitan Roads: A Case Study of Mile2-Apapa and Lekki-Epe Corridors. *Arts and Social Sciences Journal*, 7(1), 1-8.

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.

Oni, S.I. (2004). Urbanization and Transportation Development in Metropolitan Lagos. In: Adejugbe, M.O.A. (Ed.), *Industrialization, Urbanization and Development in Nigeria 1950–1999*. Lagos: Concept Publications Limited, pp. 193–219.

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.

Rodrigue, J P., Comtois, C., and Slack, B. (2013). *The Geography of Transport Systems*. 3rd ed., New York: Routledge, p. 411.

Schoemaker, J., Allen, J., Huschebeck, M., and Monigl, J. (2006). Quantification of Urban Freight Transport Effects I. Best Urban Freight Solutions (BESTUFS) II.

Soladoye, O., and Ajibade, L.T. (2014). A Groundwater Quality Study of Lagos State, Nigeria. *International Journal of Applied Science and Technology*, 4(4), 271-281.

Wang, T., Su, L., and Zhai, J. (2014). A case Study on Diurnal and Seasonal Variation in Pavement Temperature. *International Journal of Pavement Engineering*, 15(5), 402-408.

Wanvik, P.O. (2009). Effects of Road Lighting - An analysis based on Dutch Accident Statistics 1987–2006. *Accident Analysis and Prevention*, 41, 123-128.

Yao, L., Lu, N., Yue, X., Du, J., and Yang, C. (2015). Comparison of Hourly PM2.5 Observations between Urban and Suburban Areas in Beijing, China. *International Journal of Environmental Research and Public Health*, 12(10), 12264-12276.