

PARETO ANALYSIS OF ROAD TRAFFIC CRASHES IN NIGERIAN URBAN CENTRES: A CASE STUDY OF OGUN STATE

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ABSTRACT

Transport is the conveyance or movement of people, goods and services from one location in space to another. The fundamental functions of transport are simply to move things from one place to another, by employing the logistics of the what, where and how methods. The management of road traffic accidents has remained daunting challenge for all stakeholders in Ogun state. The study identified categories of vehicles that contributed most to road traffic accidents in Ogun state and tested the significance in the pattern of accidents in the state. Three years data of vehicle categories and accident involvement in the state were obtained from Ogun State Traffic Compliance and Enforcement Corps. Pareto analysis and Analysis of Variance (ANOVA) were used to analyze the data. The study identified private cars and commercial cars as the categories of vehicles that involved most in accidents in the state as they involved in 70% of accidents in the three years analyzed. The study further revealed that there is no significance difference in the pattern of accidents for the three years as number of vehicle involved in accidents from 2016 to 2018 were statistically indistinguishable. To reduce accident rate by 70% in Ogun state, road traffic accident countermeasures should focus more on private cars and commercial cars.

Keywords: Road, Traffic, Vehicles, Infrastructure, Accident

1.0 Introduction

Transportation is an indispensable component of the social, economic and political life of every society because it has a major role to play in the spatial relationship between different locations, particularly in facilitating movement of people, goods, services and information through space which is shaped by both cultural and physical constraints such as time, distance, topography and political boundaries. There is no doubt that the

functioning of an economy requires the use of transport, and that as economies develop, specialized production increases and therefore it act as a stimulus for economic growth and also increases accessibility of locations which means it is one of the major factors that explain the location of economic activities. Road transport system is by far the most widely used mode of transport in Nigeria. It involves the use of bicycles, motorcycle,

tricycles, carts, cars, buses, trailers, lorries, tankers etc, in moving people, goods and services from one location to another where they are mostly needed. The contribution of road transportation to the socio-economic development in Nigeria is not only significant but also decisive since it opened up new lands for industrial, agricultural and residential development. Modern trades, industries and general activities depend on road transport infrastructures. Road network constitute an important element in urban growth and development as roads provide accessibility to the different land uses in the urban area.

Road traffic accident can be defined as an unexpected and unpleasant event that causes loss or injuries to passengers, vehicles and other mobile or immobile facilities along a route (Onokala, 2015). One of the unavoidable negative consequences of transport in Nigerian urban environment is the road traffic accidents. Urban environment are the most prone to motor vehicle accidents because about 75% of traffic accidents take place in built-up areas or cities (Ogunbodede, 2004). Most of these accidents happen due to the general impatience of road users and the conflict between pedestrian and the different means of road transport in the city. These accidents do represent a cost to the urban society and the nation. Goods in transit are destroyed, people are killed or injured leading to loss of present and potential manpower; damaged transport infrastructure that will have to be replaced. Unfortunately, little attention has been paid to road traffic accident prevention in Nigeria.

In terms of distribution of road traffic accidents and fatality in Nigeria, the following states are known to give 50% of the total recorded accidents, namely; Federal capital territory (FCT), Ogun, Kogi, Nasarrawa, Kaduna and Edo State. The significantly high incidents of road traffic crashes in the state are due to

corresponding higher traffic volumes along the interstate routes and coupled with relatively bad road condition surrounding these routes (Oyesiku, 2018).

Ogun State is a transit state; linking Lagos to other parts of the country. It also serves as transit state for international traffic to Benin Republic and other country. Her geographical location makes her roads to carries un-usual volume of traffic because the State shared boundary with Lagos, the commercial nerve centre of Nigeria and home to one of the busiest ports in the West Coast of Africa. About eighty seven percent of Lagos-Ibadan and Sagamu-Ore expressway falls within Ogun State corridor. This corridor carries one of the largest volumes of traffic on West Coast of Africa. Ogun State has the largest concentration of cement manufacturing companies in Nigeria namely: Lafarge in Sagamu, Ewekoro and Lakatabu as well as Dangote Cement in Ibese. From investigation, each of these factories has not less than five thousand trucks for haulages attached to them.

Apart from being the headquarters of major religious organizations, the state equally has a large concentration of tertiary institutions, public and private numbering about nineteen as at the last count in 2013 (Sangofadeji, 2013). The implication of all these is not only to the motoring public but on Ogun State resources in particular where health facilities are often challenged and stretched beyond limit as a result of frequent road traffic accidents on the corridor.

With the rapid development of economy, road transportation system is playing an increase role in comprehensive transportation system. However, the occurrence of traffic accident shows a rising tendency as a result of the rapid growing of motor vehicles (Mohammadi *et al.*, 2011). Sharma (2016) in his article on road traffic accidents in India

reported that tremendous rise in road traffic accidents is due to increase in vehicular volume on the road. Causes of motor vehicle crashes are multi-factorial and involve the interaction of a number of pre-crash factors that include people, vehicle and the road environment (Haddon, 1980).

1.1 Application of Haddon Matrix in Road Safety

William Haddon (1980) developed a matrix that identifies risk factors before the crash, during the crash and after the crash, in relation to the person, vehicle and environment.

Haddon Matrix is usually used in injury prevention discipline. Haddon was instrumental in using scientific methods to examine car injuries. His pursuit was to discover the phase and component connected

to event. Haddon identifies three secular phase that he referred to as the opportunity reduction (pre-event stage), injury protection stage (event stage), and minimization of inauspicious consequence (post-event stage). These three stages represent the Haddon Matrix which is shown in the table below. It has three epidemical factors which make up the column Matrix: human, vehicle/equipment and environmental/road based. He contend that these stages and agents give the foremost series of matrices of the two practical and theoretic values in categorising route-loss phenomenal, cognition, countermeasures and platform efficaciousness. In accord with the framework, intersection to foreclose road accident and trauma figures and severity may imply varies in agents during any of these stages.

Table 1: The Haddon Matrix

PHASE		FACTORS		
		HUMAN	VEHICLES AND EQUIPMENT	ENVIRONMENT
Pre-crash	Crash prevention	- Information - Attitudes - Impairment - Police enforcement	- Roadworthiness - Lighting - Braking - Handling - Speed management	- Road design and layout - Speed limits - Pedestrian facilities
Crash	Injury prevention during crash	- Use of restraints - Impairment	- Occupant restraints - Other safety device - Crash protective design	Crash protective roadside objects
Post-crash	Life Sustaining	- First aid skills - Access to medical facilities	- Ease of access - Fire risk	- Rescue facilities - Congestion

Source: Haddon (1980)

Haddon described road transport as an ill-designed “man-machine” system in need of comprehensive systemic treatment. Each phase – pre-crash, crash and post-crash – can be analysed systematically for human, vehicle, road and environmental factors. The Haddon matrix is an analytical tool to help in identifying all factors associated with a crash. Once the multiple factors associated with a crash are identified and analysed, countermeasures can be developed and prioritized for implementation over short-term and long-term periods. For the pre-crash phase, it is necessary to select all countermeasures that prevent the crash from occurring. The crash phase is associated with countermeasures that prevent injury from occurring or reduce its severity if it does occur. Finally, the post-crash phase involves all activities that reduce the adverse outcome of the crash after it has occurred.

Afolabi and Gbadamosi (2017) attributed the increasing magnitude of fatal road traffic accident globally to population explosion and increased level of motorization.

Ohakwe *et al.* (2011) analysed road traffic accidents in Imo State, Nigeria, their results revealed that out of 5921 accident cases, reckless driving, inexperience and mechanical fault and road defects accounted for 30.3, 21.5 and 21.1%, respectively. The study also revealed that private cars, minibuses and taxis accounted for most of the accidents with 94.7% of the total accidents. Osoro *et al.* (2015) in their study, analysed the incidence and causes of road traffic accident in Kisii, Central district, Kenya and found that vehicles involved in RTAs decreased in the order of vans and mini buses (73.4%), buses (13.3%) and private vehicles (13.3%). Contributory factors identified were human errors (59.6%); bad roads (19.5%); defective vehicles (29.9%). Antecedent factors associated with RTAs were over-speeding, overloading and lax policing.

Oyetubo *et al.* (2018) study road traffic safety in Minna Niger State, Nigeria. The study revealed among many others; that male involved more in road accident compare to female counterpart in Minna Niger State. Private car had more accident compare to Taxi, the number of accidents in each zone does not depend on the population of that zone. Bun (2012) in his study on public health problems of road traffic accidents in Nigeria found that causes of road traffic accidents are not just human error or driver negligence, Nigerian highways are arguably one of the worst and most dangerous in the world.

Federal Road Safety Corps, Ogun State Command in 2016, reported 387 cases of accidents, 279 deaths and 1,393 injuries due to road traffic accidents. However, the rate for the year 2016 was 574 cases, 131 deaths, and 717 injuries as reported by Ogun State Traffic Compliance and Enforcement Corps. Cases of fatal road traffic accidents are reported almost daily on the major highways in Nigeria. Various categories of vehicular traffic are also involved in these fatal road traffic accidents in the country. Research in this area has focused on causes of road traffic accidents, collation of road traffic accident statistics and impact assessment of road safety campaign (C. Wangdi *et al.*, 2018; A. A. Osoro *et al.*, 2015; J. Ohakwe *et al.*, 2011; W. Becker, 1996).

As a result of increase in population which results to increased mobility needs, consequently cause a lot of traffic problems which includes traffic congestion and road traffic accidents. The threats to Road Traffic Safety in Ogun State have become a persistent problem. The need to tackle road traffic accidents in Ogun State will require a thorough understanding of the underlying factors that affect road safety generally in the State.

This study identified categories of vehicle that contributed most to road traffic accidents

in the state and tested the significant difference in the pattern of accidents from year 2016 to 2018 in Ogun State.

2.0 Materials and Methods

2.1 The Study Area

Ogun State is a state in southwestern Nigeria created in 1976, it borders Lagos State to the south, Oyo and Osun states to the north, Ondo State to the east and the Republic of Benin to the west. Its border with the Republic of Benin, to the west makes it an access route to the expansive market of the Economic Community of West African States (ECOWAS),

to the south by Lagos, which still remains the commercial nerve centre of the country and indeed the West Africa Sub-region and also by the Atlantic Ocean. Abeokuta is the capital and largest city in the state.

Ogun State Indigenes belong to the Yoruba ethnic group, comprising mainly the **Egba**, the **Yewa**, the **Awori**, the **Egun**, the **Ijebu** and the **Remo**. The main languages of communication in the State are Yoruba and English. Although the indigenes speak various dialects of the Yoruba language, they are all mutually intelligible to them. Ogun State consists of twenty (20) Local Government Areas.

Table 2: Local Government and their Headquarters in Ogun State

S/N	LOCAL GOVERNMENT	HEADQUARTERS
1	Abeokuta North	Akomoje
2	Abeokuta South	Ake
3	Ado-Odo/Ota	Ota
4	Ewekoro	Ewekoro
5	Ifo	Ifo
6	Ijebu-East	Ogbere
7	Ijebu North	Ijebu-igbo
8	Ijebu North East	Atan
9	Ijebu Ode	Ijebu Ode
10	Ikenne	Ikenne
11	Imeko Afon	Imeko
12	Ipokia	Ipokia
13	Obafemi Owode	Owode
14	Odogbolu	Odogbolu
15	Odeda	Odeda
16	Ogun Waterside	Abigi
17	Remo North	Ishara
18	Shagamu	Shagamu
19	Yewa North (former Egbado North)	Ilaro
20	Yewa South (former Egbado South)	Ayetoro

Source: Author Survey, 2019



Figure 1: The Study Area

2.2 Pareto Analysis

Pareto Analysis is a statistical technique in decision-making used for the selection of a limited number of tasks that produce significant overall effect. It uses the Pareto Principle (also known as the 80/20 rule), the idea that by doing 20% of the work you can generate 80% of the benefit of doing the entire job. Take quality improvement, for example, a vast majority of problems (80%) are produced by a few key causes (20%). This technique is also called the vital few and the trivial many. In the late 1940s Romanian-born American engineer and management consultant, Joseph M. Juran suggested the principle and named it after Italian economist

Vilfredo Pareto (Powell and Sammut-Bonnici., 2015).

This technique was used to analysed and identified the categories of vehicle that contributed most to road accidents in Ogun state in the last three years (2016, 2017 and 2018).

2.3 Analysis of Variance (ANOVA)

For analysis of the pattern of accidents, Analysis of variance (ANOVA) was used specifically to test if there is significance difference in the pattern of accidents among the three years analyzed.

TABLE 3: Number of vehicles involved in accidents from 2016 to 2018

VEHICLE CATEGORIES	NUMBER OF ACCIDENT INVOLVEMENT			
	2016	2017	2018	TOTAL
Car Private	224	215	317	756
Car Commercial	260	232	284	776
Motorcycle Private	27	23	22	72
Motorcycle Commercial	48	47	35	130
Truck Private	28	29	36	93
Truck Commercial	127	130	159	416
Total	714	676	853	2243

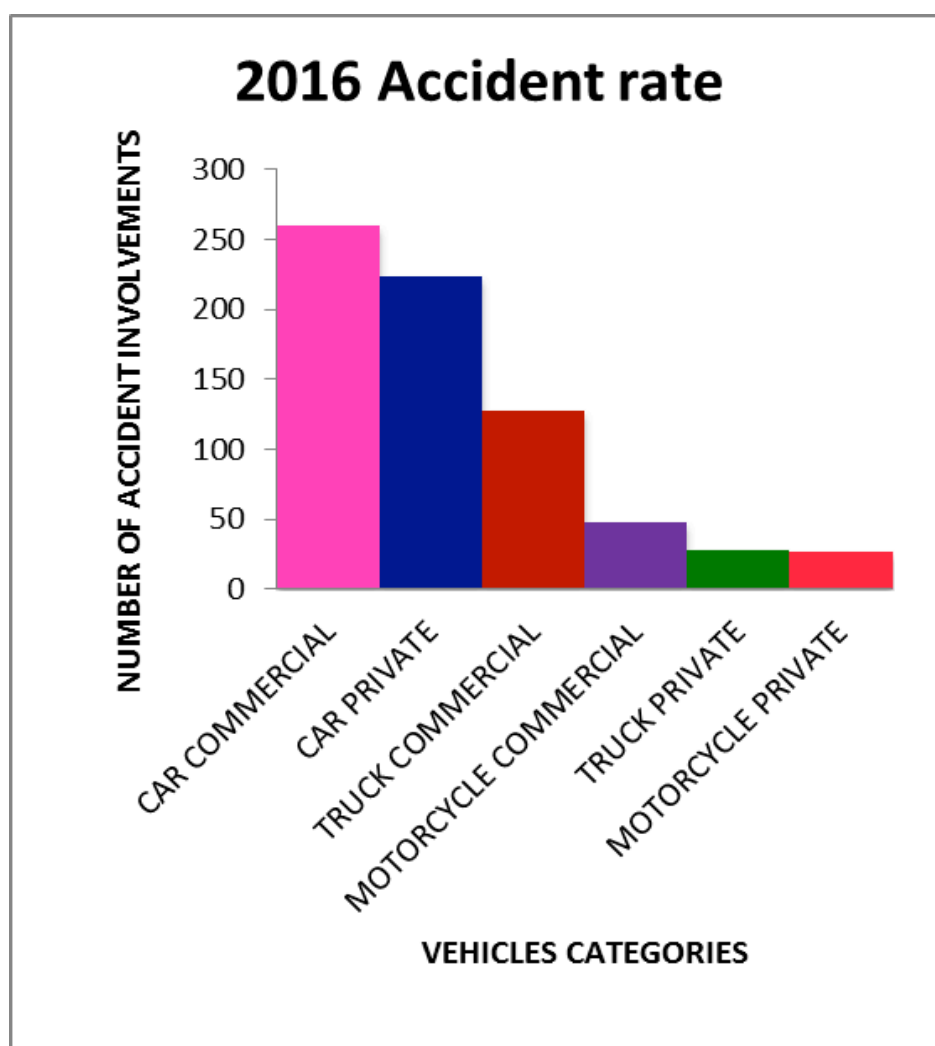


Figure 2: Chart of Vehicles Accidents Involvement, 2016

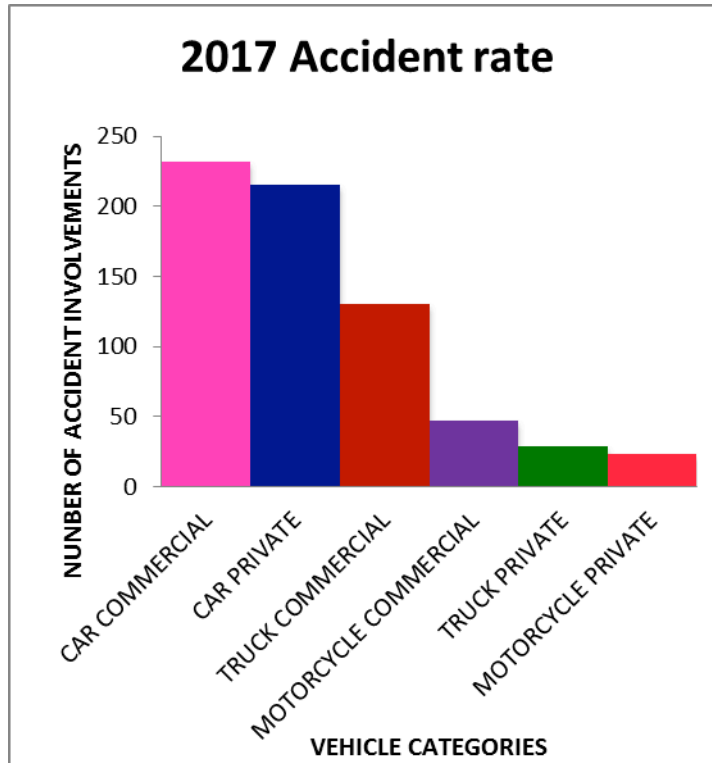


Figure 3: Chart of Vehicles Accidents Involvement, 2017

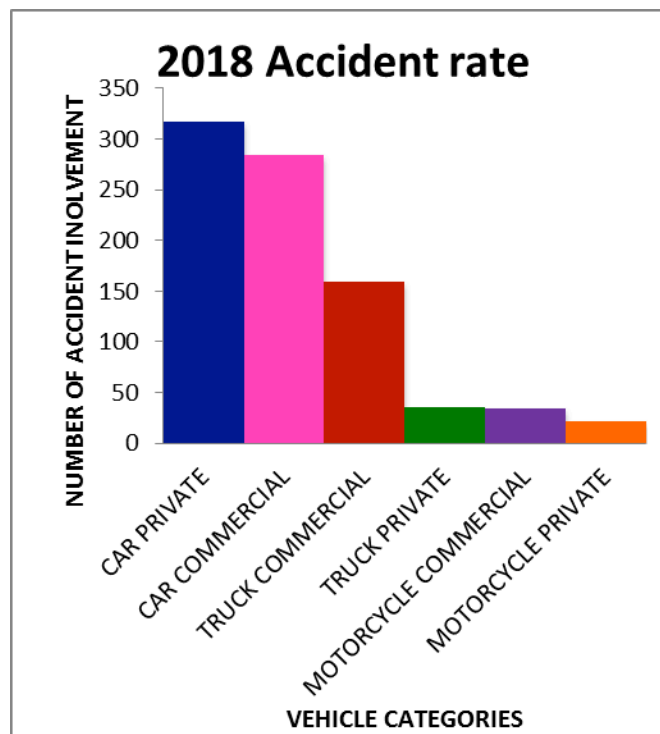


Figure 4: Chart of Vehicles Accidents Involvement, 2018

Pareto Analysis of Vehicle Accidents Involvement (2016-2018)

Table 4: Results for Pareto Analysis on Excel

VEHICLE CATEGORIES	NUMBERS OF INVOLVEMENT	CUMMULATIVE	PERCENTAGE INVOLVEMENT
CAR COMMERCIAL	776	776	35%
CAR PRIVATE	756	1532	68%
TRUCK COMMERCIAL	416	1948	87%
MOTORCYCLE COMMERCIAL	130	2078	93%
TRUCK PRIVATE	93	2171	97%
MOTORCYCLE PRIVATE	72	2243	100%

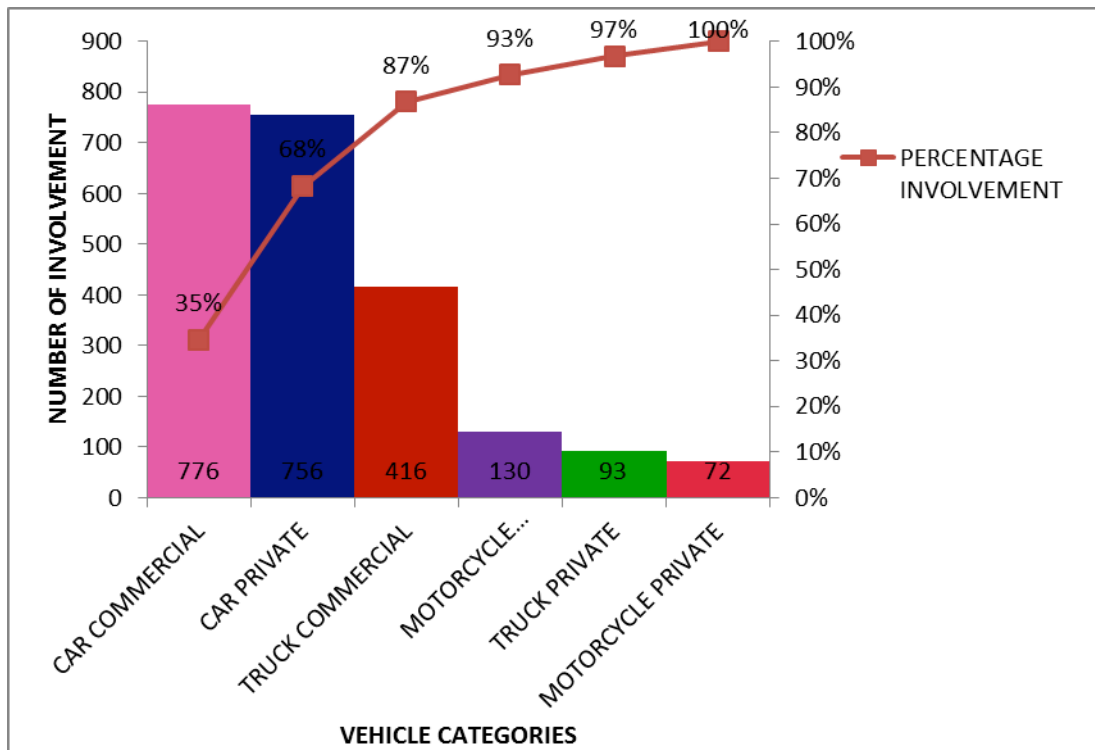


Figure 5: Pareto Analysis Chart

Pareto analysis above showed that commercial car and private car combined to give almost 70% of accidents that occurred in the state.

Analysis of Variance (ANOVA)

Analysis of variance was used to test if there was statistical difference in the number of vehicles involved in accident for the year (2016, 2017 and 2018). Table 5 below shows the results obtained.

Table 5: Results of Analysis of Variance (ANOVA)

TOTAL SUM OF SQUARES (TSS)	188178.3
SUM OF SQUARES WITHIN GROUP (SSW)	185284.2
SUM OF SQUARES BETWEEN GROUP (SSB)	2894.111
DEGREE OF FREEDOM (DF) SSB	2
DF SSW	15
SSB/DF SSB	1447.056
SSW/ DF SSW	12352.28
F VALUE	0.117149
CRITICAL VALUES (95% CL)	3.68
CRITICAL VALUES (99% CL)	6.36
Sig.	Accept H_0

Discussion

From figures 1, 2, and 3 above, car had the largest number of accidents involvement in all the three years of analysis while motorcycle had the lowest number of accidents involvement in the 3 years of analysis.

Looking at private and commercial categorization, commercial categories of all types of vehicle contributed more to accidents in all the three years than the private vehicles except in year 2018 where private vehicles have higher accident involvement than the commercial car.

Pareto analysis in figure 4 above showed that commercial car and private car combined to give almost 70% of accidents that occurred in the state. This result is consistent with the work of J. Ohakwe et al, 2011.

The analysis of variance (ANOVA) test revealed that there is no significance difference in the frequency of the accidents for the three years as number of vehicles involves in accidents from 2016 to 2018 were statistically indistinguishable.

Conclusion and Recommendations

Based on the findings of this study, the major contributors to accidents in Ogun state are private car and commercial car as they are

responsible for almost 70% of accidents in the state. Also, from the analysis commercial categories of all types of vehicle contributed more to accidents in the state. The analysis of variance (ANOVA) test revealed that there is no significance difference in the patterned of the accidents for the three years as number of vehicles involves in accidents from 2016 to 2018 were statistically indistinguishable. Hence to reduce accidents rate by 70% in Ogun state, road traffic accidents countermeasures should focus more on private cars and commercial cars.

Based on this problems identified, the following recommendations are provided as follows;

- i. Government of Ogun state should make adequate funds available for regular and periodic maintenance of road network.
- ii. Result-oriented training, research and development in all areas of transportation, including transport policy formulation and implementation.
- iii. Providing reliable and seamless transportation options and quality information for all modes for improving modal efficiency.

- iv. Putting in place effective traffic engineering, transport planning and transport management practices.
- v. Land-use planning measures should be put in place to reduce traffic accidents and congestion in urban centres
- vi. Government of Ogun state should put other Transport stakeholders to work, by making it compulsory for those stakeholders to enlightening the public on Road Traffic Safety as part of their monthly or weekly program.
- vii. Vehicle users should ensure to carry out morning inspection on their vehicle before travelling.
- viii. Finally, Accident black spot should be identified and Intelligent Transport System should be put in place in such area.

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