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Analysis of Traffic Congestion On Major Urban Roads in Nigeria

Ajala, Abdul-Rahman T.
Department of Transportation Planning and Management
The Federal Polytechnic
Ilaro, Ogun State, Nigeria
Email: taiwoajala2014@gmail.com
Phone: 08034858513

ABSTRACT

This study aim at assessing operating capacity of existing road facility, examine the causes and effects of traffic congestion and suggest measures to ameliorate recurring traffic congestion on urban roads. Traffic counts was conducted for three days of the week (Monday, Wednesday and Saturday) on Sango-Winners corridor of Owode-Idi-Iroko road between the hours of 7am and 7pm. Road side interview were also conducted with the use of structured questionnaire, 68 vehicles were selected randomly within the survey period and 240 road users successfully interview at four major locations along the corridor. The British standard of Passenger Car Unit (PCU) was used in the computation and analysis of the road capacity. The study revealed that congestion is a common occurrence along the corridor with its peak in the morning periods of 7am to 12noon. Factors such as poor road infrastructure, street trading, on-street parking and uncontrolled high capacity junctions have been identified as the causes. Assessment of the road capacity revealed that it presently operates above the design capacity of 1200PCU/hour. Sango section of the road has 93% excess capacity, while other three sections Oju-ore, Obasnajo and Winners have relatively uniform excess capacity of 34%, 32% and 43% respectively. The study concludes by recommending junction improvement at Sango, Oju-Ore and Winners with total up-grading and expansion of the road, adequate provision of public transport facilities and land use control.

Keywords: congestion, road capacity, traffic, traffic volume, urban road,

1. INTRODUCTION

Movement of goods, services and commuters is influenced by factors of traffic congestion, such as increase in logistics cost, travel time, waiting time and fuel cost. Congestion has equally created artificial impediments to logistic flow of goods and persons along urban roads (Popoola, Abiola and Adeniji, 2013). It has however becomes a phenomenal common to major urban settlement of the world especially in the developing countries. The Joint Transport Research Centre of the Organisation for Economic Cooperation and Development (OECD) and the European Conference of Ministers of Transport (ECMT) provide conceptual definitions of traffic congestion as impediment imposed by vehicles on each other, where the volume equals or more than capacity.

It equally expressed as the difference between the roadway system design capacity and the actually operating capacity, and simply put a situation where demand for road space exceeds supply (ECMT, 2007). These definitions actually point to inability of the current system to accommodate the contemporary traffic situation. Traffic congestion is one of the consequences of urbanization, it is a reflection of the urban development, housing, employment and cultural policies which influence where people live and work. OECD and ECMT put the relationship between urban cities and traffic congestion in perspective, *"Cities and traffic have developed hand-in-hand since the earliest large human settlements. The same forces that draw inhabitants to congregate in large urban areas also lead to sometimes intolerable levels of traffic congestion on urban streets and thoroughfares."* (ECMT 2007:5).

Causes of traffic congestion differ slightly from place to place (Joseph, Ukpata, and Anderson, 2012) depending on a number of determinant factors which include the road network, land use pattern, traffic composition and the public transport policy. Identifying the causes of traffic congestion, Ogunsanya (2006) categorized it into physical, human and institutional matrix. Physical are transport infrastructures, while human refer to road users attitude, the regulatory institutions saddle with the responsibility of managing the road users and the infrastructure. Aworemi, J. R., Abdul-Azeez, I. A., Oyedokun, A. J. and Adewoye, J. O (2009) and Bashiru and Waziri (2008) in a different studies in Lagos identified bad road condition and inadequate road infrastructure, others are poor traffic planning, drivers' behaviour and lack of integrated transport system. Joseph et al (2012) identified Road intersections as major component of urban roads that are generally prone to generate traffic congestion while Momoh (2011) opine that over dependence in motor vehicle and lack of integrated transport system are responsible for the traffic congestion.

Earlier studies (Popoola *et al*., 2012; Joseph et al, 2012; Aworemi *et al* (2009) and Bashiru and Waziri (2008) have place emphasis on road users perceptions and the role of regulatory agencies in traffic congestion analysis, little were the study on the physical infrastructure capacity *vis-à-vis* the existing traffic volume and characteristics. This study examines the adequacy of the highway in meeting the traffic demand for road space and traffic facilities in terms of capacity. Capacity of a facilities is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point (Ajala, 2016) or uniform section of a lane or roadway during given time period under prevailing roadway, traffic and control conditions. It is express using passenger car unit (PCU) per hour. The "prevailing road traffic conditions referred to in the above definition Is a function of the following factors which include: Lane width; number of lanes; Lateral clearance; Surface condition; Availability of shoulder; Road Alignments; waving sections; Traffic managements facilities; Grades; and other auxiliary road facility.

Capacity can be expressed in three categories, first the basic capacity; second the possible/operating capacity and thirdly the practical/design capacity (Kadiyali, 2013). The basic capacity is the ideal number of vehicle that can pass a point on a lane of road where there is no impediments to traffic movement, while the possible/operating capacity is the maximum number of vehicle that can pass a given point on a lane or roadway under prevailing roadway and traffic operating condition. The practical or design capacity is the projected maximum number of vehicle that can traverse a roadway or a point taken into consideration the maximum traffic density that will not unreasonably cause delay, hazard or restriction to the road users freedom to measure under prevailing roadway and traffic conditions. According to London ministry of Transportation (1966) as noted by Bruton (1985) the design capacity for a two lane road of 7.3m lane width is 1200 PCU/hour for two directional flows.

Understanding of capacity is very relevant to this study because it allows for comparison of the present operating capacity (Traffic Volume) with the design or practical capacity of the facilities to determine it adequacy or deficiently. The study investigates the main causes of traffic congestion associated with Nigerian urban roads in Ota. The city of Ota is one of the development pressure area of Ogun state (Ogun state, 2009), that witness high influx of vehicular traffic from both the national and international road corridor that significantly form the framework of the road network (Lagos-Abeokuta and Owode-Idi-Iroko expressway) of the city. Aside playing the role of primary roads linking cities, state and neighbouring countries, it also serve as access road and collector road in most cases, thus the attendant

traffic challenges on the road. The study aims to assess the transport facility vis-a-vis the current trend of traffic along the road, examine the causes and effects of traffic congestion and suggest measures to ameliorate recurring traffic gridlock. Findings from this study will provide basic information to guide relevant authorities, private individuals, organizations and international agencies in their bid to curb the challenges of traffic congestion in Nigeria. The need for further research in road infrastructure capacity is also brought to the fore by this study.

2. STUDY AREA

Ota is a town within Ado-Odo/Ota local government area of Ogun state, south-Western Nigeria. It is located in an extensive undulating plain characteristic of the south western part of Nigeria. It has much of its land area rising gently from the coastal plain to about 100m above the sea level. The city lies within the tropical rainforest and has an average annual rainfall of 154cm with 29^0C average daily temperature (Oyesiku and Kadiri, 1992)

Ota is located on the latitude 6°40'29.57"N and longitude 3°11'52.99"E. It is bounded in the south by Agege and Alimoso in Lagos state, in the North by Ifo and Agbado of Ifo local government of Ogun state, Owode Idi-Iroko, a border town to Benin Republic form the boundary in the west.(See figure 1)

The structure of development in Ota can best be explained with the frame work of the two primary roads that intercepted within the city. The roads connect the city to Lagos (the commercial hub of the country) and also to Cotonu (international trade route). Owode - idiroko Road is a trunk 'A' road, constructed to link Sango-Ota to the border town of Idiroko and the Benin Republic (Cotonu). It is a two way road that serves as intercity transit corridor as well as international corridor. The basic features of the road include: dua carriage way of 24meters road width; No drainage and good shoulders; the road is divided with concrete barrier between Sango and Winners Chapel location; the road provides access to all abutting plots with no restriction to parking.
Sango-Winners corridor of the road is a distance of 10.5km. This section provides access to major land uses such as the industrial estate, Ogun State housing Estate; Ota Judicial complex, Ogun state hospital, Ota; the Bells University of technology; Covenant University, Obasanjo Farms and a host of other industrial and commercial land uses including major city market.

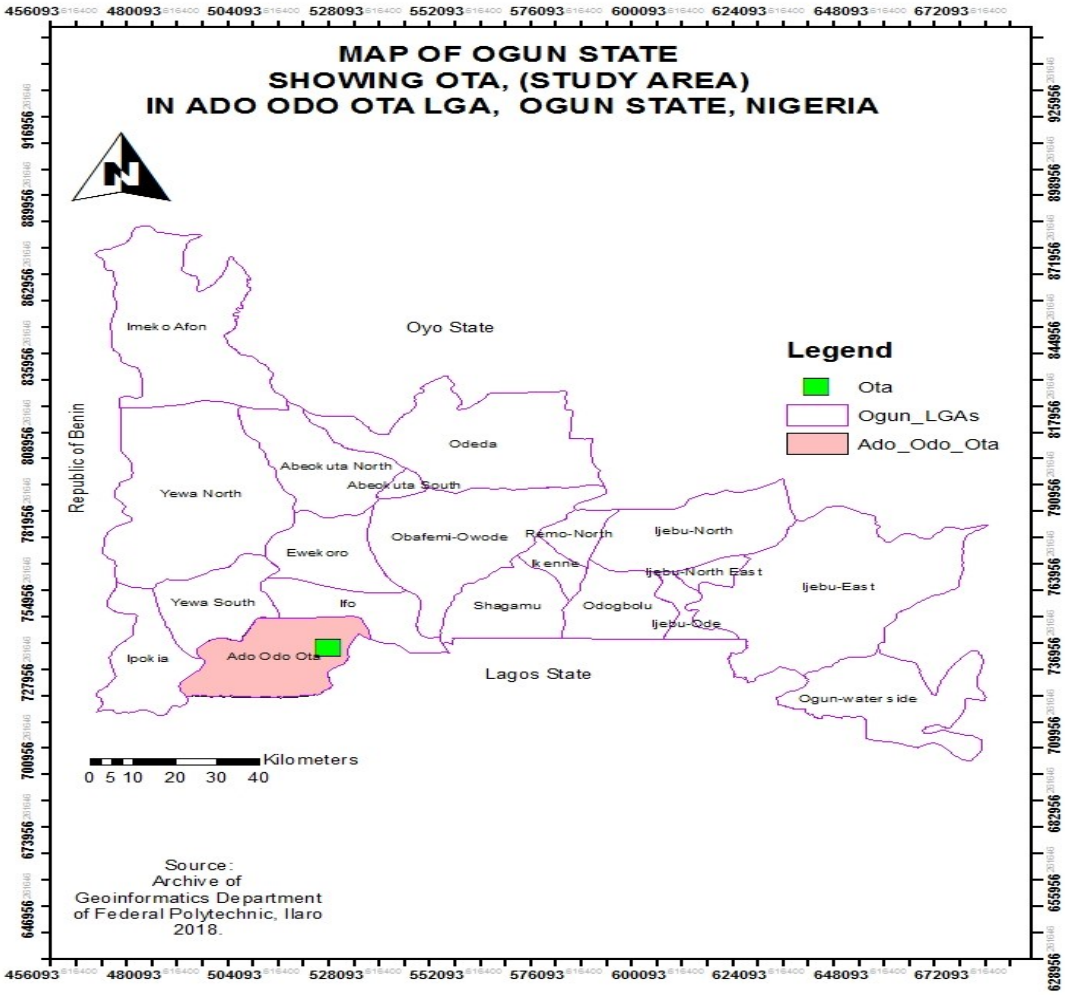

Figure 1: Map of Ota, Ogun State, Nigeria

3. METHODOLOGY

The process and procedure of the study was based on both observational and questionnaire survey, data gathered were in two folds, the traffic volume; and road users' perception of and traffic and transportation problems. The observational survey was basically the traffic volume counts. Four major points leading to the congested areas were selected as survey points namely, Sango; Oju-Ore; Obasanjo and Winners' Chapel. Volume of traffic discharge into the roads by the link roads were also taken into consideration in the counts. Seven major link roads were selected namely Ota road; Joju road; Toll gate road; Ilogbo road; Obasanjo road; Iyana Iyesi road and Winner's road. A sample of three days was selected (Monday, Wednesday and Saturday). Traffic counts were conducted manually between the hours of 7am and 7pm daily. Traffic characteristic was also taken into consideration, Motorcycle / Tricycle; Car; Bus; Truck /Trailer; and Good Vehicles / Van were the major vehicle types. The British standard of passenger car unit (PCU) was use in the computation and analysis of the road capacity.Road side interview was conducted with the aid of a well-structured questionnaire designed to seek road users' information, causes and effects of traffic congestion.

Public and private Vehicles were stop at random and a total of 68 vehicles were selected while 240 questionnaires administered on both drivers and commuters by trained survey assistants at the four survey points within the survey period of 7am and 7pm. Statistical package for social sciences (SPSS) version 23, was used in the analysis of the data.

4. DATA PRESENTATION AND DISCUSSION

4.1 Traffic Volume and Road Capacity

This section present the traffic volume counts obtained on both the main corridor and the link roads. Also the traffic characteristics i.e. composition, variations and the operating capacity of the corridor are presented.in the following sub-sections.

4.1.1 Average daily traffic volume: main corridor (Owode-Idiroko Road)

Table 1 present the average daily traffic volume for the four points along the corridor, it reflected the hourly variation in the traffic volume between 7am and 7pm. From the table the highest daily volume on any section of the road is 19,029 recorded at Sango section of the road while other section has relatively uniform volume of 14251, 14961 and 14166 for Oju-ore, Obasanjo and winners respectively.

4.1.2 Daily traffic variation: peak and off peaks period

Daily traffic variation along the corridor presents an undulating graph with relatively many peaks and off-peaks. This means that there is relatively uniform flow along the corridor throughout the day. From figure 2, the graph for Sango survey point presents a steady growth in traffic from the 7am and attain peak by 2pm through 5pm. For Oju-Ore point the peak is between 9 – 10am and off by 4 – 5pm, while Obasanjo point attain peak between 8 – 9am and off-peak between 5- 6pm. Winners attain peak between 12 – 1pm and off-peak follows immediately between 1 – 2pm. Traffic volume is significantly influenced by the function perform by the road facilities (Kadiri, 2005), it types and location. Urban roads abating major traffic generating land user are found to have high volume because of the intensity of use. The other important factor is the road type and design characteristics which also effect speed and flow of traffic. Traffic volume is simply derived through the counts of vehicle that passes a survey point over a period of time, usually graduated into hourly time period. Volume study is required for the computation of practical or operating capacity of exerting road facility. This section present the traffic volume count, analysis of traffic variation and characteristics, it also established the existing road capacity.

Table 2: Average daily traffic

TIME	Sango	Oju-Ore	Obasanjo	Winners
7:00am - 8:00am	1070	1026	1501	965
8:00am - 9:00am	1453	1145	1842	1284
9:00am - 10:00am	1476	1535	1706	1110
10:00am - 11:00am	1558	1345	1079	1159
11:00am - 12:00noon	1597	1325	1394	1205
12:00noon - 1:00pm	1684	1052	1079	1358
1:00pm - 2:00pm	1556	1112	1116	1006
2:00pm - 3:00pm	1838	1125	1298	1187
3:00pm - 4:00pm	1853	1221	1067	1049
4:00pm - 5:00pm	1832	982	950	1143
5:00pm - 6:00pm	1525	1099	940	1144
6:00pm - 7:00pm	1587	1284	989	1556
TOTAL	**19029**	**14251**	**14961**	**14166**

Source: field survey, 2017

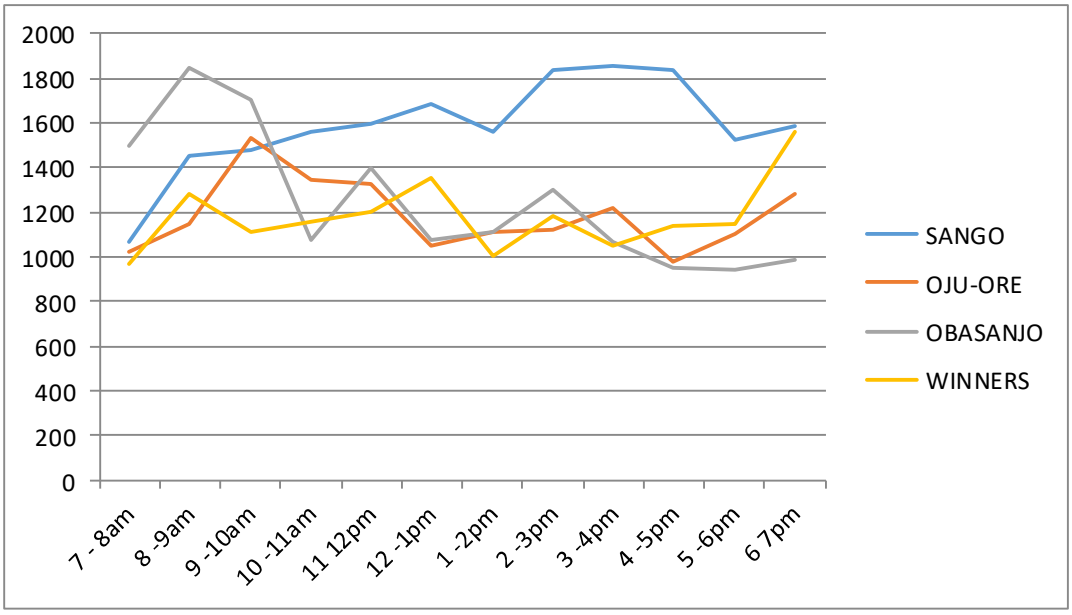

Figure 1: Traffic Variation Chart

4.1.3 Traffic characteristic

Traffic characteristics (Table 2) revealed the dominance of low capacity vehicle i.e. motorcycle cars and mini-buses. At every section of the road, motorcycle has the highest counts follow by cars, buses, truck/trailers and goods van respectively. (See figure 3). The study revealed uniform characteristics along the corridor with motorcycle and cars leading the record. However, the implication is that para-transit dominates the traffic. Hence, congestion is inevitable especially during the peak periods.

Table 3 Average daily traffic characteristics

VEHICLES	A	B	C	D
Motorcycle / Tricycle	6706	5591	5373	5352
Car	5734	4300	4013	3688
Bus	2964	2364	2908	2489
Truck / Trailer	1911	1056	1275	1320
Good Vehicle / Van	1701	941	1392	1318
TOTAL	**19029**	**14251**	**14961**	**14166**

Source: field survey, 2017

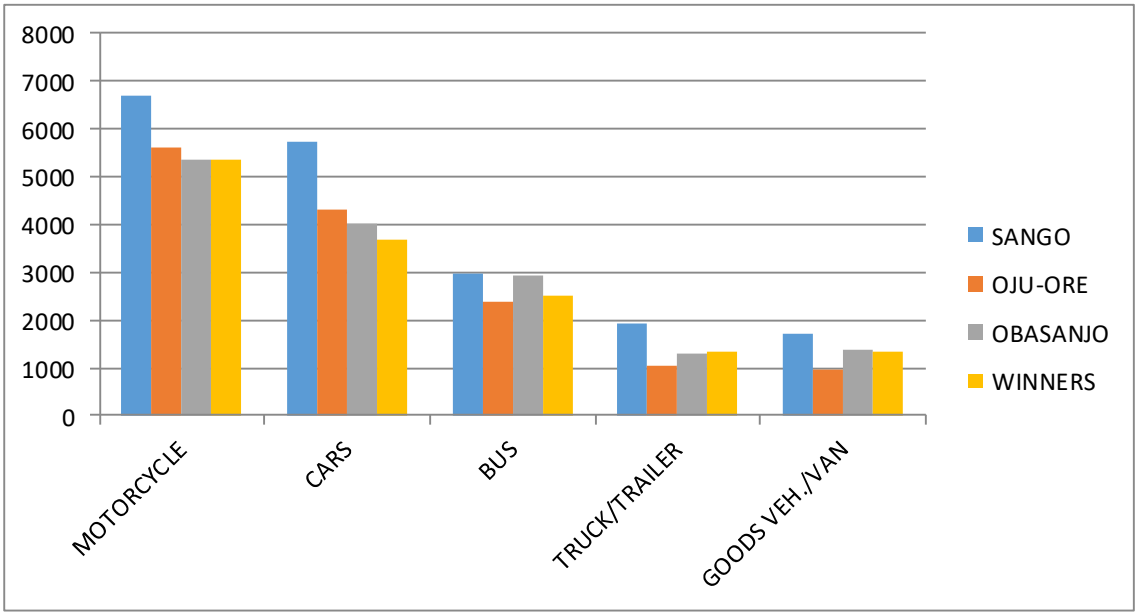

Figure 2: Traffic Characteristics

4.1.4 Summary of traffic count: link roads

Seven major link roads were also selected to assess the volume of traffic discharge into the study road corridor with a view to determine the link that has the greatest influence on the traffic. Table 3 revealed the summary of the traffic counts. Toll gate (R3) and winners (R7) road has the highest average daily traffic, 10,830 and 10,585 respectively, followed by Joju road (R2) and Ilogbo road (R4) with 6354 and 5,686 respectively. Ota road (R1) and Iyana Iyesi road (R6) were also in the same category of 3,666 and 3,738 average daily traffic respectively. Obasanjo road (R5) has the least average daily traffic of 1973.

Table 4 Summary of traffic count: link roads

Roads	R1	R2	R3	R4	R5	R6	R7
Average daily traffic	3666	6354	10830	5686	1973	3738	10585

Source: field survey, 2017

4.1.5 Computation of operating road capacity

Table 4 presents the passenger car unit equivalent of the traffic volume. Using the British standard, the PCU factor for each classes of vehicle are; motorcycle 0.75; car 1.00; mini busses/goods van/truck 2.00 and trailers/articulated vehicles 4.00. (Kadiyali, 2013). The table revealed the PCU capacity per day for each section of the road, Sango has 27,738 PCU/day; 19,327 PCU/day for Oju-ore; 19052 PCU/day for Obasanjo and 20,596 PCU/day for winners. For a twelve hours survey, the average capacity per hour at every section is 2,312 PCU/hr. at Sango; 111 PCU/hr. at Oju-ore; 1,588 PCU/hr. at Obasanjo and 1,716 PCU/hr. at Winners.As earlier review, for a dual carriage road of 2-lanes (7.3m/lanes) under the prevailing condition of been All-purpose street with high capacity junctions (Oju-ore and winners) and No waiting restriction, the capacity is put at 1200 PCU/hour for both direction of flow. (British Standard). Further analysis on table5 revealed excess capacities at each sections of the road. Sango section of the road has 93% excess capacity, while other three sections Oju-ore, Obasnajo and Winners has a relatively uniform excess capacity of 34%, 32% and 43% respectively. The reason for the almost 100% at Sango may be due to the role play by the traffic node as the terminal end of most journey along the corridor.

Table 5 Passengers Car Unit Equivalent (PCU)

VEHICLE	PCU	A	PCUE	B	PCUE	C	PCUE	D	PCUE
Motorcycle / Tricycle	0.75	6706	5030	5591	4193	5373	4030	5352	4014
Car	1.00	5734	5734	4300	4300	4013	4013	3688	3688
Bus	2.00	2964	5928	2364	4728	2908	5816	2489	4978
Truck / Trailer	4.50	1911	7644	1056	4224	1275	5100	1320	5280
Good Vehicle / Van	2.00	1701	3402	941	1882	1392	2784	1318	2636
TOTAL/		**19029**	**27738**	**14251**	**19327**	**14961**	**19052**	**14166**	**20596**
Average capacity/hour		**2312**		**1611**		**1588**		**1716**	
Excess capacity/hour		**1112**		**411**		**388**		**516**	
% (1200)		**93**		**34**		**32**		**43**	

Source: field survey, 2017

4.2. Road Users Background Information

4.2.1 Road Users Socio-Cultural Characteristics

Basic characteristics such as road user's status, age, gender, and level of education were considered. Two categories of the road users were identified, these are drivers and commuters. Table 6 revealed that 32% of the sample road users are drivers while 68% are commuters. The age distribution of the road users revealed that 32.5% are between 18 – 25 years, 35% are between ages 25 – 40 years while above 40 years accounted for 32.5%. This structure revealed a uniform distribution across the age structure. The table further revealed the gender of the road users, 59.17% are male while 40.83% are female. Road users level of education were also presented in the table, 11.67% had primary level of education, those with secondary education accounted for 35.85% and 25.83% had tertiary level of education while 26.67% had no formal education. In the aggregate, over 60% has secondary and tertiary education, hence, the road users are literate.

Table 6: Socio-demographic characteristics of road users

Category	Frequency	Percentage
Driver	76	32
Commuter	164	68
Total	**240**	**100**
Age (Years)	**Frequency**	**Percentage**
Below 18	0	0
18-25	78	32.50
25-40	84	35
Above 40	78	32.50
Total	**240**	**100.00**
Gender	**Frequency**	**Percentage**
Male	142	59.17
Female	98	40.83
Total	**240**	**100.00**
Education	**Frequency**	**Percentage**
Primary	28	11.67
Secondary	86	35.83
Tertiary	62	25.83
No formal education	64	26.67
Total	**240**	**100.00**

Source: Field Survey, 2017

4.2.2 Causes of traffic congestion

Identifying the causes of traffic congestion along the road corridor, 35% causes are due to bad portion of the road. On-street parking and disregard to traffic rules and regulations accounted for 33.33% and 25% respectively. Indiscriminate picking of passenger by public transport vehicles accounted for 6% while street trading and other causes like pedestrian crossing accounted for 0.67% and 0.33% respectively. From the analysis, it therefore mean that bad road infrastructure, street parking and disregard to traffic rules and regulations are the major causes of traffic congestion along Owode-Idi-Iroko road.

Table 7: Causes of traffic congestion along Owode- Idi-Iroko road

Causes of Traffic Congestion	Frequency	Percentage
Bad roads	52	35
Vehicles parked along the road	55	33
Disobedience to traffic law and agents	35	25
Indiscriminate dislodging and picking of passengers	59	6
Road side trading	39	0.67
Others	0	0.33
Total	**240**	**100.00**

Source: Field Survey, 2017

4.2.3 Effect of traffic congestion

Road users experience different challenges as a result of congestion, while travelling along the corridor. Increase travel time accounted for 25% of the challenges, longer waiting time at the bus stop accounted for 29%while high cost of public transport accounted for 20%. Environmental pollution was 15% of the effects and other factors such as crime, pedestrian and vehicular conflict accounted for 11%. Increase travel time and waiting time are the major effect of traffic congestion, it is also acknowledge to have influenced high cost of public transport. Other effects are environment pollution, crime and pedestrian/vehicular conflicts. This is in agreement with earlier studies (Popoola et al, 2013) that traffic congestion drastically increases the travel time and the cost of transportation.

Table 8: Challenge faced by road users

Challenges	Frequency	Percentage
Increase travel time	60	25
Delay at bus stops	69	29
High cost of public transport	48	20
Environmental pollution	36	15
Pedestrian/vehicular conflict/ crime	27	11
Total	**240**	**100.00**

Source: Field Survey, 2017

5. CONCLUSION

Efficient transport system is central to development of smart city. Where movement is impeded socio economic prosperity is restricted and lots of resources are wasted in terms of man-hours. Other implications of traffic congestion are environmental pollution, poor city livability and poverty. Measures to minimize these effects are the concern of planners and environmentalist in the contemporary world. However, the effect of Land use development along the corridor need be studied to identify the contribution of land development to traffic generation. Other important contributors to the phenomena are the increased use of paratransit., low capacity Junction and lack of urban Public transport facilities..

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