TRANSPORTATION CHARACTERISTICS IN A MEDIUM-SIZED CITY OF OSUN STATE, NIGERIA: IMPLICATIONS FOR SUSTAINABLE TRANSPORTATION PLANNING AND MANAGEMENT

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ABSTRACT

In order to ensure sustainable transportation planning and management in Nigeria, it is imperative to have adequate knowledge of its traffic characteristics. This study, therefore, was carried out to elicit relevant traffic data for transportation planning and management, using the medium-city of Inisa in Osun State as a case study. Data were collected through observational survey and questionnaire administration. Data on volumetric counts were sourced through observational survey at two locations. In addition, a total of 800 households' heads were administered questionnaire in the study area, using systematic sampling method. The data were analyzed using descriptive and inferential statistics. Results showed no significant variation in traffic volume throughout the week. The characteristics of the typical traffic flow in the town also followed the normal conventional traffic of early morning and late evening peak periods. The modal split of traffic indicated that motorcycle mode accounted for more than half of the total traffic in the town. The possible implications of the traffic characteristics for transportation planning and management in Inisa town were categorized into four, namely safety, air pollution, noise and vibration. The article advocated stringent road transport policies coupled with the provision of safe transport facilities to enhance livable city.

Keywords: *Medium-Sized City; Modal Split; Transportation Planning; Traffic Flow; Traffic Survey.*

1. INTRODUCTION

Road transport system is the predominant mode for movement of goods and services in Nigeria. It accounts for over 80% of both passenger and freight traffic in Nigeria (FGN, 2010). Roads are pivotal to the social, economic and political development of any community. It represents the only means of reaching some rural communities, thereby integrating rural areas with urban centres in the country.

Nigeria has about 194,200 kms of roads, made up of 34,179.20 kms of Federal roads, representing 17% of the total road network, 30,489.40 kms of State roads, representing 16% and 129,531.40 kms of Local Government roads, representing 67% (FGN, 2017). The predominance of the road over the other modes is not only because of its inherent advantages but because Government has, until recently, paid greater attention to this mode (FGN, 2017).

In spite of the huge public fund committed to road subsector, the condition of road infrastructure is still very deplorable due to high intensity of usage, especially by heavy trucks, and poor maintenance. For instance, the percentage of road infrastructure in poor condition increased from 23% in 1985 to 85% 2007 (Ogunsanya, 2004; World Bank 2008; Foster and Pushak, 2011). However, the deterioration may have been worsened over the years. In order to ensure effective road management, there is need to be abreast with information on the characteristics of the road which include among other things the pavement structure, condition of the road and amount of traffic carried. These sets of information can only be acquired through traffic survey.

Traffic surveys are pivotal for local traffic planning, engineering and management purposes. Data collected from traffic surveys are useful for a wide range of decision-making processes in the planning, construction and maintenance of transport facilities (Salisu and Oyesiku, 2020). Traffic data are crucial for traffic planning purposes such as to calculate historical trends, assess seasonal variations, identify existing problems and serve as a base for predicting future traffic demand and improvements. In the same vein, traffic volume (traffic counts) studies are conducted to determine the number, movements and classifications of roadway vehicles at a given location. Traffic count studies help to identify critical flow time periods, determine the influence of large traffic on vehicular traffic flow or document traffic volumes (Hernandez *et al*, 2021). Current and historical traffic volume counts provide vital information that can be used in traffic planning and evaluations, traffic modeling as well as in the selection and design of road network improvements (GTZ, 2004).

The data gathered plays a major role in informing the decision-making process in transport planning. This may include contributing to projects related to the planning, construction and maintenance of transport infrastructure. Importantly, with major investment apparently in short supply, traffic survey reports influence investment in future infrastructure as well as making the best of our current road networks. On a local level, surveys are also utilized for smaller projects to generate traffic volume study report and traffic impact study report that deal with parking issues or the effectiveness of traffic calming measures in regards to road safety issues.

Therefore, in order to ensure sustainable transportation planning and management, it is imperative to have adequate knowledge of its traffic characteristics and robust data on travel pattern. This will provide a springboard for the government to adopt policies and strategies for efficient road management. This study, therefore, was carried out to elicit relevant and necessary traffic data for road planning and management in Inisa, Nigeria.

2. STUDY AREA AND METHODOLOGY

The Inisa community has three classes of roads namely, the federal, state and local government roads (access roads). The Osogbo-Inisa-Offa expressway (a high-capacity road by-passing the eastern part of the town) is a federal road which is under the exclusive responsibility of the Federal Ministry of Transportation. Roads such as Railway station-Sege-Yidi Road, Eko-Ende, Eko-Ajala and Okua road (these are roads traversing the town from various sides) are owned by the State and, therefore, being managed by the State government. While access roads such as Bola-Ige, Odesado, Shekinnah, Alaarin, Ukunkun, Palace Road, Onita, among others, are under the control of the local government. The federal road and all the state roads are single carriage roads and some of them had evidence of being tarred before.

Although, Inisa community has a very good road connectivity, almost all the roads are in deplorable conditions. Both the engineering and geometric designs of the roads are poor. Some of the roads within the town have widths that are just wide enough to accommodate two opposing vehicles. The carriageways are dotted with very wide potholes which cause ponding and result in unnecessary traffic bottlenecks. Also, there are no road shoulders along some sections of the roads. However, where road shoulders are available, they have been severely eroded. Both sidewalks (pedestrian lane) and lane markings are completely absent on all the roads. Similarly, the drainage system is so poor that water floods the road anytime it rains because some of them have collapsed, silted with sand and other debris. These debris also litter the roads when rain falls.

The rail mode by-passes the community at the Ikirun end and there is an existing train station located about 4kms away from Inisa community. Though in deplorable condition, the station receives two train services in a week: Tuesdays and Thursdays. In the past, the town enjoyed passenger rail, however, currently (at the time of survey in 2021) the station handles only cargo train, and their services are not regular. Within the Federal Government Rail Transformation Master Plan, a proposed standard rail transport traverses the town and it is expected to provide

a new fillip to transportation in the community. The proposed line had been marked but construction activities were yet to commence.

Data were collected through observational survey and questionnaire administration. Data on volumetric counts were sourced through observational survey. This involved collecting traffic data by the road side. For the purpose of this research, two locations were screened in the study area. The first location was along Ikirun-Osogbo Expressway at Wednesday Market Junction while the second location was at the Central Mosque along the road that runs across the town from Okuku town to Wednesday Market Junction called Palace Road. Trained traffic surveyors were stationed along these roads in order to record both the incoming and outgoing vehicles. The survey ran for one week (Monday to Sunday) continuously between 6am and 7pm each day. Manual counting method was used throughout the period of the survey. This required surveyors standing by the roadside, counting and classifying vehicles as they pass and the survey was divided into fixed periods. Manual counts are recorded using tally sheet method which involves recording traffic data with a tick mark on a pre-prepared field form using a stopwatch to measure the desired count interval. This method was adopted because of its low cost and simplicity. Data collected included the number of incoming and outgoing vehicles and the types (modal split) of vehicles as well as the time of the day of the movement of the vehicles.

A total of 800 households' heads were administered questionnaire in the study area, using systematic sampling method. The information obtained included demographic characteristics of the respondents, mode of travel, expenditure on transport, use of Non- Motorized Transport (NMT) and their mobility challenges among others. Data on the implications of transport externalities were also collected.

The data gathered were presented and analyzed using descriptive and inferential statistics. Tables of percentage, charts and graphs were used to depict the descriptive statistics. Analysis of Variance (ANOVA) technique was used to determine variations in vehicular traffic volume, flow situation (inbound and outbound) and modal split.

3. RESULTS AND DISCUSSION

This section looks at the volume of traffic and modal split of vehicle in Inisa town. The incoming and outgoing vehicles as well as daily and hourly traffic volumes were considered. Similarly, both daily and weekly pattern of modal split were also analysed.

3.1 Pattern of Traffic Volume and Modal Split in Inisa Town

The traffic flow at the Wednesday Market survey station along Ikirun-Inisa-Offa Road is presented in Table 1. The total traffic flow for both the incoming and outgoing vehicles for the period of survey stood at 45,356 vehicles. Incoming vehicles accounted for 49.9% of the total traffic. Traffic variations throughout the week indicated that the highest number of vehicles was recorded on Wednesday, accounting for 18.3% of the total traffic. This is not surprising because Wednesday is usually the market day in the area. In fact, the location where the survey was carried out is called Wednesday Market. This was followed by Thursday and Tuesday with traffic volumes accounting for 14.6% and 14.5%, respectively. The seemingly high traffic on Sunday, which is not a working day is not clear but may not be unconnected with religious activities along the traffic corridor.

Both the incoming and outgoing traffic vary throughout the week. For instance, the highest incoming vehicles was recorded on Wednesday with a total incoming traffic of 4,086 vehicles. Thursday and Tuesday accounted for 3,467 and 3,391 vehicles, respectively. In terms of the outgoing traffic, Wednesday again recorded the highest outgoing traffic (4,203). Sunday and Monday accounted for 3,270 and 3,227 vehicles, respectively. The average daily traffic (ADT) on the road is 6,480 vehicles.

Table 1: Daily traffic flow at Wednesday Market Survey Station

Day	Incoming	Outgoing	Total	Percentage
Monday	3349	3227	6576	14.4
Tuesday	3391	3210	6601	14.5
Wednesday	4086	4203	8289	18.3
Thursday	3467	3178	6645	14.6
Friday	2678	2840	5518	12.2
Saturday	2670	2774	5444	12.0
Sunday	3013	3270	6283	13.9
Total	22654	22702	45356	100

(Source: Fieldwork, 2021)

Attempt was made to see whether there is a significant difference in the volume of the daily traffic flow along the Wednesday Market Survey Station route. The results of the analysis of variance (ANOVA), as presented in Tables 2 and 3, indicate that there is no significant variation in traffic volume throughout the week, because the p-value of 0.996 (Table 3) is greater that the critical p< 0.05 value.

Table 2: Descriptives: Volume of Traffic (Wednesday Market Survey Station)

					95% Confidence Interval for Mean	
Weekdays	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
Monday	6	1096.0000	1273.44195	519.88050	-240.3954	2432.3954
Tuesday	6	1100.1667	1299.19859	530.39560	-263.2586	2463.5920
Wednesday	6	1382.1667	1491.87270	609.05448	-183.4577	2947.7911
Thursday	6	1107.5000	1186.19859	484.26355	-137.3391	2352.3391
Friday	6	919.6667	1041.56107	425.21553	-173.3846	2012.7180
Saturday	6	907.3333	1038.39177	423.92166	-182.3920	1997.0587
Sunday	6	1047.1667	1143.32103	466.75885	-152.6752	2247.0085
Total	42	1080.0000	1136.52225	175.36919	725.8347	1434.1653

(Source: Fieldwork, 2021)

Table 3: ANOVA for Volume of Traffic (Wednesday Market Survey Station)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	895933.333	6	149322.222	0.100	0.996
Within Groups	52063062.667	35	1487516.076		
Total	52958996.000	41			

(Source: Fieldwork, 2021)

Table 4 shows the traffic volume of both incoming and outgoing traffic along Central Mosque Survey Station route. The volume of outgoing traffic is more than the incoming traffic. For instance, the outgoing traffic represents 50.6% of the total traffic volume. There are also variations in terms of daily flow of traffic in the area. For instance, Thursday constitutes the peak day with 7,074 (16.6%) vehicles of the total traffic for the week. This is followed by Sunday and Tuesday with total traffic volumes of 7,047 and 6,747 vehicles, respectively. The high traffic on Thursday resulted from the activities of Oja Oba market day that coincided with our survey day. The market takes place every 5-day. However, the high traffic on Sunday which is not a working or market, as notice in the Wednesday Market traffic count location, may be as a result of religious and social activities because this is the day that some community organizations hold their meetings.
Similarly, the pattern of incoming and outgoing traffic differs throughout the week. For incoming traffic, Sunday constituted the peak day with 3,588 vehicles of all the total incoming traffic for the week. This is followed by Thursday and Tuesday with a total incoming traffic volume of 3,577 and 3,309 vehicles respectively. The outgoing traffic flow shows a similar pattern with incoming traffic flow. For instance., the three days of Sunday, Tuesday and Thursday also constituted the highest

traffic for the week. For example, Thursday accounted for 3,479 vehicles, Sunday 3,459 and Tuesday 3,438 vehicles. The average Daily Traffic (ADT) is 6,088 vehicles**.**

Table 4: Daily Traffic Flow at the Central Mosque Survey Station

Day	Incoming	Outgoing	Total	Percentage
Monday	2,439	2,554	4,993	11.7
Tuesday	3,309	3,438	6,747	15.8
Wednesday	2,844	2,850	5,694	13.4
Thursday	3,577	3,497	7,074	16.6
Friday	2,632	3,152	5,784	13.6
Saturday	2,659	2,619	5,278	12.4
Sunday	3,588	3,459	7,047	16.5
Total	21,048	21,569	42,617	1000

(Source: Fieldwork, 2021)

Attempt was made to see whether there is a significant difference in the volume of the daily traffic flow along the Central Mosque Survey Station route. The results of the analysis of variance (ANOVA), as presented in Tables 5 and 6, indicate that there is no significant variation in traffic volume throughout the week, because the p-value of 1.000 (Table 6) is greater that the critical p< 0.05 value.

Table 5: Descriptives: Volume of Traffic (Central Mosque Survey Station Route)

					95% Confidence Interval for Mean	
Weekdays	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**Lower Bound**	**Upper Bound**
Monday	6	832.1667	1336.20618	545.50389	-570.0957	2234.4291
Tuesday	6	1124.5000	2159.19381	881.48718	-1141.4349	3390.4349
Wednesday	6	949.0000	1754.16145	716.13341	-891.8795	2789.8795
Thursday	6	1179.0000	2296.63240	937.59625	-1231.1679	3589.1679
Friday	6	964.0000	1736.01878	708.72670	-857.8400	2785.8400
Saturday	6	879.6667	1567.69457	640.00863	-765.5279	2524.8612
Sunday	6	1174.5000	2247.86341	917.68639	-1184.4880	3533.4880
Total	42	1014.6905	1762.45104	271.95210	465.4721	1563.9089

(Source: Fieldwork, 2021)

Table 6: ANOVA for Volume of Traffic (Central Mosque Survey Station Route)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	738155.810	6	123025.968	0.034	1.000
Within Groups	126617425.167	35	3617640.719		
Total	127355580.976	41			

(Source: Fieldwork, 2021)

However, when the modal split is considered, a completely different pattern of traffic flow emerges (Table 7). The categories of vehicles surveyed included bicycles, motorcycles, cars, buses and heavy-duty vehicles (lorries, trucks and trailers). The use of cars accounted for 46.6% of the modal split. Buses constituted 20.9%, motorcycle 27.8% and trucks 4.5%. The use of tricycle and bicycle constituted less than one percent. The modal split along Ikirun-Inisa-Offa Road (Wednesday Market Survey Station route) brings to fore some important information. First, more than a quarter of those who use the road ride motorcycles (Plate 1). This is clearly unacceptable because of the design speed of this category of road and the vulnerability of this mode to road crashes. It is, therefore, suggested that their activities should be concentrated on lower order roads with reduced speed.

Table 7: Modal split of all categories of vehicles at the Wednesday Market Station

Day	Car	Buses	Motorcycle	Trailer/Trucks	Tricycles	Bicycle
Monday	3174 (48.3)	1327 (20.2)	1855 (28.2)	197 (2.9)	23 (0.4)	0 (0)
Tuesday	3254 (49.3)	1210 (18.3)	1896 (28.7)	233 (3.5)	8 (0.2)	0 (0)
Wednesday	3760 (45.4)	1860 (22.4)	2182 (26.3)	482 (5.8)	9 (0.1)	0 (0)
Thursday	2952 (44.4)	1198 (18.1)	2008 (30.2)	461 (6.9)	24 (0.36)	2 (0.04)
Friday	2623 (47.5)	1270 (23.0)	1401 (25.4)	207 (3.8)	17 (0.3)	0 (0)
Saturday	2623 (48.2)	1210 (22.2)	1394 (25.6)	208 (3.8)	9 (0.2)	0 (0)
Sunday	2739 (43.6)	1409 (22.4)	1890 (30.1)	236 (3.7)	8 (0.12)	1 (0.08)
Total	21128 (46.6)	9484 (20.9)	12626 (27.8)	2023 (4.45)	98 (0.21)	03 (0.007)

(Source: Fieldwork, 2021)

**All figures in brackets are row percentages*.

Plate 1: Typical traffic along Orisunbanre Market, Inisa
(Source: Fieldwork, 2021)

Analysis of variance (ANOVA) was carried out to assess the variation in the volume of traffic flow between the various modes along Wednesday Market Survey Station route. The results, as shown in Tables 8 and 9, indicate that there is a significant variation in the volume of flow amongst the various modes. The F-value is 184.815 while the p-value is 0.000, which is less than the critical $p<0.05$ (Table 9).

Table 8: Descriptives: Volume of Traffic (Wednesday Market Survey Station)

Vehicle Types	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Car	7	3017.8571	413.28821	156.20826	2635.6293	3400.0850
Bus	7	1354.8571	235.46014	88.99557	1137.0928	1572.6214
Motorcycle	7	1803.7143	298.18043	112.70161	1527.9434	2079.4852
Trailer/Trucks	7	289.1429	125.51684	47.44090	173.0591	405.2266
Tricycle	7	14.0000	7.21110	2.72554	7.3308	20.6692
Bicycles	7	0.4286	0.78680	0.29738	-0.2991	1.1562
Total	**42**	**1080.0000**	**1136.52225**	**175.36919**	**725.8347**	**1434.1653**

(Source: Fieldwork, 2021)

Table 9: ANOVA for Volume of Traffic (Wednesday Market Survey Station)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	50973192.286	5	10194638.457	184.815	0.000
Within Groups	1985803.714	36	55161.214		
Total	52958996.000	41			

(Source: Fieldwork, 2021)

Table 10 shows the modal split along Palace Road (Central Mosque Survey Station**).** This traffic cuts across the heart of Inisa town. It runs from Wednesday Market through Central Mosque to Okuku Town. More than three quarters of the modal split is motorcycle. The use of car accounted for 19.0% and buses, 2.5%. This, also, portends grave danger for road users in the town because of the number of people that rely on motorcycles to achieve their day-to-day activities. It is, therefore, imperative to strictly regulate the activities of motorcycle operation in the town as well as providing parking facilities for the motorcyclists because currently they park indiscriminately along the road or at junctions.

Table 10: Modal Split of all Categories of Vehicles at the (Central Mosque Survey Station)

Day	Car	Buses	Motorcycle	Trailer/Trucks	Tricycles	Bicycle
Monday	1407 (28.2)	171 (3.4)	3327 (66.7)	62 (1.26)	24 (0.5)	2 (0.04)
Tuesday	1075 (15.9)	160 (2.4)	5451 (80.8)	54 (0.8)	7 (0.1)	0 (0)
Wednesday	1042 (18.3)	147 (2.6)	4436 (77.9)	59 (1.03)	8 (0.14)	2 (0.03)
Thursday	1168 (16.5)	93 (1.3)	5774 (81.6)	29 (0.40)	7 (0.09)	3 (0.04)
Friday	1182 (20.4)	161 (2.9)	4384 (75.78)	44 (0.70)	12 (0.20)	1 {0.02)
Saturday	1001 (18.9)	233 (4.47)	3984 (75.48)	51 (0.96)	8 (0.15)	1 (0.02)
Sunday	1245 (17.7)	102 (1.5)	5655 (80.2)	41 (0.55)	4 (0.05)	0 (0)
Total	8120 (19.0)	1067 (2.5)	33022 (77.5)	340 (0.8)	70 (0.18)	09 (0.02)

(Source: Fieldwork, 2021)

**All figures in bracket are row percentages.*

Analysis of variance (ANOVA) was carried out to assess the variation in the volume of traffic flow between the various modes along Central Mosque Survey Station route. The results, as shown in Tables 11 and 12, indicate that there is a significant variation in the volume of flow amongst the

various modes. The F-value is 165.018 while the p-value is 0.000, which is less than the critical p<0.05 (Table 12).

Table 11: Descriptives: Volume of Traffic (Central Mosque Survey Station)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Car	7	1160.0000	138.57128	52.37502	1031.8429	1288.1571
Bus	7	152.4286	46.67568	17.64175	109.2608	195.5964
Motorcycle	7	4715.8571	930.50872	351.69924	3855.2801	5576.4342
Trailer/Trucks	7	48.5714	11.44344	4.32521	37.9880	59.1548
Tricycle	7	10.0000	6.60808	2.49762	3.8885	16.1115
Bicycles	7	1.2857	1.11270	0.42056	0.2566	2.3148
Total	42	1014.6905	1762.45104	271.95210	465.4721	1563.9089

(Source: Fieldwork, 2021)

Table 12: ANOVA for Volume of Traffic (the Central Mosque Survey Station)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	122031163.262	5	24406232.652	165.018	0.000
Within Groups	5324417.714	36	147900.492		
Total	127355580.976	41			

(Source: Fieldwork, 2021)

The characteristics of the summary hourly traffic flow during average day of the week were examined. The typical traffic flow along Ikirun-Inisa-Offa Road (Wednesday Market Survey Station) indicates that the pattern of traffic in the town follows the normal conventional traffic of early morning and late evening peak periods (Figure 1). The morning peak period (between 7am and 9am) is associated with journey from home to work and other means of livelihoods. While the evening peak (4-6pm) marks the return of people from their places of work back home. The daily pattern of traffic indicates an early rise of traffic that peak around 9am but came down by 10am. It rises gently again before coming down between 1-2pm and later peak by 5-6pm. This pattern is expected because many people rise early in the morning and travel to their places of work outside Inisa town and later come back home. This pattern may be attributed to Osogbo as the major pull factor owing to its strategic position as the primate city in Osun state. Hence, the proposed development planning for Inisa can address this pattern, if livelihood options are provided in the city to curb the daily urban journey to work This explains, to some extent, the morning and evening peaks.

The typical traffic flow along Palace Road (Central Mosque Survey Station) shows similar pattern of morning and evening peaks as shown in Figure 2. However, the peaks are not as pronounced as what is obtainable along Ikirun-Inisa-Offa Road. The traffic rises gently in the morning and peaked around 9am. It dropped gently from 10am and began to rise again by 2pm and reached its peak by 3-4pm, earlier than what took place along Ikirun-Inisa-Offa Road. The early evening peak may not be unconnected with school children closing time which starts from 2pm. Also, most state and local government workers close from work around 3.30 pm.

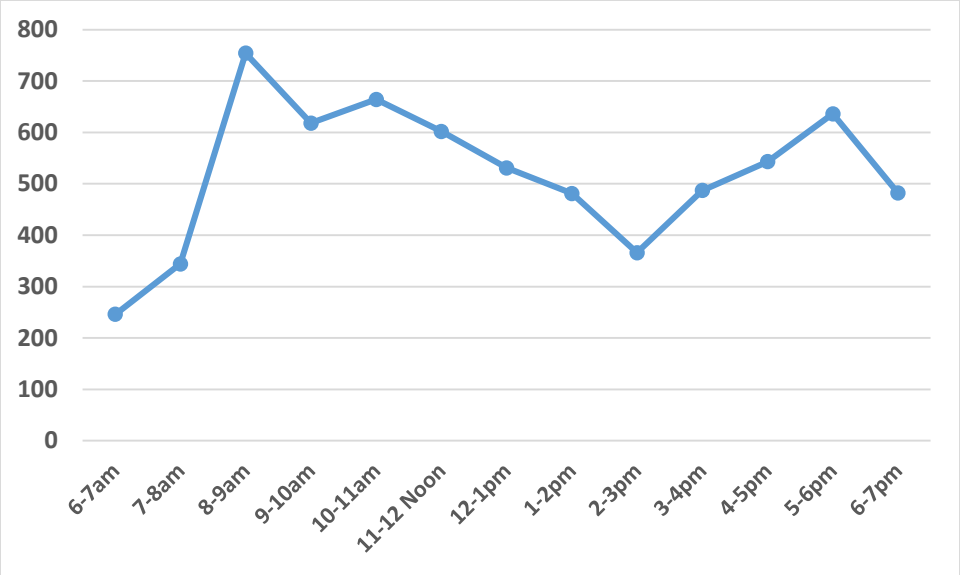

Figure 1: A typical daily traffic flow along Ikirun-Inisa-Offa Road
(Source: Fieldwork, 2021)

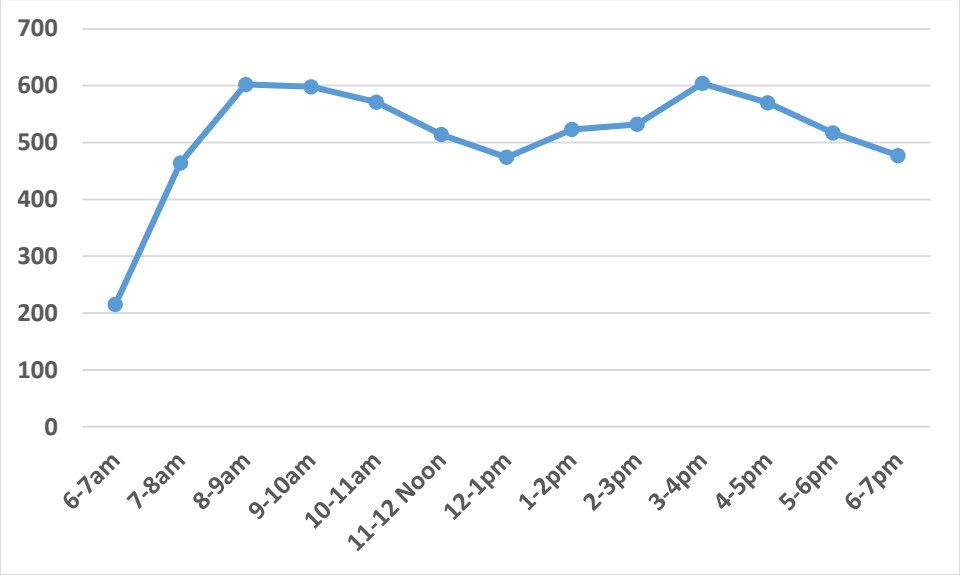

Figure 2: A typical daily traffic flow along Palace Road
(Source: Fieldwork, 2021)

Figure 3 gives the average traffic flow between the two roads corridors on which volumetric survey was conducted. A test of similarity or dissimilarity between the two roads corridors was conducted using paired sample t-test. The mean, standard deviation and standard errors between the two corridors are as shown in Table 13. The computed t-value (Table 14) was 0.271 with p-value of 0.788 ($p>0.5$), indicating that there is no significant difference between the traffic flow characteristics between the two roads corridors.

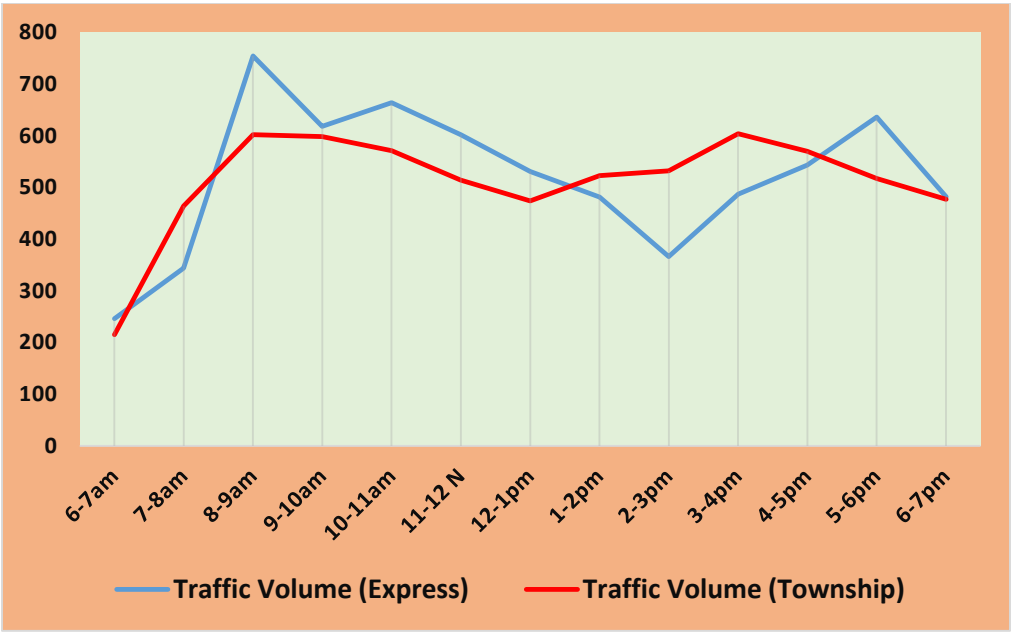

Figure 3: A typical daily traffic flow along Ikirun-Inisa-Offa Road (Expressway) and along Palace Road (Township)
(Source: Fieldwork, 2021)

Table 13: Paired Samples Statistics (Express and Township): Descriptives.

	Location of Survey	Mean	N	Std. Deviation	Std. Error
Pair 1	Volume of Traffic (Expressway)	1,080.0000	42	1136.52225	175.36919
	Volume of Traffic (Township)	1,014.6905	42	1762.45104	271.95210

(Source: Fieldwork, 2021)

Table 14: Paired Samples t-Test Result.

	Location of Survey	t	df	Sig. (2-tailed)
Pair 1	Volume of Traffic (Expressway) Volume of Traffic (Township)	0.271	41	0.788

(Source: Fieldwork, 2021)

Furthermore, the total volume of vehicles in the study area was also investigated (Table 15). About 87,982 vehicles moved within Inisa town in a week. A week-long distribution indicated that Wednesday had the highest number of traffic totaling 13,983, which also accounted for 15.9% of the total traffic for the week. This is closely followed by Thursday and Tuesday with traffic volumes of 13,719 and 13,348, respectively. The lowest volume of traffic was recorded on Saturday (10,722). The unusual high traffic on Sunday is not clear, because it negates the conventional trend of weekly traffic. However, it may not be unconnected with religious and cultural activities in the area.

The modal split of traffic (Table 16) indicated that motorcycle mode accounted for more than half of the total traffic in the town. This is distantly followed by the use of cars (33.25%), buses (12.0) and trucks/trailers (2.68%). In spite of the health, economic and environmental benefits of bicycles, this mode of transport accounted for just 0.01%. The low usage of bicycles may be as a result of lack of infrastructure, cultural practices and perception of people with respect to those who use vehicles. The Average Daily Traffic (ADT) is 12,569.

Table 15: Total Traffic Volume in Inisa Town

Day	Total	Percentage
Monday	11,569	13.1
Tuesday	13,348	15.2
Wednesday	13,983	15.9
Thursday	13,719	15.6
Friday	11,302	12.8
Saturday	10,722	12.2
Sunday	13,330	15.2
Total	**87,982**	**100.0**

(Source: Fieldwork, 2021)

Table 16: Modal Split in Inisa Town

Total Modal Split	Percentage
Car	33.25
Bus	12.00
Motorcycle	51.87
Truck/Trailer	2.68
Tricycle	0.19
Bicycle	0.01
Total	**100.00**

(Source: Fieldwork, 2021)

Furthermore, the use of public transportation was common among the people of Inisa (Table 17). More than 80% of them make use of commercial motorcycle for their daily activities. Similarly, about one fifth of the residents at one time or the other make use of tricycle, 22.4% use Van, 45.0% bus and more than half of the population use car (cab) as commercial transport. Again, motorcycles still remained the most preferred mode of public transportation.

In terms of vehicle ownership (Table 17), 46.6% of the respondents had motorcycles, 6.9% possessed tricycles and those who had pick-up vans accounted 9.5%. Residents who had buses constituted 26.4% while those who owned cars accounted for 33.5%. Also, only 17.9% had personal vehicle.

Table 17: Public Mode of Transportation and Vehicle Ownership

Public Mode of Transportation	Yes	No	Total
Motorcycle	650 (81.3%)	150 (18.7%)	800 (100)
Tricycle	164 (20.5%)	636 (79.5%)	800 (100)
Pick Up Van	179 (22.4%)	621 (77.6%)	800 (100)
Bus	360 (45.0%)	440 (55.0%)	800 (100)
Car/Cab	429 (53.6%)	371 (46.4%)	800 (100)
Vehicle Ownership	**Yes**	**No**	**Total**
Motorcycle	373 (46.6%)	427 (53.4%)	800 (100%)
Tricycle	55 (6.9%)	745 (93.1)	800 (100%)
Pick Up Van	76 (9.5%)	724 (90.5%)	800 (100%)
Bus	211 (26.4%)	589 (73.6%)	800 (100%)
Car	268 (33.5%)	532 (66.5%)	800 (100%)
No Vehicle Owned	143 (17.9%)	657 (82.1%)	800 (100%)

(Source: Fieldwork, 2021)

The condition of traffic in the town was also examined as indicated in Figure 4. Majority of the respondents indicated that the traffic in the town was light (81.6%). Only 6.5% and 2.8% of the respondents considered the traffic heavy and very heavy, respectively. However, heavy traffic is expected in the nearest future given the location of the town as a transport hub and its enabling environment for socio-economic development.

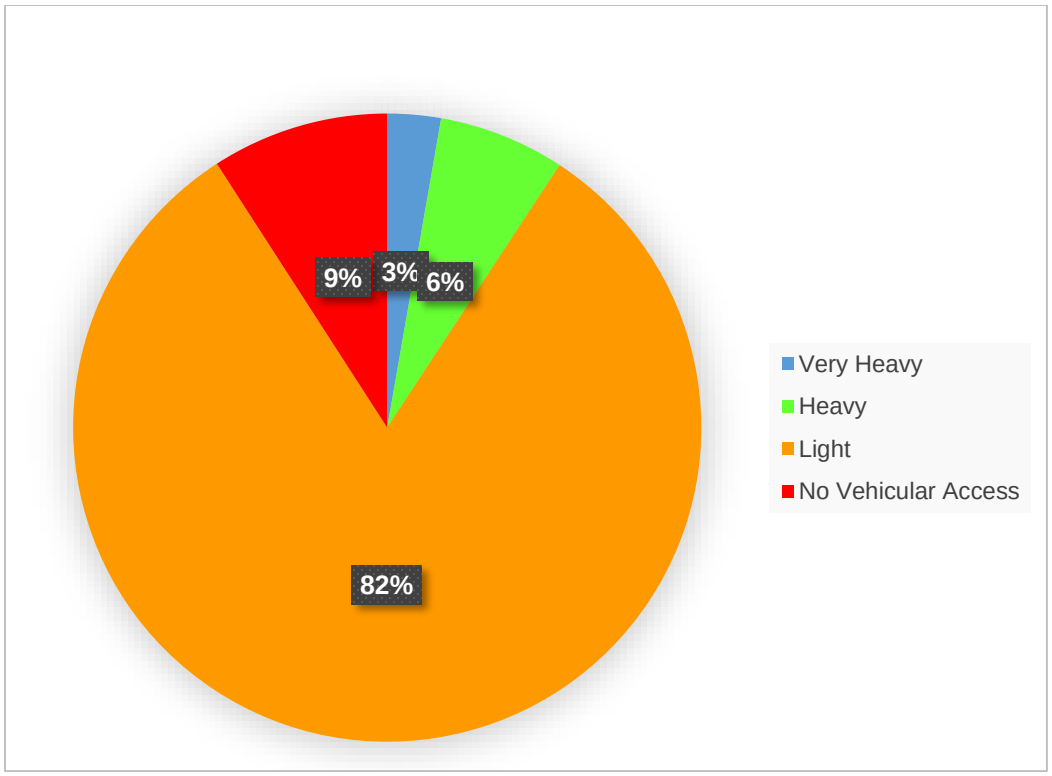

Figure 4: Condition of Traffic Flow in the Study Area.
(Source: Fieldwork, 2021)

In view of the global campaign of *Mobility for All*, the level of access of the physically challenged to transport facilities was also investigated. This is depicted in Table 18. Only 16.4% of the respondents noted the existence of physically challenged facilities in the study area. From this figure, 54.1% claimed the existence of ramps will help to provide access for the physically challenged. Over half of the respondents supported availability of vehicles with low floor, 48.8% were of the opinion that tricycles and motorcycles should be specifically designed for them and those who suggested wheel chairs accounted for 42.7%.

Table 18: Transport Facilities for the Physically Challenged

Transport Facilities for the Physically Challenged	Yes	No	Total
Any Transport Facilities for the Physically Challenged	**131 (16.4%)**	669 (83.6%)	800 (100%)
With Ramps	**71 (54.1%)**	60 (45.9%)	131(100%)
Vehicles with Low Ground Clearance	**66 (50.3%)**	65 (49.7%)	131 (100%)
M/C or Tricycle designed for them	**64 (48.9%)**	67 (51.1%)	131 (100%)
Wheel Chairs for them	**56 (42.7%)**	75 (57.3%)	131 (100%)

(Source: Fieldwork, 2021)

Table 19 indicated that only 11.9% of the respondents used bicycles as a mode of transportation. This is extremely insignificant compared to the benefits of bicycle usage. However, about one-third of the residents supported the provision of bicycle lanes in the town.

Table 19: Bicycle Usage in the Town

Bicycle Usage in the Town	Yes	No	Total
Bicycle Use	**95 (11.9%)**	705 (88.1%)	800 (100%)
Support Provision of Bicycle lanes	**255 (31.9%)**	545 (68.1%)	800 (100%)

(Source: Fieldwork, 2021)

4.0 Implications for Transportation Planning and Management

The possible implications of the traffic volume for traffic planning and management in Inisa town could be categorized into four namely safety, air pollution, noise and vibration.

4.1 Traffic Safety

The high volume of traffic in the town, averaging over 12,569 vehicles on daily basis, may compromise the safety of the residents of the community. Road accidents may occur occasionally when members of the community need to cross the road. This is compounded because there are no designated crossing facilities for pedestrians in the community. In addition, the roads which are single carriageways have neither road shoulders nor sidewalks for use of pedestrians. This portends a grave danger for the pedestrians (PIARC, 2016). The safety problem is further worsened by the substantial percentage share of motorcycles in the modal-split. It is common knowledge that motorcycle operators engage in reckless driving behaviour which frequently results in road crashes particularly in Nigeria (Ipingbemi, 2008). Poor traffic education, inadequate training, inordinate desire for high profit margin among others have been identified as the main causes of road crashes among commercial motorcyclists (Arosanyin, 2010; Abayomi, 2019).
It is therefore imperative to introduce traffic calming measures on the roads in order to slow moving traffic. Traffic calming measures such as speed humps, mini roundabout, road diet among others are inevitable. Similarly, there is need for extensive drivers' education particularly for motorcycle operators who constitute substantial percentage of the operators. Also**,** guardrails should be constructed around Wednesday Market to prevent pedestrians from having direct contact with vehicles. All these measures are proven strategies for road crash prevention (Mohan et al , 2020).

4.2 Vehicular Air Pollution (VAP)

Transport contributes about 25% of all carbon dioxide worldwide and is responsible for up to 90% of atmospheric lead in cities where leaded gasoline is still in use (Lefevre *et al* 2020; GTZ, 2005). Road transport related pollution such as carbon monoxide (CO), nitrogen oxide ($NO_{2)}$, Carbon dioxide ($CO_{2)}$, Hydrocarbons and Lead (Pb) as well as particulate matters (PM) are very harmful to man and the environment (Ghorani-Azam, Riahi-Zanjani, and Balali-Mood, 2016). High lead (Pb) concentration in human system can lead to low IQ and decreased concentration. The high level of traffic presupposes that the air pollution will be high and likely to increase in the future as more development activities take place in the town**.** It is, therefore, imperative to invest in transport modes that are environmentally friendly such as pedestrianization, bicycle use and high-capacity buses. Construction of pedestrian walkways and crossing facilities, creation of awareness on and removal of cultural inhibition to the use of bicycle as well as replacing paratransit with the introduction of high-capacity vehicles are sustainable measures for reducing vehicular air pollution.

4.3 Noise Pollution from Vehicles.

Noise is also a form of pollution which is measured in decibel. The proximity of the community to Ikirun-Inisa-Offa expressway road implies that noise pollution from moving vehicles would be high. This will come mostly from cars and motorcycles that account for almost 80% of the Average Daily Traffic. In particular, motorcycle operations, which account for over 60% of the township mode of transport, is a major source of noise pollution in the town. Depending on its duration and volume, the effects of noise on human health can be categorized into four areas namely physical effects (hearing defects); physiological effects (increased blood pressure, irregularity of heart rhythms and ulcers); psychological effects (disorders, sleeplessness and going to sleep late) and irritability and stress (effects on work performance, such as reduction of productivity and misunderstanding what is heard), (Quis, 2001; Tijunelis et al., 2005). The noise from these vehicles constitutes physical, emotional, educational and psychological nuisance to the residents of the town (Pronello and Cammuso, 2012). However, the effects of noise pollution could be reduced by constructing by-pass roads for large trucks as well as building quiet and sound–absorbing road surface. Other measures include speed and truck restrictions, adherence to minimum setbacks and construction of buffers e.g., vegetation.

4.4 Vibration from Motorized Traffic

Vibration from heavy vehicles such as lorries, trailers and trucks can have negative effects on technical condition of residential buildings and engineering structures, as well as the comfort of life of the residents (Hunaidi, 2000; Xia, Wei, and Cao, 2005). Vibration will be aggravated with increased motorization. This should not be a big problem because of the small proportion of this category of vehicles in the total traffic volume.

5. Conclusion

Road transport remains the most patronized mode of transport and the backbone of Nigerian economy. With respect to the study area, the quantity of road infrastructure is insufficient while the road condition is very deplorable. Increased motorization coupled with absence of safety features on the road pose serious threat to the town in the future. As motorized transport increases, particularly commercial motorcycles, stringent road transport policies coupled with provision of safe transport facilities are advocated. Increased mobility will further exacerbate carbon emission resulting in increase in vehicular air pollution. Legislation on pollution as well as provision of pedestrians and cycling infrastructure to reduce motorized transport are recommended. Similarly, noise pollution from vehicles will increase as motorized traffic escalates. It is, therefore, imperative that noise abatement measures are implemented in neighborhoods. Furthermore, there is need for more traffic education to reduce poor driving behavior that accentuates noise pollution. In the same vein, road vibration could be attenuated through provision of buffers along the roads. If all these measures are religiously implemented the envisaged increased mobility will enhance the socio-economic development of the town and providing goal of sustainable and livable city.

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