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Full Length Research Paper

Study of the Traffic Volume for the Selected Roads in Sokoto, Kebbi and Zamfara States

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ABSTRACT: The ability to estimate traffic volume is a crucial first step in the development, analysis, and operation of transportation networks. A substantial effort has been undertaken to investigate the traffic volume of chosen routes in the states of Sokoto, Kebbi, and Zamfara. In order to gain a better grasp of the current state of traffic flow around market places. Traffic flow, which is closely related to traffic characteristics, is essential for the safe and efficient movement of people and products. In traffic flow, we must consider three factors: volume, speed, and capacity. While traffic volume can be defined as the number of cars passing through a specific stretch of road or traffic lane in a given amount of time, this definition falls short when the traffic consists of a diverse range of vehicles with radically different static and dynamic characteristics. Traffic volume studies are required because they help with planning, traffic management, and forecasting the need for future road widening. The biggest problem occurs during the busiest times of the day, when traffic on the road is at its peak. The traffic volume was calculated using an indirect human counting method. The difficulty of estimating the volume of such traffic has been solved by converting various types of vehicles into equivalent passenger cars and quantifying the volume in Passenger Car Units (PCU) per hour. Some remedial actions to improve traffic safety in the region have been suggested, such as expanding the route, hiring traffic control personnel, and relocating other market places.

Keywords: Traffic volume, passenger carrying unit (PCU), Congestion, market, average hourly traffic flow (AHTF)

INTRODUCTION

The purpose of traffic volume measurement is to determine the number of cars traveling through a certain place. Volume is simply the number of vehicles moving through a section of road. It is determined by the number of vehicles traveling across a piece of road at regular intervals. Heterogeneous traffic is addressed by converting various types of vehicles into passenger car equivalents, with the volume indicated in passenger car unit (PCU) per hour (Raj et al., 2018). The flow is affected by volume, speed, and density, according to Sireesha and Durga (2021). Traffic volume studies are necessary because they aid in planning, traffic management, and predicting whether road widening is necessary. The number of cars travelling through a specific stretch of road or traffic lane in a given amount of time is referred to as traffic volume. Traffic volume studies are carried out to determine the number, movement, and categorization of highway vehicles at a certain location in order to be aware of the peak hours of the day when traffic volume is at its highest (Prachi and Somkuwar, 2020). According to the United Nations Centre for Human Settlements (UNCHS, 1998), in developing nations, travel speeds are dropping and the travel environment for walkers and people-powered vehicles is degrading. For example, five of the

sixteen developing cities with populations of more than 4 million that were recorded in the UNCHS global urban indicators database in 1998, namely Bucharest, Jakarta, Kinshasa, Lagos, and Manila, have average one-way commute durations of one and a quarter hour or more. According to Odeleye (2008), urban transportation is tightly linked to residential, job, and service location. It connects people's homes to places of work and services including schools, hospitals, markets, stores, and even places of worship like mosques and churches. In reality, transportation is merely a means to an aim. In this case, the goals are access and communication. Congestion is expected to occur when flow rates approach their maximum, causing drivers to face substantial delays (Flaherty, 1986). According to the highway capacity manual, a facility's capacity is defined as the greatest hourly rate at which people or vehicles can reasonably be expected to cross a point or uniform part of a lane or roadway during a given time under current roadway, traffic, and control circumstances (HCM). Birva and Raval (2016) found out that estimation of traffic volume is fundamental to planning, design and operation of the roads. It helps in improving new and existing transportation facilities for safe and time efficient movement of vehicle on roads. On rural roadways, Hall and Pendletan (1990) looked at the relationship between hourly crash rates and the ratio of traffic volume to capacity. They discovered that as traffic volume grows, the speed of traffic crashes on roadway sections increases. However, the evidence required to support this association was extremely dispersed. The hypothesis of a link between traffic crash rates and traffic volume, according to the authors, is legitimate, but the exact nature of the link is uncertain.

Markets play a critical part in people's economic lives, and they are necessary in the distribution of commodities, according to Osoja (2019). However, the rapid rise of metropolitan centers has resulted in management issues, according to Osoja (2019). The invasion of open areas, as well as environmental and health challenges such as solid waste management, water supply, housing, traffic congestion, and water pollution, are the most pressing of these difficulties.

According to Abdurrahman and Nasiru (2022), traffic congestion is caused in part by traders who sell their wares along the roadside for the advantage of road users on the lookout for items placed along the road and motorists who park indiscriminately while buying items from the traders. Congestion has a variety of effects, some of which are indirect while others are direct, such as the impact on motorists' sense of well-being, be it time spent stuck in traffic or changes in driver behavior, which may include rude gestures, verbal insults, intentionally driving in an unsafe or threatening manner, or making threats. This can lead to arguments, attacks, and crashes, all of which can result in injuries and even death.

The notion of passenger car equivalents (PCE) was developed in the Highway Capacity Manual 1965 to account for the effects of trucks and buses, according to Kiran and Ashish (2016). In HCM 1965, PCE was defined as "the number of passenger automobiles displaced in the traffic flow by a truck or a bus, under the prevailing roadway and traffic conditions." This concept is expanded in HCM 2000 to include the effects of heavy vehicles in general. Several approaches based on various equivalence criteria have been presented to estimate these PCE values.

According to Lucy (2013) Nigerian roads have been classified as Trunk Road A, Trunk Road B and Trunk Road C respectively. Trunk Road A forms the skeleton of the national road grid. It cuts across regional boundaries in the country. This class of road is constructed, maintained and financed by the federal government through the Federal Ministry of Works and Housing. While Trunk Road B, is the second categories of main road in Nigeria. It links the major cities within states. These roads are financed by the State Governments. They are tarred roads. Also the Trunk Road C is local feeder road constructed and maintained by the Works Department of Local Government Authorities in Nigeria. This class of road is usually untarred and seasonal in nature.

Therefore, this article examined the traffic volume of some selected roads in Sokoto, Kebbi and Zamfara States. Also the following objectives were employed to meet the aim.

1 To determine the vehicle composition in traffic stream
2 To determine traffic volume passing in and out of the roads
3 To determine the nature of the traffic flow
4 To determine the number of drivers distracted on the roads

METHODOLOGY

The following methods were adopted in meeting the objectives, namely: reconnaissance survey, indirect manual volume count and photograph.

Reconnaissance survey

According to the survey, all states' roadways are made up of Trunk Road A, Trunk Road B, and Trunk Road C. In all of the states, Trunk Road A was chosen because it fitted the requirements of this study project, as it is where market activities take place. Illela market along Konni road is one of the designated locations in Sokoto State. The designated sites in Sokoto central market, Kebbi State, are Dodori market along Tambuwal road and Jega market along Yawuri road. The designated places in Zamfara State are Kaura Namoda market on Gusau Road and Tsafe market on Zaria Road.

Table 1: Traffic classification count, at Sokoto Central Market on Wednesday.

Time	Passenger Cars				Light/Heavy Vehicles	Heavy Vehicles	Nature of Flow	Observed Number of Driver Distracted
	Bicycle	Tricycle	Car	Motorcycle				
9:00-9:30	–	02	11	47	17	–	Free flow	–
9:30-10:00		04	15	51	26	01	”	03
10:0010:30		01	13	49	33	–	”	11
10:30-11:00		05	18	63		03	”	08
11:00-11:30	02	02	22	39	19	02	”	
11:30-12:00	09	08	33	44	18	04	Congestion	12
12:00-12:30	08	03	45	75	27	03	”	18
12:30-1:00	06	06	21	36	14	–	Free flow	13
1:00-1:30	–	09	18	28	11	03	”	09
1:30-2:00	03	05	16	43	09	04	”	05
2:00-2:30	07	11	11	38	16	04	”	02
2:30-3:00	06	04	13	41	25	03	”	04
3:00-3:30	13	08	08	38	28	05	”	03
3:30-4:00	08	06	13	56	32	–	”	09
4:00-4:30	01	03	17	63	27	06	”	10
4:30-5:00	06	01	19	46	31	03	”	11
5:00-5:30	05	09	23	37	21	–	Cons/ff	08
5:30-6:00	04	06	22	49	18	02	”	06

Table 2: Traffic classification Count at Illela, Konni Road on Sunday.

Time	Passenger Cars				Light/Heavy Vehicles	Heavy Vehicles	Nature of Flow	Observed Number of Driver Distracted
	Bicycle	Tricycle	Car	Motorcycle				
7:00-7:30	03	–	03	25	–	–	Free flow	–
7:30-8:00		–	11	32	–	02	”	–
8:00-8:30	08	–	22	123	05	–	”	–
8:30-9:00	06	–	15	79	12	05	”	–
9:00-9:30	–	03	18	83	15	03	”	–
9:30-10:00	03	–	16	102	18	07	”	–
10:00-10:30	06	06	29	93	25	05	”	06
10:30-11:00	04	04	24	106	33	09	Ff/Conges	08
11:00-11:30	08	03	20	87	26	06	Ff	05
11:30-12:00	10	07	26	96	31	03	”	03
12:00-12:30		08	21	127	43	05	Free/Cong	10
12:30-1:00		11	36	89	18	01	Ff	03
1:00-1:30	11	09	39	95	15	–	”	
1:30-2:00	13	06	28	79	23	03	”	07
2:00-2:30	06	03	47	83	27	08	”	09
2:30-3:00	03	10	42	91	32		”	11
3:00-3:30		07	49	113	28	08	”	07
3:30-4:00		05	53	137	36	06	Ff/Conges	13
4:00-4:30	03	01	56	104	39	04	”	08
4:30-5:00	04	11	67	133	44	03	”	
5:00-5:30	03	09	43	147	26	02	”	13
5:30-6:00	08	04	21	163	17	03	Ff	11

Indirect manual counting

The indirect manual counting method necessitates the collection of traffic volume data on tally sheets by a team. This method is used to collect data such as the classification of passing cars, the nature of flow, the character of traffic, vehicle movements, and the number of drivers distracted by commercial activities. Manual hours are involved in talking complete counts using statically sampling approaches.

It is critical to monitor traffic volume fluctuations during the day and daily variations. Then, at the busiest times of the day, peak hours are chosen; this is a typical brief count period.

Photograph

Pictures were taken in all the affected roads for further clarification and understanding of the nature of roads and traffic flow due to the roadside activities.

RESULTS AND DISCUSSION

All traffic classifications, such as bicycles, tricycles, motorcycles, cars, light, medium, and heavy, were observed to flow on all of the roads studied, as shown in (Tables 1, 2, 3, 4, 5, and 6). The flow is claimed to be

Table 3: Traffic Classification Count at Dodori, Jega Road on Monday.

Time	Passenger Cars				Light/Heavy Vehicles	Heavy Vehicles	Nature of Flow	Observed Number of Driver Distracted
	Bicycle	Tricycle	Car	Motorcycle				
8:00-8:300	09	–	15	86	15	06	Free flow	–
8:30-9:00	06	–	26	97	18		”	–
9:00-9:30		06	28	63	21	07	”	10
9:30-10:00		08	34	59	23	10	”	08
10:00-10:30	07	05	15	36	24	09	”	
10:30-11:00		10	31	79	18		”	06
11:00-11:30	03		27	83	15	08	”	11
11:30-12:00		12	22	67	21	06	”	09
12:00-12:30		05	33	33	24	07	Cong/ff	06
12:30-1:00	08	08	28	29	21	11	”	03
1:00-1:30	04	09	23	18	18	09	”	10
1:30-2:00	07	11	18	16	16	10	Cong/ff	07
2:00-2:30	03	03	27	27	13	07	Ff	
2:30-3:00	06		34	28	27	09	”	13
3:00-3:30	07	04	52	23	31	10	”	
3:30-4:00		06	55	17	33	13	”	
4:00-4:30	05	01	43	81	37	16	Cong/ff	06
4:30-5:00	06	09	34	19	48	20	Ff	21
5:00-5:30	09	02	41	27	43		Ff	03
5:30-6:00	16	05	28	48	36	22	Cons/ff	05

Table 4: Traffic Classification Count at Jega, Yawuri Road on Monday.

Time	Passenger Cars				Light/Heavy Vehicles	Heavy Vehicles	Nature of Flow	Observed Number of Driver Distracted
	Bicycle	Tricycle	Car	Motorcycle				
9:00-9:30	–	–	21	73	10	03	Free flow	–
9:30-10:00	06	02	33	68	12	02	”	–
10:00-10:30	08	05	47	82	14	05	”	–
10:30-11:00	04	07	44	94	09	08	”	–
11:00-11:30		08	28	102	07	06	”	–
11:30-12:00	10	10	25	96	11	09	”	06
12:00-12:30	05	13	38	116	13	07	”	10
12:30-1:00	04	09	23	123	10	05	”	08
1:00-1:30	12	11	42	89	09	09	”	12
1:30-2:00	07	06	26	73	13	10	”	09
2:00-2:30	09	04	24	66	08	08	”	06
2:30-3:00	06	03	21	93	15	11	”	03
3:00-3:30	10	07	32	103	17	13	”	08
3:30-4:00	14	10	37	119	20	09	”	11
4:00-4:30	12	13	41	123	25	12	Cong/ff	13
4:30-5:00	08	15	45	109	29	10	”	12
5:00-5:30	06	08	49	123	31	14	”	12
5:30-6:00	11	05	38	138	26	11	”	08

Table 5: Traffic classification count at kaura Namoda, Gusau Road on Monday.

Time	Passenger Cars				Light/Heavy Vehicles	Heavy Vehicles	Nature of Flow	Observed Number of Driver Distracted
	Bicycle	Tricycle	Car	Motorcycle				
10:00-10:30	13	8	34	75	28	07	Cong/free flow	25
10:30-11:00	8	9	60	87	37	06	”	
11:00-11:30	11	6	20	84	23	8	”	
11:30-12:00		8	18	108	32	9	”	
12:00-12:30		11	32	54	9	8	”	03
12:30-1:00	17	7	36	112	11	6	”	01
1:00-1:30	9	10	46	25	13		”	02
1:30-2:00	14	6	30	50	14	9	”	
2:00-2:30	11	13	26	86	30	04	”	04
2:30-3:00	8	11	22	36	34	8	”	
3:00-3:30	6	7	34	23	39		”	
3:30-4:00	16	12	56	66	24	6	”	09
4:00-4:30	21	9	28	57	13	8	”	07
4:30-5:00	08	10	37	78	18	6	”	15
5:00-5:30	03	11	41	56	26	5	”	18
5:30-6:00	13	14	66	72	15	3	”	11

Table 6: Traffic classification count at Tsafe, Zaria road on Sunday

Time	Passenger Cars				Light/Heavy Vehicles	Heavy Vehicle	Nature of Flow	Observed Number of Driver Distracted
	Bicycle	Tricycle	Car	Motorcycle				
7:00-7:30	–	2	9	56	5	1	Free flow	–
7:30-8:00	–	4	11	43	7	2	”	–
8:00-8:30	–	3	20	129	4	3	”	2
8:30-9:00	–	5	18	133	2	1	”	
9:00-9:30	–	3	29	127		–	”	5
9:30-10:00	4	2	33	31	4	2	Congestion	10
10:00-10:30	–	–	45	68	5	1	Free flow	13
10:30-11:00	5	3	41	93	2	3	”	11
11:00-11:30	3	1	26	70	3	–	”	4
11:30-12:00	6	5	28	72	–	2	”	–
12:00-12:30		8	56	84	12	5	Congestion	17
12:30-1:00	16	10	43	96	8	3	Congestion	11
1:00-1:30	12	6	59	90	6	1	Free flow	17
1:30-2:00		4	73	98	9	4	Congestion	09
2:00-2:30	32	–	61	193	10	2	”	19
2:30-3:00	6	3	52	675	12	3	Congestion	14
3:00-3:30	–	6	32	719	–	1	Free flow	12
3:30-4:00	5	8	36	93	4	–	”	11
4:00-4:30	3	7	25	86	3	2	”	6
4:30-5:00	5	9	17	793	6	–	”	2

Table 7: Total traffic and average hourly traffic flow.

Name	Total Traffic in PCU		AHTF	
	Medium	Heavy	Medium	Heavy
Sokoto/C Market	744	129	83	14
Illela Market	1026	249	93	23
Dodori Market	974	540	97	54
Jega Market	558	456	62	51
K/ Namoda Market	712	279	89	35
Tsafe Market	716	366	90	46

congested during peak hours and free during non-peak hours, which is consistent with Flaherty's (1986) suggestion that when flow rates near their maximum, congestion is likely to occur. This resulted in a reduction in speed and an increase in trip time. As shown in (Tables 1,2,3,4,5, and 6) correspondingly, business activities on and along the roads, such as loading and unloading of goods and services, displacement of goods along the road shoulders, and even the roadways themselves, have a substantial number of drivers distracted. According to Abdurrahman and Nasiru (2022), dealers who advertise their things along the roadside for the advantage of road users looking for items displaced along the roads contribute to traffic congestion.

Average Hourly Traffic Flow (AHTF)

$$AHTF = \frac{\text{Total number of vehicle}}{\text{Total hours}}$$

The total volume of medium and heavy traffic has increased in recent years (Table 7). Because only the values of medium and heavy vehicles were illustrated in civil engineering work, a critical condition/value was addressed in design. The average hourly traffic flow at none of the locations has reached or above 100%, indicating that the roads are in good condition. The only issue that has caused traffic congestion on the roads is the existence of markets along such routes.

For example, the Tsafe market has reached capacity and must be relocated; in the Kaura Namoda market, the road must be dialyzed to reduce traffic congestion. However, traffic control devices/personnel must be placed on other roads to address traffic congestion issues. Traffic volume studies are undertaken, according to Prachi and Somkuwar (2020), to identify the count movement and classification of highway vehicles at a certain area in order to be aware of the peak hours of the day when traffic volume is at its highest. It also agrees with Sireesha and Durga (2021), who argue that traffic volume studies are important since they aid traffic management planning and predict whether road widening is required.

As illustrated in, there are issues with loading and uploading, as well as on-street parking (Plate 1).

Because the market is full, as depicted in (Plate 2), there is congestion. As a result, some dealers are forced to reposition their items on the shoulder of the road. Because there are no traffic control devices or personnel, congestion has occurred as illustrated in (Plates 3, 4 and 5), and some traders have moved their wares on the

Plate 1: Kaura Namoda Market

Plate 2: Tsafe Market

Plate 3: Dodori Market

Plate 4: Dodori Market

Plate 5: Jega Market

Plate 6: Sokoto Central Market

Plate 7: Sokoto Central Market.

Plate 8: Illela Market

shoulder of the road, as well as on-street parking. Congestion developed as a result of people entering and exiting the market and the traffic that flowed through the road, as depicted in (Plates 6 and 7), as well as trading activities on the road shoulder and even on the road itself. As a result, traffic control personnel must be employed to alleviate the congestion situation.

Although the Illela market is an international market located far from the main road, traffic congestion nevertheless happens often. The solution is to provide appropriate parking, loading, and uploading facilities located far from the main road (Plate 8).

Conclusion

The difficulties of traffic congestion and distracted drivers were caused by business activity along the impacted roadways; yet, traffic flow was sometimes free and other times not. Because the average hourly traffic does not surpass 100% on all of the selected roads, it is considered normal. The roads are also in decent condition. Tsafe market has to be relocated since it cannot handle all of the traders at once, causing some traders to dispense their wares on the road and on the shoulder of the road, as well as a difficulty with on-street parking, all of which cause traffic congestion, particularly during peak hours. The challenges at kaura Namoda market are the same as at Tsafe market, but it can handle more traders at once, and the problem will be solved by providing effective traffic control. The introduction of traffic control along with parking space in the Dodori market could address the problem, and the flow will become free. People in the Sokoto central market must cease trading activities on the road in order to alleviate traffic congestion.

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