

Highway Development and Capacity Utilisation in Ogun State, Nigeria

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Abstract: Highway development in Nigeria pioneered other modes of transport including rail, air, water and pipeline. It serves as the most efficient means of distributing agricultural products, locally-made products and natural resources. As a result of this, highways requires adequate planning and periodic maintenance for effective and efficient performance. This study examined traffic situation and capacity utilisation of highways in Ogun State, Nigeria with particular reference to Lagos-Ibadan, Lagos-Abeokuta and Sagamu-Benin Highways. Manual traffic count method was employed for the estimation of traffic volume and flow pattern. The count took 12 hours a day for three consecutive days (Tuesday, Thursday and Saturday) of a week. The traffic data gathered were analyzed and interpreted using descriptive and inferential techniques to determine Average Daily Traffic Volume (ADTV), flow situation and capacity utilization rate of each highway through thorough observation of inbound and outbound traffic. Findings revealed significant variation in traffic flow situation observed on Tuesday, Thursday and Saturday of selected highways. Findings also revealed that Lagos-Ibadan Highway (2,085 vehicles/hour/lane) is well utilized while Abeokuta-Lagos and Sagamu-Benin Highways are underutilized with 820 and 1,184 vehicles/hour/lane respectively. Improvement measures and strategies to address traffic flow situation including route development and utilisation issues on the highways were proposed.

Keywords: Highway; capacity utilization; traffic volume; traffic flow; manual count

1. Introduction

A nation's socio-economic and political development and growth are closely tied to the quality of its transportation system. Efficient transport system which accounts for a well-organized, safe,

reliable, accessible, affordable, response functional and convenient movement of people, goods, service, ideas and information in space is dependent upon reliable transport infrastructure [1] and dependable transport infrastructure most especially highways no doubt facilitates industrial and employment base development by ensuring businesses receiving high inputs production facilities and ease of transporting finished goods to market in an efficient manner [2]. Thus, it is not an overstatement that the importance of highway transportation vis-a-vis infrastructural characteristics, and operational services cannot be overemphasized, as it gives life, nurtures life and as well serves as the 'lifeline' for socio-economic development and engine of growth of any nation [3]. Highway transportation development facilitates the conveyance of people, goods, and raw-materials speedily and easily within space; act as the only source of interaction and communication among regions, urban and rural areas of both high and low altitude; and facilitates growth in trade and other economy activities in and outside towns particularly through efficient distribution of agricultural products and natural resources [1,2,4]. The overall purpose of highway transportation is to ensure safe and efficient movement of people between homes, work, shops, factories etc. and conveyance of goods from and to aerodromes, harbours and railway stations etc. through roadways and motorized vehicles [5]. However, it is the most efficient means for distribution and logistics of raw materials and finished products and as well serves as feeders for airways, waterways and railways [1,6,7]. Without its adequate developmental paradigms, the progress and well-being of a nation could not be achieved [7-11]. Thus, since time immemorial nations, cities and urban centers depend much on its services to flourish.

Despite the noticeable benefits of highway development to the socio-economic and political affluence of Nigeria and its huge capital investment nature by the Nigerian government, highway transportation is still faced with numerous management and operational challenges in the country. There have been equitable problems resulting from the deficiencies in its supply and distribution of traffic; provision of infrastructural facilities are not only inadequate but faulty; carriageway are poorly design with lack of drainage system, thus causing washing away of pavements and fallen bridges; and noticeable potholes are observed along major highway corridors in Nigeria due poor maintenance culture and carefree attitude of the Government. These challenges have significantly reduced the utility and performance of highways in the study area. Also, the poor situation of highways have made production cost highly inflated and posed difficult. Equally, it is highly expensive and arduous to move products and services efficiently from manufacturer to end consumers, as well as farm produce from rural to urban centres in Nigeria context. However, major highways (both federal and state government owned) within

Ogun state are in poor condition, mostly inconsistent in road facilities and furniture, lack intelligent traffic control and monitoring devices, and equally characterized by unpredictable travel time with low level transit coverage. These dilemma consequently causes increasing rate of road accidents and crime incidents along major highway corridors, despite allotting bulk of the governments' annual budgeted funds for road repairs and rehabilitation in recent times. Furthermore, it important to note that the current capacity utilization of these highways are yet to be measured, although previous related works dealt with pattern of traffic volume on some corridors along the Nigerian highways. It is on these backdrops that this study examined the traffic flow situation and capacity utilization of highways in Ogun State, Nigeria with particular reference to Lagos-Ibadan, Lagos- Abeokuta and Sagamu-Benin Highways towards proffering better possible approaches and policies in minimizing traffic bottlenecks and for sustainable highway development and planning in Nigeria.

Research Hypothesis

H₀: The selected highways in the study area are not well-utilized

2. Materials and Methods

2.1 Study Area

Ogun state is located in the Southwestern part of Nigeria and occupies 16,742sq km representing about 1.82 percent of the total Nigerian land area. It has a disproportionate growth of population compared with many other states in Nigeria. The Gateway state is densely populated with a population of about 6 million in 2019 [1] and equally a major producer of cocoa, rubber, timber etc. harbouring several industrial establishments that contribute significantly to the nation's trade and commerce. The state is luckily located between two significant metropolitan regions in the country Nigeria, which are Lagos with an estimated population of about 18 million in 2019 and Oyo state with over 7 million in the same period and as well accommodating the spillover effect of the growing population of these two socio-economic and political affluence states.

2.2 Methods

This survey covers only three prominent highways in Southwestern part of Nigeria in 2016 and 2019, these are Abeokuta-Lagos Highway (Fig. 1); Sagamu-Benin Highway (Fig.2), and Lagos-Ibadan Highway (Fig. 3). It is pertinent to note that three (3) cordon points were used as screen line points having one per expressway, they include; Wapco Lafarge-Ewekoro (Fig. 1); Coleman Nigerian Wires and Cable Distributor CNWCD (Fig. 2) and NASFAT Praying Ground Mowe-Ibafo (Fig. 3) cordon points, with traffic count carried out for three consecutive days of a week

(Tuesday, Thursday and Saturday) within the hours of 7 am to 7 pm daily. The justification for picking these three days of the week was to avoid traffic count during Monday and Friday rush hours, which if observed may show exceptionally high volume and perhaps are not normally used in the analysis; therefore, based the count on Tuesday, Thursday and Saturday. The study also took to cognizance the ways of measuring traffic volume using the manual method of the vehicular count with the help of research assistants and police officers to ensure thorough observation and safety of the investigators. In other words, the researchers and their assistants observed traffic volume counting of Bicycle/Motorcycle, Car/SUV, Mini Bus/Van, Trailer, Truck, Tanker, Luxurious Bus, and Tricycle/Auto Rickshaw. In other words, Road Capacity Rate was adopted to establish the present state of the capacity of theses highways against the designed capacity to reveal level of highways utilization based on the formula adopted from Highway Capacity Manual and Western Australia Model Road State classification Manual [7,10,12].



Fig. 1 Abeokuta–Lagos Highway (Lafarge Ewekoro C.P.). Source: authors



Fig 2 Sagamu–Benin Highway (CNWCD C.P.). Source: authors

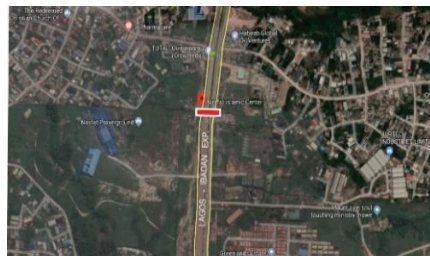


Fig. 3 Lagos-Ibadan Expressway (NASFAT Praying Ground, Mowe-Ibafo C.P.). Source: authors

3. Results and Discussions

The survey takes to cognizance a significant manual way of measuring traffic volume and variation in traffic on the sampled highways. The traffic count observed both inbound and

outbound traffic at a cordon point for three days, the traffic count was observed based on the volume, flow and characteristics of vehicles at the aforementioned locations on hourly basis.

Table 1 Abeokuta-Lagos Highway (Wapco Lafarge Ewekoro Cordon Point) Tuesday Count.
Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	308	234	111	88	41	24	18	18	40	66	1	3	4	2	3	6	0	2
8-9am	324	362	60	71	29	42	18	24	43	56	1	5	0	0	5	4	0	0
9-10am	242	307	59	57	24	40	13	16	76	33	3	3	0	0	7	5	1	0
10-11am	274	314	58	55	30	29	18	13	61	56	10	2	2	1	7	8	0	0
11-12noon	260	285	81	68	19	33	19	26	57	65	6	13	1	0	8	7	5	0
12-1pm	308	255	64	76	25	12	11	22	48	62	5	2	0	0	17	6	0	0
1-2pm	340	204	94	85	16	22	6	15	52	75	4	3	3	3	19	7	0	0
2-3pm	276	213	67	50	22	16	21	10	54	35	4	5	1	0	9	3	6	0
3-4pm	390	327	75	103	36	35	16	30	33	104	6	1	0	0	4	3	1	0
4-5pm	318	422	96	96	34	36	25	34	38	75	4	0	3	0	3	2	2	0
5-6pm	325	374	74	100	22	17	19	35	52	108	6	0	0	1	7	8	1	0
6-7pm	338	462	79	128	16	38	38	19	60	117	3	2	3	7	11	5	0	0
	3703	3759	918	977	314	344	222	262	614	852	53	39	17	14	100	64	16	2

Table 2 Abeokuta-Lagos Highway (Wapco Lafarge Ewekoro Cordon Point) Thursday Count.
Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	303	456	62	100	35	46	33	22	39	68	7	11	1	2	6	7	2	0
8-9am	358	524	61	83	32	38	21	11	46	59	1	3	0	0	8	10	1	0
9-10am	317	526	75	118	21	46	27	15	61	77	4	0	1	1	12	12	0	0
10-11am	364	473	83	87	34	53	18	6	61	66	6	0	1	1	10	13	3	0
11-12noon	302	407	63	82	41	37	13	18	60	62	4	3	1	1	11	6	2	0
12-1pm	325	396	84	71	36	77	22	29	53	50	8	3	2	4	16	7	3	0
1-2pm	341	363	85	73	30	41	30	20	52	48	2	2	0	1	11	9	0	0
2-3pm	380	322	62	88	45	26	34	28	49	75	3	0	3	2	4	6	1	0
3-4pm	405	434	84	119	32	32	26	29	46	65	4	3	0	1	7	4	0	0
4-5pm	347	557	100	103	46	61	20	22	45	63	6	3	1	2	4	7	2	0
5-6pm	410	467	106	129	43	53	26	25	47	100	7	5	3	1	5	9	1	0
6-7pm	426	659	115	139	31	31	31	32	31	106	4	6	1	2	2	13	0	0
	4278	5584	980	1192	426	541	301	257	590	839	56	39	14	18	96	103	15	0

Table 1, 2 and 3 reveals the Tuesday, Thursday and Saturday traffic count on Abeokuta–Lagos Highway, using Wapco Lafarge Ewekoro as cordon point for both the Inbound and Outbound traffic. Significantly, a total of 12,270; 15,234 and 15,093 vehicles/day with an average of 1,023; 1,270, and 1,258 vehicles/day was observed and counted at the cordon point on Tuesday, Thursday and Saturday respectively.

Also, observed outbound traffic route recorded more vehicular movement than the inbound route at the cordon point for the three observed days of the week, while the Car/SUV vehicle type recorded the most vehicular type plying the route ahead of other vehicle types for both inbound and outbound carriageways with a close count of 7,462; 9,862 and 9,171 on Tuesday, Thursday and Saturday respectively.

Table 3 Abeokuta-Lagos Highway (Wapco Lafarge Ewekoro Cordon Point) Saturday Count.
Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	277	301	60	97	13	41	23	16	39	49	1	10	1	3	2	3	0	0
8-9am	395	457	77	111	27	43	29	16	43	69	5	5	0	5	4	1	1	0
9-10am	417	269	90	113	35	43	21	12	70	79	1	4	1	2	3	5	0	0
10-11am	511	426	116	119	38	39	36	19	62	80	4	7	2	3	3	6	2	0
11-12noon	218	421	72	115	44	38	22	19	70	65	0	3	3	6	6	4	1	0
12-1pm	349	353	105	113	62	28	30	16	72	71	0	7	3	1	4	3	5	0
1-2pm	418	306	137	109	58	42	23	9	81	72	4	2	3	1	7	9	6	0
2-3pm	375	385	94	82	52	29	23	12	59	58	3	8	1	4	3	7	2	0
3-4pm	519	321	105	97	55	23	31	14	60	69	4	4	3	3	5	10	0	0
4-5pm	482	324	135	111	60	42	21	17	52	77	3	6	1	1	3	8	1	0
5-6pm	457	388	127	122	32	44	18	12	44	68	5	3	4	0	7	12	0	0
6-7pm	520	282	139	119	40	16	28	16	37	75	2	6	0	0	2	7	0	0
	4938	4233	1257	1308	516	428	305	178	689	832	32	65	22	29	49	75	18	0

Table 4 Sagamu-Benin Highway (Sagamu CNWCD Cordon Point) Tuesday Count.

Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	552	268	192	97	29	122	113	30	23	22	27	10	4	20	0	0	0	0
8-9am	387	209	271	65	76	93	75	51	9	38	9	9	2	2	0	0	0	0
9-10am	352	292	262	80	74	70	53	40	4	15	11	19	2	1	0	0	0	0
10-11am	304	254	253	93	50	80	43	42	8	12	10	13	7	4	0	0	0	0
11-12noon	312	421	232	115	45	80	55	55	8	29	6	19	1	2	0	0	0	0
12-1pm	389	413	157	123	50	59	45	105	5	39	7	22	4	1	0	0	0	0
1-2pm	295	390	138	175	43	15	67	65	13	33	10	23	3	4	0	0	0	0
2-3pm	347	415	149	190	72	37	59	90	14	22	16	22	4	6	0	0	0	0
3-4pm	311	357	148	230	52	33	73	66	10	10	17	12	1	4	0	0	0	0
4-5pm	399	375	165	267	26	7	72	39	7	25	9	5	1	3	0	0	0	0
5-6pm	350	300	232	275	58	22	89	85	13	15	14	15	8	7	0	0	0	0
6-7pm	448	363	210	244	56	11	91	52	15	41	10	31	13	4	0	0	0	0
	4446	4057	2409	1954	631	629	835	720	129	301	146	200	50	58	0	0	0	0

Furthermore, the peak period for the observed days was between the hour of 6 pm-7 pm local time with the traffic volume of 1,326 (Tuesday) and 1,633 vehicles (Thursday). This is because most road users especially those from the adjoining towns and cities make use the expressway to link Ogun State capital and prominent places for access to work and related commercial activities. In other words, the peak period for Saturday traffic was between the hours of 10 am-11 am with the traffic volume of 1,473 vehicles.

The observed variation in peak period for this day of the week was not unconnected to the increasing number of socio-economic and political activities that might be scheduled for weekend such as wedding, burial, political parties meetings and visitation within the state and/or interstate particularly from Lagos to/or through Abeokuta, to other part of the state.

Table 4, 5 and 6 reveals the Tuesday, Thursday and Saturday traffic count on Sagamu–Benin Highway, using Coleman Nigerian Wires and Cable Distributor CNWCD as cordon point for both the Inbound and Outbound traffic. Worthwhile, a total of 16,565; 20,168 and 19,822

vehicles/day with an average of 1,380; 1,681, and 1,652 vehicles/day was observed and counted at the cordon point on Tuesday, Thursday and Saturday respectively.

Table 5 Sagamu-Benin Highway (Sagamu CNWCD Cordon Point) Thursday Count.

Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	704	227	362	79	125	140	79	80	40	45	25	52	7	6	0	0	0	0
8-9am	759	328	448	83	114	110	75	62	11	15	14	12	14	0	0	0	0	0
9-10am	446	407	363	81	103	100	52	75	16	21	9	11	9	3	0	0	0	2
10-11am	574	385	263	117	62	62	59	30	23	14	13	13	8	0	0	0	0	0
11-12noon	460	368	183	112	77	101	42	52	16	23	10	19	4	1	0	0	0	0
12-1pm	452	327	197	143	44	62	43	90	22	15	21	23	1	1	0	0	0	0
1-2pm	524	427	202	188	69	82	71	47	18	19	29	16	2	5	0	0	0	0
2-3pm	553	370	177	225	82	85	70	69	12	15	16	22	10	7	0	0	0	2
3-4pm	308	352	131	223	57	66	80	64	31	33	29	18	1	1	0	0	0	0
4-5pm	382	419	172	218	68	51	86	82	19	16	25	20	2	8	0	0	0	0
5-6pm	361	458	158	227	100	56	83	80	23	20	27	21	4	3	0	0	0	0
6-7pm	512	435	203	229	120	110	129	100	18	21	18	22	5	3	0	0	0	0
	603	450	285	192	1021	1025	869	831	249	257	236	249	67	38	0	0	0	4
	5	3	9	5														

Table 6 Sagamu-Benin Highway (Sagamu CNWCD Cordon Point) Saturday Count.

Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	488	209	178	57	101	37	87	33	10	9	35	11	8	4	0	0	0	0
8-9am	386	342	227	104	82	29	71	42	6	5	16	9	5	3	0	0	0	0
9-10am	582	380	281	110	100	100	69	77	14	35	13	15	8	4	0	0	0	0
10-11am	402	362	170	90	101	50	75	61	20	15	18	5	2	3	0	0	0	0
11-12noon	473	340	268	107	60	33	46	57	11	28	8	8	2	3	0	0	0	0
12-1pm	375	487	133	166	75	30	67	77	39	27	12	19	4	1	0	0	0	0
1-2pm	589	439	192	297	65	55	72	90	29	40	13	42	4	7	0	0	0	0
2-3pm	466	427	133	177	69	43	89	54	21	41	24	42	7	5	0	0	0	0
3-4pm	366	394	166	143	58	28	88	42	33	22	14	20	3	5	0	0	0	0
4-5pm	308	712	106	329	72	13	79	31	6	17	9	17	2	4	0	0	0	0
5-6pm	281	922	141	433	97	38	96	125	16	110	18	115	4	7	0	0	0	0
6-7pm	372	650	171	284	86	45	106	130	12	97	16	99	7	13	0	0	0	0
	5088	5664	2166	2297	966	501	945	819	217	446	196	402	56	59	0	0	0	0

Meanwhile, it is important to note that the observed inbound traffic route recorded more vehicular movement than the outbound route at the cordon point for the three observed days of the week (See Table 4, 5 and 6). Similarly, the Car/SUV vehicle type recorded the most vehicular type plying the route ahead of other vehicle types for both inbound and outbound carriageways with a close count of 8,503; 10,538 and 10,752 on Tuesday, Thursday and Saturday traffic respectively. Furthermore, there is an obvious variation in the peak period for the observed days. For the Tuesday traffic count at the cordon point, the peak period for the day was between the hour of 6 pm-7 pm local time with the traffic volume of 1,589, 8am – 9am was recorded on Thursday with 2,045 vehicles and 5pm – 6pm on Saturday with 2,403 vehicles. This

observation no doubt is different from what was observed on Abeokuta – Lagos expressway (Wapco Lafarge cordon point). The reason for this is not unconnected to the economic and political importance of the route, serving as a significant link for traffic generated from different parts of Ogun State and other adjoining settlements within Southwestern part of Nigeria, most especially for work, business and political related issues.

Table 7 Lagos-Ibadan Expressway (NASFAT Praying Ground, Mowe-Ibafo Cordon Point)
Tuesday Count. Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	560	507	395	370	15	37	24	40	10	11	13	18	5	5	0	37	0	0
8-9am	630	652	415	197	60	44	59	39	26	7	36	13	6	5	0	28	2	0
9-10am	580	590	383	600	32	26	80	40	19	14	39	20	6	7	0	19	0	0
10-11am	370	450	300	605	28	30	88	51	23	17	21	21	0	2	0	28	0	0
11-12noon	790	511	384	430	32	39	171	64	36	15	55	39	5	4	0	45	0	0
12-1pm	457	573	274	450	10	15	38	35	29	12	75	31	10	3	0	41	0	0
1-2pm	623	569	354	326	25	46	147	93	28	8	71	57	16	2	0	51	0	0
2-3pm	477	355	269	325	26	39	128	66	33	15	67	52	10	2	0	49	1	0
3-4pm	470	535	340	327	17	33	85	100	31	51	61	62	3	5	0	100	0	0
4-5pm	561	488	425	375	62	33	112	135	35	48	48	65	5	10	0	35	0	0
5-6pm	570	623	515	376	5	53	126	116	53	42	14	56	8	7	0	38	0	0
6-7pm	268	633	515	460	1	54	60	156	14	28	33	62	5	18	0	37	0	0
	6356	6486	4569	4841	313	449	1118	935	337	268	533	496	79	70	0	508	3	0

Table 8 Lagos-Ibadan Expressway (NASFAT Praying Ground, Mowe-Ibafo Cordon Point)
Thursday Count. Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	590	1108	364	580	27	73	105	72	17	69	60	68	4	17	0	66	0	0
8-9am	653	1103	423	700	12	65	67	26	30	51	42	32	18	22	0	30	0	2
9-10am	627	718	315	635	25	11	72	38	37	76	52	33	1	10	0	35	0	0
10-11am	378	673	276	455	17	20	104	62	31	51	46	35	2	14	0	11	0	0
11-12noon	623	889	326	485	132	61	27	65	64	52	4	28	17	9	0	31	0	0
12-1pm	410	792	275	375	19	36	108	66	50	57	65	40	6	4	0	44	0	0
1-2pm	404	734	342	491	4	43	113	155	15	53	102	77	5	2	0	39	0	0
2-3pm	735	663	485	360	4	43	107	117	45	73	75	60	6	8	0	52	0	0
3-4pm	445	622	310	387	28	49	95	110	35	90	30	77	6	1	0	27	0	0
4-5pm	420	610	355	375	16	38	73	122	25	64	42	74	12	4	0	33	0	0
5-6pm	830	910	460	296	0	31	140	97	16	68	62	68	11	9	0	21	0	0
6-7pm	545	914	314	488	40	72	110	142	42	59	29	76	6	18	0	31	0	0
	6660	9736	4245	5627	324	542	1121	1072	407	763	609	668	94	118	0	420	0	2

Table 7, 8 and 9 reveals the Tuesday, Thursday and Saturday traffic count on Lagos-Ibadan expressway, using Mowe-Ibafo as cordon point for both the Inbound and Outbound traffic. Remarkably, a huge total of 27,361; 32,408 and 40,858 vehicles/day with an average of 2,280; 2,701, and 3,405 vehicles/day was observed and counted at the cordon point on Tuesday, Thursday and Saturday respectively. This observed traffic volume is a clearly more than the volume of traffic observed on the two earlier screened highways (Abeokuta –Lagos expressway and Sagamu –Benin expressway).

Table 9 Lagos - Ibadan Expressway (NASFAT Praying Ground, Mowe-Ibafo Cordon Point)
Saturday Count. Source: authors

Hours	Car/SUV		Mini Bus/ Van		Okada		Trailer		Tipper Truck		Tanker		Luxurious Bus		Tricycle		Bicycle	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
7-8am	590	1424	206	500	20	60	18	60	15	102	5	102	10	21	0	16	0	0
8-9am	600	1476	137	735	42	46	50	74	23	43	23	43	19	53	0	17	0	0
9-10am	980	1362	540	721	210	54	100	89	14	54	34	41	15	15	0	11	0	0
10-11am	1030	1140	510	443	118	95	87	86	28	26	20	36	21	12	0	10	0	0
11-12noon	950	1305	460	494	10	51	155	93	38	52	35	48	18	5	0	16	0	0
12-1pm	655	1214	403	441	30	59	65	95	55	47	32	60	13	10	0	19	0	0
1-2pm	695	984	420	380	52	66	106	110	64	23	25	27	11	2	0	22	0	0
2-3pm	550	986	430	368	190	71	51	143	40	38	25	38	12	4	0	13	0	0
3-4pm	1100	878	600	404	2	63	150	145	17	51	33	65	7	11	0	19	0	1
4-5pm	1245	791	730	381	30	65	135	267	25	63	5	84	0	16	0	15	0	0
5-6pm	1035	1078	545	509	30	59	82	207	21	63	11	84	0	7	0	16	0	0
6-7pm	380	941	190	477	4	86	20	171	13	30	16	41	8	8	0	22	0	0
	9810	13579	5171	5853	738	775	1019	1540	353	592	264	669	134	164	0	196	0	1

Meanwhile, it is important to note that the observed outbound traffic recorded more vehicular movement than the inbound traffic at the cordon point for the three observed days of the week (See Table 7, 8 and 9). This finding is similar to the observed on Abeokuta- Lagos highway indicating that Lagos city attracts more vehicles than other adjoining cities along all the selected highways. Similarly, the Car/SUV vehicle type recorded the most vehicular type plying the route ahead of other vehicle types on the carriageways. Furthermore, there is an obvious variation in the peak period for the observed days. For the Tuesday traffic count at the cordon point, the peak period for the day was between 11am-12noon local time with the traffic volume of 2,620; 8am – 9am was recorded on Thursday with 3,276 vehicles and 9am–10am on Saturday with 4,240 vehicles. This observation no doubt similar to what was observed on Sagamu – Benin expressway, but, however deferent in terms of period and volume observed. The reason for this is not unconnected to the high-rated socioeconomic importance of the route, serving as a major link for both traffic generated within and outside Ogun State particularly from the Norther, Eastern and Southern parts of Nigeria for socioeconomic related transactions in the Western cities e.g. Lagos.

3.3 Capacity Utilization Flow Rate by Highways

The result of the capacity rate analysis revealed above help in determining the level of utilization of the highways using the three days traffic count. Comparing the computed capacity flow rate of observed highways (Abeokuta–Lagos, Sagamu-Benin and Lagos–Ibadan) and the international highway capacity manual standard and benchmark of 2000 vehicle per hour per lane in a 3.75m design lane width [9,10,13,14]. We can easily and convincingly say that Abeokuta–Lagos Highway (820 vehicles/hour/lane) and Sagami-Benin (1,184 vehicles/hour/lane) are considered to be underutilized, while Lagos-Ibadan (2,085vehicle/hour/lane) is well utilized. Hence, the

incessant traffic flow and situational issues along the observed highways are not as results the road capacity but the consequences of traffic bottlenecks occasioned by human factor.

$$C = \frac{N}{t}, \quad [\text{vehicle/hour/lane}] \quad (1)$$

where C is the capacity flow rate [vehicle/hour/lane]; N is the passenger car unit equivalent values * Total number of traffic count (total traffic volume or passenger car unit); T is the time interval (h or s).

Table 10 Passenger Car Unit (pcu). Source: [7,10,12,-14]

Vehicle Type	pcu	Traffic Volume by Highways					
		Abeokuta – Lagos		Sagamu – Benin		Lagos – Ibadan	
	Equiv. Values	Traffic Count	PCU*TC	Traffic Count	PCU*TC	Traffic Count	PCU*TC
Car/SUV	1.0	26,495	26,495	29,793	29,793	52,627	52,627
Mini Bus/Van	1.5	6,632	9,948	13,610	20,415	30,306	45,459
Okada	0.5	2,569	1284.5	4,773	2386.5	3,141	1570.5
Trailer	4.5	1,525	6862.5	5,019	22585.5	6,805	30622.5
Tipper/Lorry	3.0	4,903	13248	1,599	4797	3,844	8160
Tanker	3.0	284	852	1,429	4287	3,239	9717
Luxurious Bus	3.0	114	342	328	984	659	1977
Bicycle	0.2	51	10.2	4	0.8	6	1.2
		42,573	59,042	56,555	85,249	100,627	150,134

Abeokuta – Lagos Highway

N = Passenger Car Unit Equivalent Values * Total Traffic Count = (59,042 traffic volume in PCU)

$t = 12 + 12 + 12 = 36$ hours

Formula recall

$$C = \frac{59,042}{36} = 1,640.06 \text{ vehicle per hour} \quad C = \frac{1640}{2} = \mathbf{820} \text{ vehicle per hour per lane} <$$

2,000v/h/l

Sagamu – Benin Highway

$N = 85,249$ traffic volume in PCU

$t = 36$ hours

Formula recall

$$C = \frac{85,249}{36} = 2,368.03 \text{ vehicle per hour} \quad C = \frac{2368}{2} = \mathbf{1,184} \text{ vehicle/hour/lane} < \mathbf{2,000v/h/l}$$

Lagos – Ibadan Highway

$N = 150,134$ traffic volume in PCU

$t = 36$ hours

Formula recall

$$C = \frac{150,134}{36} = 4,170.39 \text{ vehicle per hour} \quad C = \frac{4170}{2} = 2,085 \text{ vehicle/hour/lane} < 2,000 \text{v/h/l}$$

4. Conclusion and Recommendations

The study critically examined the variation in volume of traffic, pattern of traffic flow, level of utilization as well as proffer better transport planning dynamics on the selected highways in Ogun State, Nigeria towards achieving free traffic flow and accessibility. Thus, the study recommends that: the beneficiaries of the highways particularly the general public should be involved in all stages of highway planning project and programmes, which is perhaps missing in Nigeria context; priority should be given to the routine or periodic maintenance of existing highways particularly to avoid shoulder over-growing weeds, drainage blocking and continuous damage of road portion; employment of indigenous/local competent personnel to handle with thorough, construction, supervision and routine road works management; adequate expansion and repair of carriageways particularly Lagos-Ibadan Highway and Abeokuta-Lagos Highway; adequate provision of basic road infrastructural furniture and devices needed for smooth flow of traffic on these highways such as real-time automated road signal, automated monitoring devices including CCTV and ramp metering, pedestrian bridges at some road segments; and finally, State highways that serves as feeders to the observed highways should be properly rehabilitated particularly Papalanto-Sagamu Highway to ease the traffic bottlenecks of Lagos-Ibadan and Abeokuta-Lagos Highways.

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