Assessment of the Current Bus Route Network in the Federal Capital City, Abuja, Nigeria

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ORIGINAL RESEARCH

Abstract- The inadequacy of buses for the public transportation system in the Federal Capital City (FCC) of Abuja has resulted to the dominant use of private automobiles, which has created a lot of problems, such as, long waiting times, lateness to work, kidnapping and loss of man-hours. The effort of Government in providing high-capacity public buses through Abuja Urban Mass Transit Company (AUMTCO), has not been satisfactory. Therefore, in this study, an evaluation of the existing bus route networks and the availability of public transport bus services in the FCC, including an assessment of the factors that determine the present choice of travel mode in the city is presented. The methodology adopted includes: manual traffic volume count, measurement of traffic data and scope of the current bus route network using GPSmap76Cx (GARMIN) receiver, and questionnaire administration. The results show that public bus is 0.12% of vehicular traffic volume in the metropolitan city, while private car has 86.81%, which carries significant consequences that impact different facets of its citizen's lives. The existing bus routes network does not cover Wuse II and Maitama districts. Mode choice influences by social demographic characteristics, such as; occupation, marital status, time spent going to work, bus inconvenience, time to leave home for work, and decision to patronize public mode if available are among the trip factors assessed. The mean peak travel speed on the bus routes ranges from 15km/hr to 23 km/hr, while average time spent from house to and at bus stop are 10 minutes and 20 minutes respectively for public bus. The results suggest that the existing bus route networks should be optimized to cover all the districts of the Federal Capital City for effective accessibility and services to commuters. This will improve the security indices of commuters in the Federal capital city.

Keywords- Abuja Urban Mass Transit Company, commuters, routes, public buses, and security

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1 INTRODUCTION

Buses, light rail, and subways are examples of public transportation systems. When these systems become available to the general public, they may charge a fare and operate at predetermined periods. The goal of introducing or expanding public transportation systems is to increase access to and use of public transportation systems while reducing motor vehicle miles or kilometres driven and traffic congestion (Fitzgerald, 2012). An effective way to move big crowds of people from one place to another, particularly in densely populated urban areas, is through high occupancy public bus transportation systems (Taylor and Fink, 2013).

According to studies, the public bus system can reach urban dwellers without private vehicles and without the means to pay for regular taxi fares (Andaleeb *et al.* 2007). Furthermore, research has shown that the provision of public bus transportation directly affects the country's economy (Ali, 2010, Henry and Litman, 2006). Communities that offer excellent public transportation services typically have far lower car ownership rates (Litman, 2015). Consequently, reducing the number of cars and traffic congestion on urban roadway could be accomplished by legislative tools such as the bus system.

A public transportation system's perceived and actual performance is measured by its users (Fu and Xin, 2007, Too and Earl, 2010). The utilization of public buses is influenced by travel behaviour, which is influenced by perceptions and expectations (Birago *et al.,* 2017). Commuters have reasons for their choice of travel mode. They consider the advantages of the use of private automobile over the public buses. Such advantages include security, comfort, saving time and flexibility.

However, in the developed countries where public transits are very efficient, adequately available and satisfactory, many people drop their private vehicles for the use of public buses Charles and Tina (2021). The rate of infrastructures development within Abuja has brought along with it the high cost of transportation, loss of man-hours due to unnecessary long trekking or walking distance to bus terminals and waiting time for buses, increased stress, environmental pollution and road traffic accidents Sumaila, (2012). The Federal Capital City is dominated by unregulated public transportation systems with no established routes. At the moment, only Abuja Urban Mass Transit Company (AUMTCO) operates inter-city and intra city transport services, in the form of buses.

2 BACKGROUND OF STUDY

Ali (2014) examined how satisfactory the transportation system in Abuja is, the study revealed that the public bus service does not meet the expectation of passengers. Ojekunle (2016) studied effective quality of the public transportation system in the city, and concluded that the government should improve the existing transport services. Evaluation of the accessibility level of passengers to public transportation system in the Federal Capital City (FCT) is the research work of Oluwole (2017),

who counselled that changes should be made to the structure and functions of the current bus route networks to meet the standard of the City. Olonisakin, (2014) in his study on the application of Global Positioning System (GPS) and Geographic Information Systems (GIS) in management of traffic, developed a traveller information system (TIS) that provided traffic information, which enables commuters and motorists to take rational decisions as to which route (less or non-congested or the fastest route) to take during peak hour travel. The research of Yusoff, et al., (2023) examines how employees should use public transportation as their primary means of transportation to work. The outcome suggested a path that encouraged using public transportation to get to work while taking the respondents' experience issues and mobility parameters into account.

Yu *et al.*, (2023) employed data envelopment analysis (DEA) to assess the bus route network's effectiveness in Akita City, Akita Prefecture, Japan. The DEA was utilized to identify inefficient bus routes, and a network with transfers was evaluated to determine how they may be improved. An analysis of the primary time losses during bus movement within the route network was conducted in the Fuad (2023) article. The drawback of the approach that is currently in use to account for the time lost by buses at controlled junctions when they travel certain routes was demonstrated. The primary objective of the research of Charles and Tina (2021) is to ascertain how commuters' happiness and use of bus services in Ghana are correlated with their perception and expectations of service quality characteristics. According to their findings, when transportation operators offer services that meet passengers' demands for quality of service, passengers will be more satisfied and use PBT. This research work is purposely for assessment of the current bus route network in federal capital city of Nigeria and the results will assist the government in improving bus services for effective transportation system in the City. The objectives inherent include: assessment of the availability of public bus services, assessment of the scope of bus route network and the factors that determine the present choice of travel mode in the city.

3 METHODOLOGY
3.1 TRAFFIC VOLUME COUNT
Manual traffic volume count (using pen and paper) was used to collect data and information for the analyses of bus service availability. A manual traffic count format was created to get the necessary data and traffic enumerators were recruited and trained on how to collect the required data. A volume count of vehicular traffic was carried out for 7 days of the week from 7:00am to 7:00pm simultaneously at three major entry/exit points to the Federal Capital City. The entry points were; Airport expressway by city gate, Nyanyan road by A.Y.A. junction and Kubwa road by Katampe junction as shown in Figure 1. The traffic flow counts were segregated on the basis of direction of flow, which were either inbound or outbound and modes of traffic.

Fig. 1: Traffic count locations

3.2 MEASUREMENT OF TRAFFIC DATA OF BUS ROUTE USING GPS RECEIVER
A vehicle was mounted with a GPSmap76Cx (GARMIN) that was capable of logging in positional and time data and later downloaded onto a laptop computer. During the peak hours (8:00am to 10:00am) in the morning and (5:00pm to 7:00pm) in the evening for 5 days (Monday to Friday), the vehicle was driven floating in the traffic stream following the general traffic flow, so as to capture the expected traffic conditions, such as; scope of routes, travel distance, travel time and average speed along major roads, with the city centre as the origin or destination of all the journeys. Mean, range, and percentiles are examples of descriptive statistics approaches that were used to analyse, summarize and describe data collected

3.3 QUESTIONNAIRE ADMINISTRATION EVALUATING FACTORS AFFECTING TRANSPORT MODE CHOICE
Questionnaire was prepared and designed to show all the information required from passengers and transporters, and mode of choice patterns. The questionnaire was basically divided into three sections; these are information about the respondents, qualities of transport services and the general factors that influence respondents' choice of travel modes. In-person method was used in the distribution of the paper questionnaires. Various statistical tools were used, which include, frequency to determine the socioeconomic characteristic of the respondents. Also, descriptive statistics was used to determine the mean value and standard deviation of the respondents. Finally, cross tabulation analysis was used to analyse the major determinants against various travel modes. The study area covers bus route networks within the Phase 1 of the Federal Capital City, Abuja as shown in Figures 2 and 3.
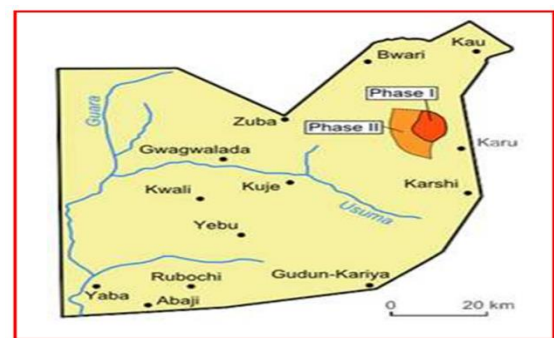

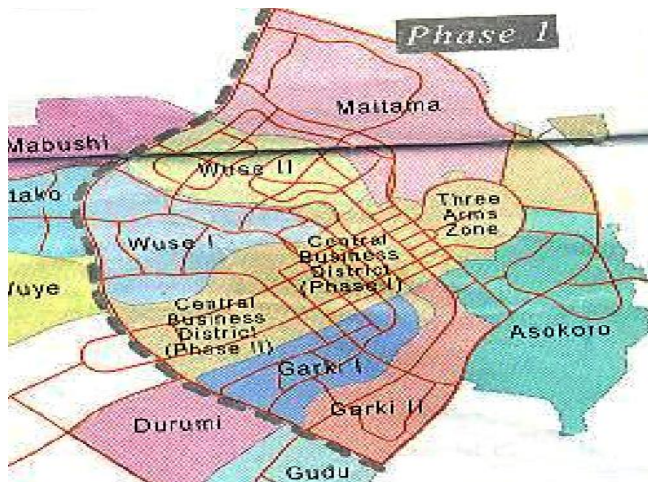Fig. 2: Map of FCT Showing Abuja City Centre (Phase 1)

Fig. 3: Map of phase 1, Federal Capital City, Abuja

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4 RESULTS AND DISCUSSION
4.1 ASSESSMENT OF THE AVAILABILITY OF PUBLIC TRANSPORT BUS SERVICES
4.1.1 Vehicular Traffic Volume– Inbound and Outbound

Table 1 presents the cumulative volume of traffic (inbound and outbound) of the Federal Capital City from all the three entry points and share of each vehicle. Table 1 indicates that, a total of 1,632,676 vehicular volume traffic was recorded as inbound and outbound vehicular traffic from the three routes survey points. Results indicate that private car use had the highest vehicular traffic volume of 1,408,644 out of which 86.81% or 716,173 were inbound traffic and 85.7% or 692,471 vehicles were outbound traffic, while public transport bus services recorded the lowest vehicular traffic volumes of 1,981 out of which 1,030 or 0.12% were inbound traffic. Also, 0.12% or 951 vehicles, which were outbound traffic, were noted. It is understood from the results that the Federal Capital City is dominated by private cars and less than 0.5% of the traffic volume make for the public buses.

Table 1. Vehicular Volume of Inbound and Outbound traffic from the three entry points

Vehicles	Inbound	%	Outbound	%	Total
Public Bus	1,030	0.12	951	0.12	1,981
Private Car	716,173	86.81	692,471	85.7	1,408,644
Taxi	66,148	8.02	68,854	8.52	135,002
Others	41,593	5.04	45,456	5.63	87,049
TOTAL	**824,944**	**100**	**807,732**	**100**	**1,632,676**

Fig. 4: Bus route network on FCC Map (GPS MapSource)

4.2 ASSESSMENT OF THE SCOPE OF BUS ROUTE NETWORK IN PHASE I

The information and results displayed in Figures 3 through 6 and Table 2 were obtained through measurement of traffic data along bus route using a GPS receiver. The bus route networks cover only three districts (Wuse, Garki and Central business) of phase I of the FCC, it does not extend to Maitama district (see Figure 5). There are few bus stops (Service Access Points) available. Figure 6 and Table 2 show the data of traffic situation on some Intra - City Routes. While Table 3 present assessment of the ease and the reliability of navigating routes, safety and cost associated with bus, taxi and private automobile modes.
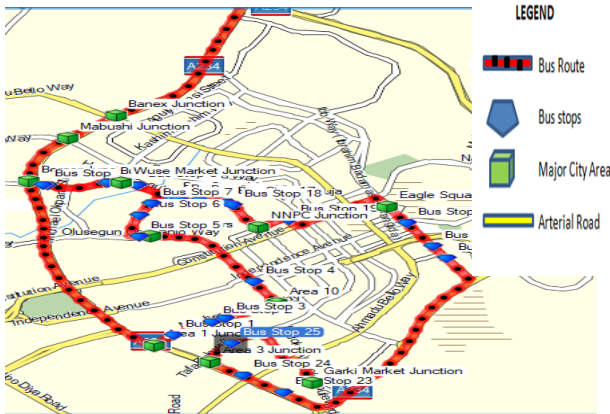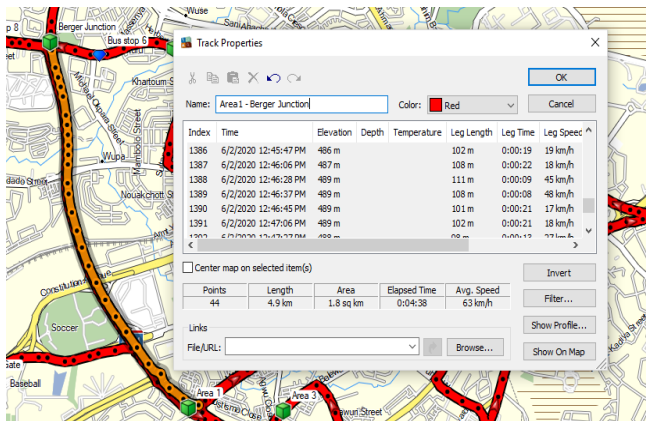

Fig. 5: Bus route network in Phase 1 of FCC

Fig. 6: Traffic situation on the route from Area 1 to Berger Junction

Table 2. Data of some sections of routes in Phase 1 of the Federal capital city

S/N	INTRA - CITY ROUTES	LENGTH (KM)	TRAVEL TIME (SECONDS)	AVERAGE SPEED (KM/H)
1	Wuse Market - Beger Junction	1.7	353	17
2	Eagle Sguare - NNPC Tower	1.9	165	42
3	Area 1 - Berger Junction	4.9	278	63
4	Area 1 - Area 10	7.1	2,108	12
5	Area 3 - Area 1	5.9	2,254	9
6	Area 1 - Garki Market	8.1	2,530	12
7	Area 10 - Hali Brother	2.9	216	49
8	Hali Brother - NNPC Tower	3.5	338	36
9	Wuse Market - Hali Brother	1.9	289	24
10	NNPC Tower - Wuse Market	2.5	597	15

4.2.1 Ease of Navigating the Routes

Travel time: Private automobiles have easy of navigating the routes than public bus considering the less travel time (5.6 minutes), and high mean peak travel (23 km/hr) and running (64.2 km/hr) speeds of private automobile compare to that of public bus which are 8.5 minutes, 15 km/hr and 54.8 km/hr respectively.

Accessibility: Private automobile is easily accessible to commuters than public bus due the less time (2 minutes) spent from house to and at bus stop compare to that of public bus which are 10 and 20 minutes respectively.

Table 3. Assessment of the ease and reliability of navigating routes, safety and cost associated with bus, taxi and private automobile modes

S/N	Description	Public bus	Taxi (registered)	Private automobile
1	Average time spent from house to bus stop in **minutes**	10	5	2
2	Average time spent at bus stop in **minutes**	20	5	2
3	Transport fare per drop in **Naira**	50	200	500
4	Mean peak travel time on the bus routes in **minutes**	8.5	6.3	4.6
5	Mean peak travel speed on the bus routes in **km/hr**	15	17	23
6	Mean peak running speed on the bus routes in **km/hr**	54.8	57	64.2

Note: Private Automobile are used for Uber, Bolt and Unregistered Taxi

4.2.2 Reliability of Navigating the Routes

On time performance: Private automobiles have the advantage of punctuality over the other modes because of less time (2 minutes) spent from house to and at bus stop.

4.2.3 Safety of Transport on the Routes

There are incidents of private automobiles being used for evil operations such as 'one chance' strategy of robbery, kidnapping and killing in the city which does not applicable to public bus.

4.2.4 Compliance with Regulations

Drivers of public bus are employed by AUMTCO, which are trained and monitored to adhere to safety regulations and standards. Unlike private automobile's drivers that are self-centred, flouting transportation services regulations.

4.2.5 Cost of Travelling

Commuters spend much money on transport fare by patronizing taxes and private automobile which have their fares range from ₦200 to ₦500 per drop compare to public bus that has a fare range from ₦50 to ₦100 per drop.

4.3 EVALUATION OF FACTORS AFFECTING TRANSPORT MODE CHOICE

Analysis of the existing transport situation carried out proves that, there is the prevalence of private cars over other modes in the Federal Capital City. This section provides data on the various reasons behind the choice of travel mode by the trip makers. Table 4 shows the socioeconomic data of respondents.

Table 4. Socioeconomic data of respondents

Categories	%	Categories	%
Gender (n = 499)		Marital Status (n = 499)	
Male	48	Single	29.5
Female	52	Married	70.5
Total	100	Total	100
Age (n = 500)		Occupational Level (n = 500)	
13 - 30 years	32	Grade 1 - 7	32.0
31 - 45 years	45.4	Grade 8 - 12	47.4
46 - 60 years	20.8	Grade 13 & above	20.6
Above 60	1.8	Total	100
Total	100		
Nature of Occupation (n = 500)		Monthly Income (n = 500)	
Applicant	13.0	N10,000 - N29,000	31.4
Self employed	27.6	N30,000 - N59,000	24.8
Private company	18.2	N60,000 - N89,000	27.8
Government establishment	41.2	N90,000 - N109,000	10.2
Total	100	N110,000 % above	5.8
		Total	100
Educational Qualification (n = 499)			
Primary	2.0	Transportation Mode (n = 500)	
Secondary	28.5	Public bus	19.2
Tertiary	69.5	Foot	6.9
Total	100	Private automobile	66.6
		Others	7.3
		Total	100

Table 4 reveals that the total number of respondents are 499 out of which 48% are male, 52% female, while about 45.4% of the respondents are aged between 31-45years and 41.2% of them are government workers. Also, out of the 499 people that responded 69.5% of them attained tertiary education with only 2% with primary school certificate holders. The study also indicates that 70.5% of the people in the sampled survey are married, while 29.5% are single. From further evaluation of results, about 47.4% are on salary grade 8 -12, while 32% and 20.6% are on government salary Grade 1 - 7 and above Grade 13 respectively. It was also noted that 66.6% prefer the use of private cars, while 19.2% choose to use the public bus system. The Bi-variate Correlation Analysis of Variance for Transportation mode based on study Variables is given in Table 5.

Table 5. Bi-variate Correlation Analysis

Description of Variables	Significant
Gender	0.118
Age	-.235
Occupation	0.025
Educational Qualification	-.178
Marital status	-.093
Occupational level	-.243
Monthly income	-.349
Time spent going to work	0.025
When you leave for work	-.061
Form of traffic mode available	-.162
Bus inconvenience	-.093
Time spent waiting for vehicle	.133
Patronage of public mode In-adequate condition	.050

If the significant level is less than 0.05 then there exist a significant difference among the variables under investigation. Thus, this explains that transportation mode is affected by the change in category of variables. Table 5 shows six variables that have significant less than 0.05, which were the major determinants of modal choice in the study area namely:- (i) Occupation (r = -0 .025), (ii) Marital status (r = -0.093), (iii) Time spent going to work (r = -0 .025), (iv) Time leave for work (r = -.061), (v) Bus inconvenience (r = -0 .093), and (vi) Patronage of public mode in-adequate condition(r = .050). In order to examine the above determinants, cross tabulation analysis was used to see how each category in the determinants affects different modes in the study area.

Table 6. Cross tab of Level of Education and Transportation mode

Determinant Categories	Public Bus	Foot	Private Car	Others	Total
Primary	0	4	5	0	9
	0.0	44.44	55.55	0.0	100.00
Secondary	12	10	102	14	138
	8.70	7.25	73.90	10.15	100.00
Tertiary	83	20	221	22	346
	24.80	5.78	63.87	6.35	100.00
Total	95	34	328	36	493
	19.27	6.90	66.53	7.30	100.00

Table 6 shows Cross tab of Level of Education and Transportation mode. It reveals that the higher the level of education of people in the study area the more they tend to use car as travel mode. For example, those that have only primary school education 55.55% of them use private cars. The figure increases to 73.90% for those that have attended secondary institutions, while for choosing public bus 8.7% of those at the secondary groups and 24% of those with tertiary school education use public mode. For the choice of foot mode about 44.44% of those with primary schools' education use the foot as compare to 7.25% among the secondary school certificate holders. Also, 10.15% of the secondary school certificate holders choose to use other mode of transport followed by 6.35%, which are those with tertiary education. To carefully address this issue, especially those at the tertiary groups, little needs to be done, in order to attract them to use the mass-transit. Already 24% of them commute by bus presently as against 63.87% that uses private car mode .

5 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The results of the data obtained, analysed and discussions there from revealed the following conclusion: (i) Public bus is 0.12% of vehicular traffic volume in the Federal Capital City, while private automobile is 86.81%, and taxis is 8.02%. This negligible availability of public bus causes many people opting for personal vehicles, leading to increased traffic congestion, longer commute time, and heightened air pollution levels. It also disproportionately affects low-income communities and individuals without access to private transportation, limiting their access to essential services, education, healthcare, and employment opportunities. (ii) The scope of existing bus routes network only covers Wuse, Garki and Central Business districts of Phase I of the city. This uneven coverage exacerbates economic disparities, as individuals living in these areas without access to public transportation face challenges in accessing services, contributing to income inequality and reduced economic mobility. Moreover, these areas of the city become inaccessible to individuals who rely on public transportation.

Six variables were identified as the major determinants of modal choice in the study area, which include: - (i) Occupation, marital status, time spent going to work, bus inconvenience, time to leave home for work, and decision to patronize public mode if available. This provides valuable insights into the dynamics of transportation behaviour and decision-making processes within the city. (ii) Due to insufficient availability of public transport bus services people spend much money on transport fare by patronizing taxes and private automobile which have their fares range from ₦200 to ₦500 per drop compare to public bus that has a fare range from ₦50 to ₦100 per drop. (iii) Considering the mean peak speed that range from 15 km/hr to 23 km/hr and the mean peak travel time range from 4.6 minutes to 8.5 minutes, the ease and reliability of navigating on the current route are very poor. (iv) Safety of transport on the routes and compliance with transportation services regulation is very poor due to the dominant of private automobile which the drivers are self-centred and not under any authority monitoring them as applied to AUMTO public bus drivers.

5.2 RECOMMENDATIONS

These results will assist the city planners and policymakers in formulating targeted transportation policies and initiatives to improve public transportation services, address infrastructure gaps, and promote sustainable and efficient transportation options that align with the needs and preferences of different demographic within the city. This will improve the security indices of commuters. The existing bus route networks should be optimized to include all the districts of the Federal Capital City for adequate accessibility and effective services to the commuters.

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