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Assessment of Mode Choice of Urban Commuters in Benue State, Nigeria

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Abstract

Mode choice behaviour is a key element in public transport planning. The main objective of this study is to examine the mode choice of urban commuters in Benue State. The travel data collected from 1545 respondents in four towns namely Makurdi, Gboko, Katsina-Ala and Otukpo, while multinomial logistic regression analysis was performed using SPSS version 23 to identify attributes that influence travel mode choice and willingness of commuters to switch from one mode to another in Benue State. Age, gender, marital status, household income, level of education, vehicle ownership, in-vehicle time and transport fare were the most significant variables that contributed towards predicting the mode choice behaviour of commuters in Benue State. Results show that the working class make more trips using motorcycles, while the high-income class uses motor cars more than other means of transportation and has varying degrees of switching willingness. Finally, policy implications are recommended in the context of providing improved transportation systems and services with a view to improving the mobility of urban dwellers in Benue State.

Keywords
Mode choice, Multinomial logistic regression, Choice behaviour, Benue State

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1. Introduction

Mode choice behaviour is a key element in public transport planning (Miskeen *et al.*, 2013), modal choice may be influenced by the availability of transport means (Senikidou *et al.*, 2022) and it has a direct impact on the design of urban transport system structure, and forms the basis for policy-making in urban public transport planning and management (Chen and Li, 2017). Mode choice analysis is the third step of the transport planning process that comes after trip generation, that is, 'the level of trip making' and trip distribution 'the relative frequency of trip lengths'. The mode choice behaviour of commuters plays an important role in urban transportation planning decisions. A commuter may choose a transport mode out of many available modes options for precise reasons, which means there are many factors accountable for a mode choice decision (Doddy et al., 2010). A careful analysis of the commuter's mode choice decisions can help in forecasting demand for new modes of transport. It can also aid in mitigating traffic congestion, assessing the general effectiveness of travel, and providing insight into the commuter's behaviour characteristics. The mode choice analysis is the process that leads to a decision a commuter takes under a set of conditions about which mode to use. The choice of a particular mode by a commuter affects the general ratio of the output to the input of travel within the city. A commuter having a choice of mode of transport observes different weights of disutility for the components of competing alternative modes in comparison with his mode. The commuter decides the mode which has the least disutility based on the totality of disutility weights (Redmond and Mokhtarian, 2001; Ashalatha *et al.*, 2013).

The major issue of travel behaviour is travel mode choice decisions which play a vital role in transportation planning and policy making in any city. It means that the mode choice for daily mobility of urban residents has significant effects on the future development of urban areas. Examination of the socioeconomic factors, their influence on the commuters' mode choice and the likelihood of switching from private mode to public transport mode could provide gainful results for transportation policy formulation in medium cities in developing countries like Nigeria.

Mode choice models estimate how many people will use public transit and the number of people that will use private cars. The use of the public transport system has more advantages since it maximizes efficient road space usage, and provides social benefits such as less congestion and accidents on the roads. Public transport also offers travel with low cost and efficient use of fuel.

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1.1 Statement of the Problem

The global count of motorised vehicles has been increasing at unprecedented rates (Cervero, 2013). Today, the desire for rapid motorisation is about to shift from the most sustainable travel modes (public transport and non-motorised forms) to the use of private vehicles that cause traffic delays. Private vehicle ownership makes up about half of all urban daily trips worldwide. In 2005, urban areas recorded 7.5 billion daily trips on a global scale (Pourbaix, 2011). The share of daily trips made by public transport was about 16 %, walking and cycling maintained about 37 %, and private motorised mode of travel had about 47 % that tripling the share of public transport (Pourbaix, 2011; Cervero, 2013). Similarly, Public transport accounts for 19% and 17% for Athens and Thessaloniki respectively. 12% of Athens residents and 17% of Thessaloniki residents walk to their workplaces and the use of bicycles for commuting was rather limited in cities; 1% in Athens and 3% in Thessaloniki (Mouratidis *et al.,* 2023). In New Zealand, the number of passenger cars has increased since 2009 (3.1 million) with an accelerated growth from 2013 onwards (3.2 million) to the highest level ever recorded (3.8 million) in 2017. The amount of travel in passenger cars per capita has also continued to grow from 2012 with 8377 km of annual travel to 9265 km in 2017 also the highest ever recorded (Ministry of Transport, 2018). In Portland USA, Singleton (2017) reported commute trips by mode, and mode shares. The car commute trips accounting for 39 %, bus accounting for 30 %, bicycle recorded 16 % and walk had 4 %.

Urbanisation in developing countries like Nigeria is changing rapidly; the big cities in these countries are reporting sustained pressure on urban infrastructure due to an increased rate of migration from rural areas and a rapid increase of private modes of transportation. The unstable urban transportation situation has become the main problem faced by cities in developing countries due to a lack of sustainable transportation planning in the past. In Benue State, a lot of people have migrated from crises/ insecurity-prone zones like Borno, Katsina, Jiggawa, Taraba, Plateau, Kano and Kaduna states in northern Nigeria to seek refuge in the more secure towns. The resultant effects of this movement are a strain on the existing infrastructure. Many people resort to the use of private cars as opposed to public transport due to the limited number of public transit.

There is a paucity of research on the mode choice behaviour of commuters in Benue State, Nigeria together with weaknesses arising from unsound investigations that solely modelled trip generation, limit the effectiveness of transportation policies and actions in managing the rapidly growing urban traffic. For this reason, the study seeks to analyse the mode choice of commuters in Benue State to unveil the preferred mode of travel and the possibility of switching to another mode. The selected four major towns in the State are the most important middle-sized cities and fast urbanising areas, and have rapid daily traffic load due to urbanisation trend and changes in socio-economic level of the people.

2. Review of Relevant Literature

In modelling demand for travels, disutility is assumed to involve endurance for the sake of achieving the desired minimum destination. This disutility is modelled as a function of time and cost, and disutility is assumed to increase when time and cost increases (Mokhtarian and Salomon, 2001). The theories of transport geography and transport economics consider travel between destinations to be determined by the reasons people have for leaving one place, and the costs or inconvenience involved when travelling to another location (Petter, 2012).

Miller et al., (2005); Bhat and Sardesai, (2006) reported that individual and household socioeconomic characteristics have a strong influence on mode choice decisions. They identified that income, gender, vehicle ownership, and employment status are the most influencing variables in mode choice decisions. Furthermore, different socioeconomic characteristics proved to be significant for the current and future mode choices, such as income, age, employment status and vehicle ownership (Abulibdeh, 2023).

Ashalatha *et al.*, (2013) used multinomial logistic regression to investigate the mode choice behaviour of commuters in Thiruvananthapuram City, India and found that as age increases preference for cars increases and preference for two-wheelers decreases in comparison with public transport. An increase in time per distance and increase in cost per distance cause the commuters to switch to cars and two-wheelers from public transport.

The theoretical framework for the study was based on utility maximisation theory which holds that the utility of an alternative travel mode is the attraction connected to that particular travelling mode available to an individual for a specific trip. Therefore, the individual will select the mode that has the maximum attraction due to various attributes like in-vehicle travel time, walking time to the road, waiting time for the mode to arrive at the bus stop, interchange time, travelling fares and parking fees (Madhuwanthi *et al.,* 2016). Chen and Li (2017) assert that individuals choose a number of goods to maximise their utility, which translates into their level of satisfaction by calculating the costs and

benefits of alternatives (income restriction) available to them.

Therefore, an individual whose preferences fulfil these assumptions has a deterministic utility function, (U) that represents the preferences. The preferences will be ordered so that the individual will choose the alternative that gives him greater satisfaction. This assumption is known as utility maximisation and all the mode choice models are based on this theory.

3. Methodology

Benue State is located in the north-central part of Nigeria as shown in Figure 1. The State consists of 23 Local Government headquarters and two other major towns namely Zaki-Biam and Ugbokolo statutory defined as urban centres, and numerous other smaller towns as indicated in Figure 2.

The study was conducted in four major towns in Benue State. The selected towns were divided into traffic analysis zones (TAZ), namely Makurdi (TAZ 1 - 24), Gboko (TAZ 25 - 46) Katsina-Ala (TAZ 47 - 65) and Otukpo (TAZ 66 - 85) according to the land use pattern as specified in Figure 3.

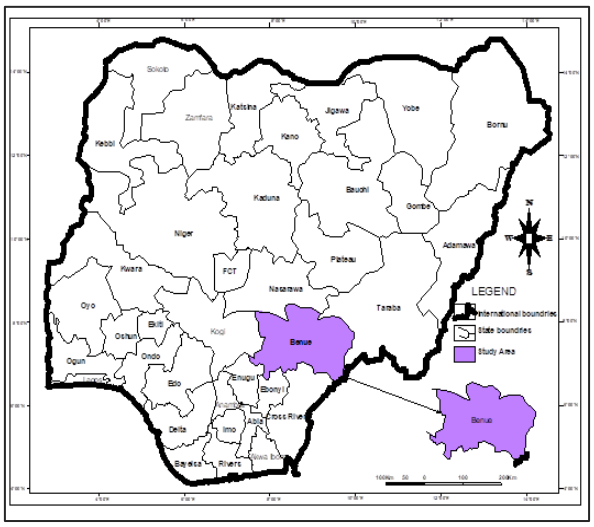

Figure 1: Map of Benue State in National Context
Source: Ministry of Lands, Survey and Solid Minerals, Makurdi (2019)

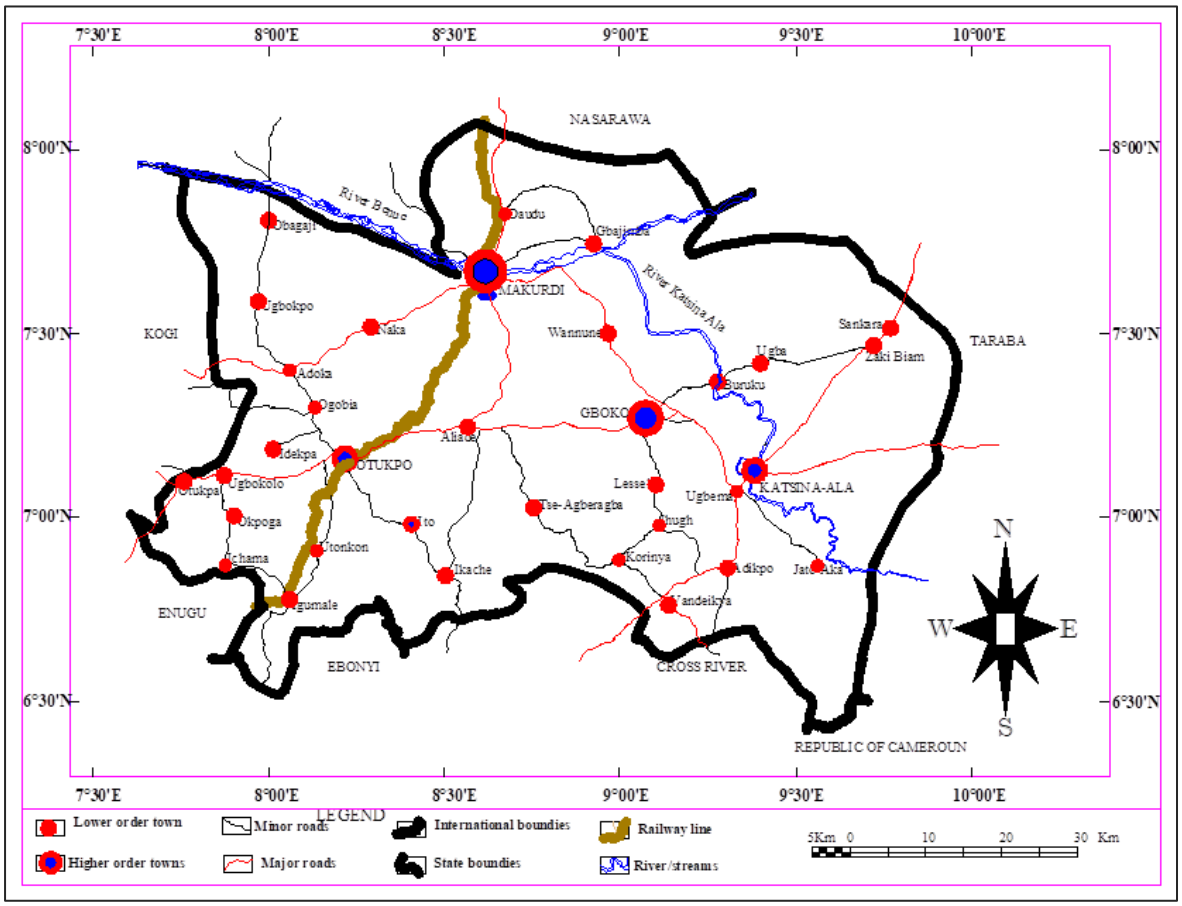

Figure 2: Map of Major Towns in Benue State Context
Source: Ministry of Lands, Survey and Solid Minerals, Makurdi (2019)

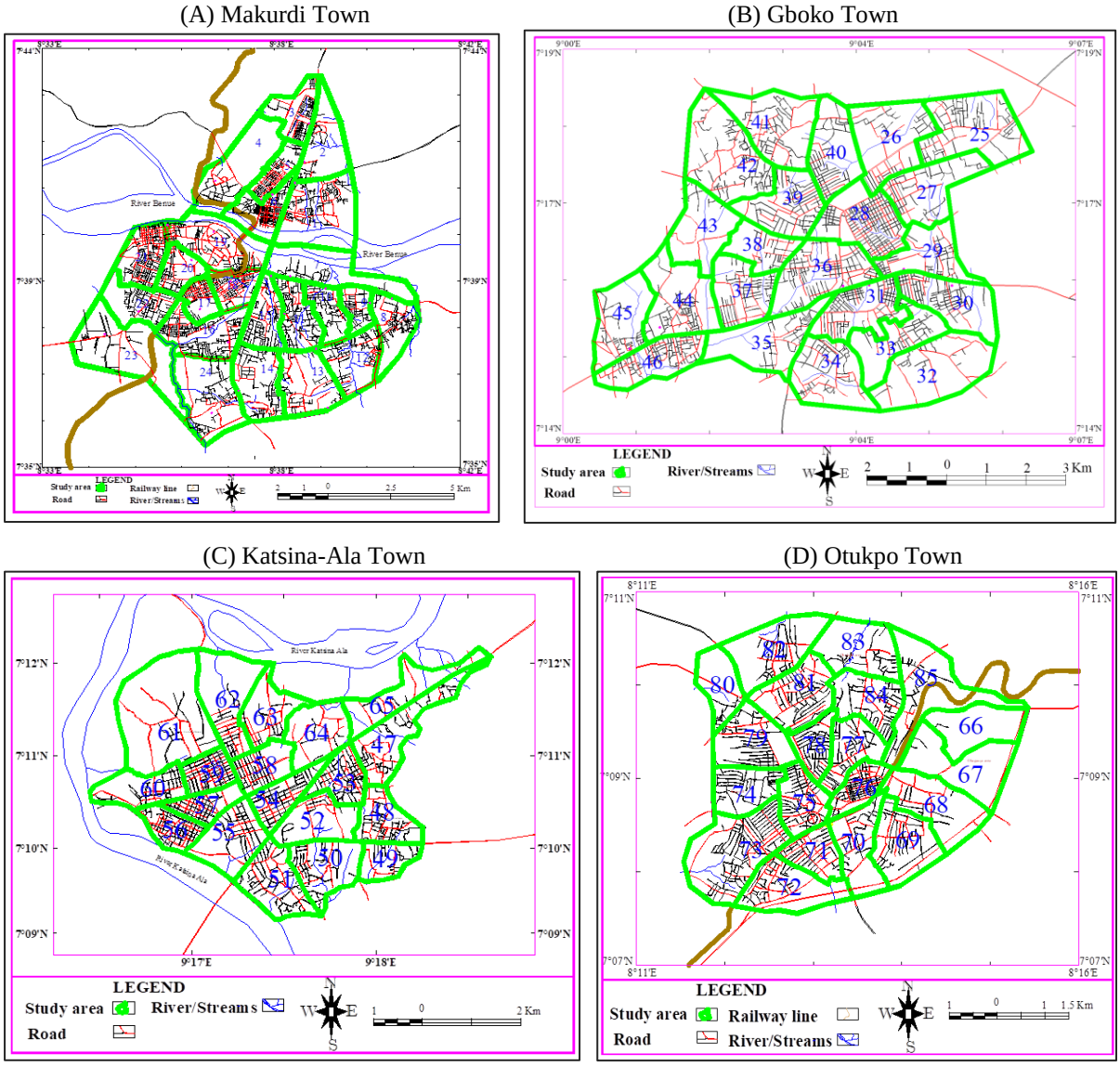

Figure 3: Map of TAZ in Four Major Towns
Source: Ministry of Lands, Survey and Solid Minerals, Makurdi (2019)

The towns were selected for the field survey because of their functionality and perceived trip generation, while traffic analysis zones were defined based on the homogeneous socioeconomic status of respondents. Secondary data were collected from the Ministry of Lands, Survey and Solid Minerals, Makurdi; National Population Commission, Makurdi; Vehicle License Office, Makurdi on the land, demography and vehicle ownership of the selected cities.

Primary data was also necessary to study the behaviour of the residents through questionnaires and travel diary surveys. The selected towns in Benue State had a total population of 1,345,895 persons out of which a sample size of 1545 respondents were interviewed. The 1545 respondents interviewed were drawn based on the total population of sampled TAZ in each town namely Makurdi town had 24 TAZ accompanied by a TAZ population of 418,101 persons with 480 respondents, Gboko town had 22 TAZ accompanied by a TAZ population of 384,265 persons with 440 respondents, Katsina-Ala town had 19 TAZ accompanied by TAZ population of 218,630 persons with 250 respondents, and Otukpo town had 20 TAZ accompanied by TAZ population of 324,900 persons with 375 respondents.

Questionnaires were given out to respondents located in houses along sampled streets of each town in a systematic order with five houses skip gap. The household travel survey attributes related to the socioeconomic condition and travel characteristics of the trip maker were taken into consideration. The questionnaire was designed to collect data on household characteristics, travel behaviour attributes and travel diaries like age, gender, marital status, monthly income, education level, motor vehicles owned per household, in-

vehicle travel time, transport fare in a week and public transport safety. The travel diary also requested information on the origin and destination of trips, number of daily trips, purpose of trips, time of trips and mode of transport used.

The study used descriptive statistics and Multinomial Logistic (MNL) regression to analyse the data. The Multinomial Logistic (MNL) regression analysis was performed using SPSS version 23 to investigate how socioeconomic characteristics and trip-related variables influenced travel mode choice of the respondents in the study area.

4. Results and Discussions

The respondent's socioeconomic characteristics were assessed by considering factors such as age, gender, monthly income, occupational status, level of education and motor vehicles owned. Travel characteristics included mode of conveyance 'frequent mode of travel'; in-vehicle travel time, fare and safety. Commuters were also asked to assess transport system facility factors by considering factors such as comfort and safety. The sample size of 1545 respondents used for the study included captive riders because they had chances to board public transit services or otherwise. Household travel survey data was coded for analysis and it provided an overview of the mode choice of commuters in four towns of Benue State. Three cross-classification tables and charts were investigated concerning age, income and occupation variables to provide insight into the mode choice used for trip-making.

Figure 4 shows that 553 (35.79 %) commuters used motorcycles, 521 (33.72 %) respondents used cars, 101 (6.54 %) people used other modes and 370 (23.95 %) commuters used public transit buses. The analysis reveals that respondents between 18 - 30 years made 25.44% of the total trips in the study area, respondents between the ages of 31-40 years made 31.46% of the total trips, while 21.75% of the trips were made by respondents between ages 41-50 years. Another 13.07% of the trips were made by respondents between ages 51-60 years, while only 8.28 % of the trips were made by respondents above 60 years of age. The analysis shows that the active working population age bracket had 822 persons that make more trips than the age consisting of 330 persons and the youth involving 393 persons in the study area.

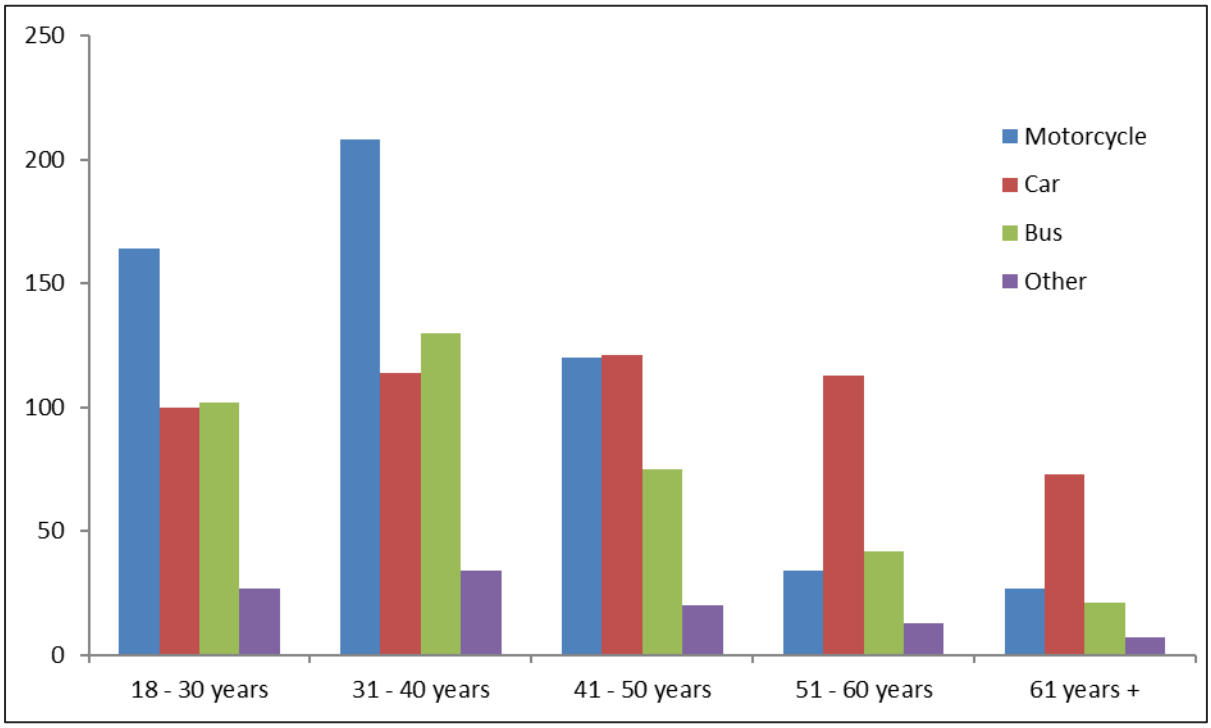

Figure 4: Age Group–Based Classification of Mode Choice.

The effect of the age of commuters on the choice of mode was established in Figure 2. It can be noted that older people tend to use their cars less compared to younger people. The use of public transit buses was chosen by the middle age group and motorcycles were more favoured by lower age groups.

The analysis showed that respondents earning ₦10,000 or less made 16.25 % of the total trips, 18.32 % of the trips were made by respondents earning between ₦11,000 - ₦25,000, group of

respondents earning between ₦26,000 - ₦75,000 made 32.75 % of the total trips in the study area. While 19.29 % of trips were made by respondents who earn between ₦76,000 - ₦100,000 and respondents earning ₦100,000 and above made the least 13.40 % of the trips in the study area.
The majority of the trips (32.75 %) were embarked upon by respondents earning ₦26,000 - ₦75,000. It implied that the respondents' trips increased progressively as they moved up the income ladder, while the active working population 'middle-income group' had a greater propensity of generating enormous trips. This could be a result of certain factors like improvements in income 'salaries/wages' of the respondents and the large number of civil servants that live in the selected towns in the study area.

Monthly Income was also found to influence the mode choice as in Figure 5. Car as a mode of travel was mostly preferred by the income group that earned between ₦76,000 - ₦100,000. However, motorcycles are mostly chosen by income groups that earn between ₦26,000 - ₦75,000.

Figure 5 shows that 554 (35.21 %) commuters used motorcycles, 570 (36.89 %) respondents used cars, 340 (22.01 %) people used other modes and 91 (5.89 %) commuters used public transit buses. The analysis shows that farmers made 16.76 % of the total trips, traders made 29.64 % of the total trips in the study area, government workers made 21.88 % of the total trips, 21.04 % of the total trips were made by private workers and 10.68 % of the total trips were made by retirees in the study area. Most of the trips in the study were made by traders to achieve their daily livelihood.

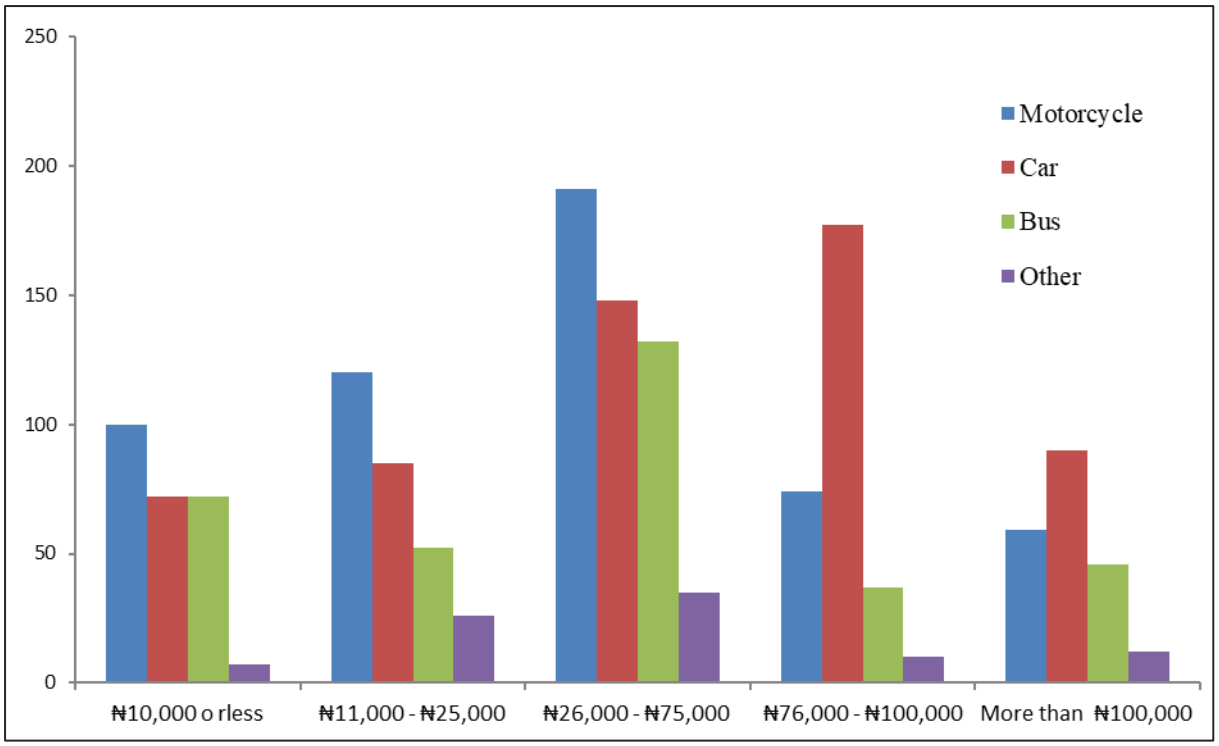

Figure 5: Monthly income-based classification of mode choice.

Occupation of commuters influenced the mode choice as in Figure 6. Car as a mode of travel was mostly preferred by traders to carry their wares to their business premises. However, motorcycles are the mode chosen by all commuters irrespective of occupation as an economic means of travel. It implied that motorcycles are the most available and affordable means of travel in the study area.

A hypothesis that the socioeconomic and travel factors do not significantly contribute to explaining the modal choice in the study area was formulated. The assumption was to conduct an inquiry into factors that contribute to explaining the modal choice of commuters in four towns namely Makurdi, Gboko, Katsina-Ala and Otukpo in Benue State. Multinomial logistic regression was used to test the null hypothesis because the dependent variable was nominal with more than two levels while the independent variables contained continuous and categorical data. The influence of various socio-economic and travel factors on the switching behaviour of commuters from motorcycle, car and other modes to bus were identified using SPSS version 23.

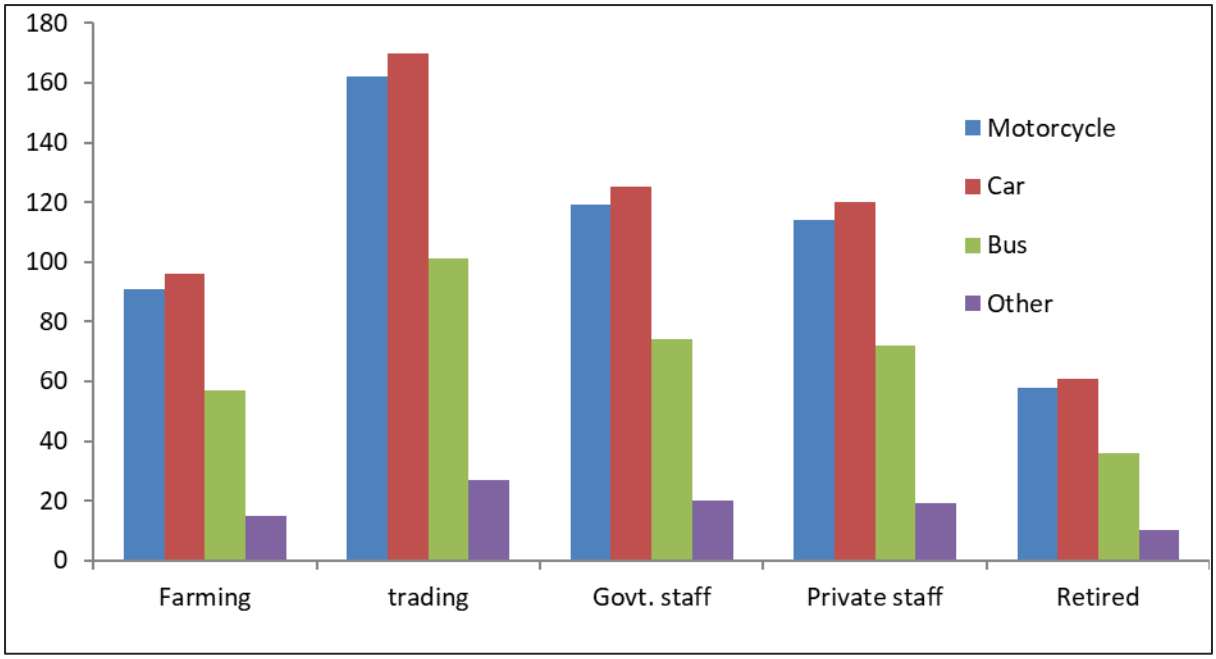

Figure 6: Occupation-based classification of mode choice

Multinomial logistic regression was used in SPSS version 23 to identify the influence of the various factors on the switching behaviour of commuters from motorcycle, car and other modes to bus. The mode of conveyance is chosen as a dependent variable since the problem was concerned with choice of mode which means switching behaviour of commuters. In order to get the preference of bus relative to other modes, bus was chosen as the reference category. The bus was compared with motorcycle, car and other modes separately to understand the factors and their degree of influence in shifting commuters from personalised modes like motorcycle, car and other to bus that is public transport. The independent variables namely age group, gender, income, occupation, level of education, vehicle owned, in-vehicle travel time, transport fare and safety were classified into various categories.

Table 1 above indicates mode choice case processing summary, in which N represents the number of observations under each case. The marginal percentage lists the proportion of valid observations found in each of the outcome variable's groups. Valid indicates the number of observations in the data in which the output variable and all predictor variables are non-missing.

Table 2 shows model-fitting information that was a statistical comparison of intercept-only model and final model. Intercept only describes a model that does not include any independent variable and simply fit an intercept to predict the dependent variable. Final described a model that included the specified independent variables and had been arrived at through an iterative process that maximised the log-likelihood of the outcomes. By including the independent variables and maximising the log-likelihood of the outcomes, the final model becomes an improvement on the intercept-only model to model. From the results of the statistical tests on the two models, the chi-square statistic showed the difference between the –2 log-likelihoods of the null/intercept-only and final models. Therefore, the model fitness was assessed using chi-square statistic. The chi-square value of the final model was 929.597 and the calculated P-value 0.001 was less than the critical P<0.05. It was concluded that the final model outperformed the null model and there was a significant relationship between dependent variable and independent variables in the final model.

Table 3 recorded that the Pearson (χ^2 = 4145.801, P = 0.001) and the deviance (χ^2 = 2124.696, P = 0.904) statistics in the Goodness-of-Fit tests proves that the model is fit because the deviance tests are not statistically significant, since the p-value is greater than 0.05.

From Table 4, the Pseudo-R^2 value of the final model according to Cox and Shell, Nagelkerke, and McFadden tests were 0.452, 0.495 and 0.245 respectively. Pseudo R^2 value indicates the proportion of variance of the dependent variable explained by the independent variables and its maximum value is 1. The large Pseudo-R^2 statistics indicate that a larger percentage of variation can be explained by the model. Therefore, based on the Pseudo R^2 values it can be concluded that the model developed in this study explains approximately 25 – 50 % variation. Therefore, the model can be considered statistically significant.

Table 1: Mode Choice Case Processing Summary

Factors selected	Categories	N	Marginal Percentage
Mode of travel	Motorcycle	544	35.2%
	Car	592	38.3%
	Bus	320	20.7%
	Other	89	5.8%
Age	18 - 30 years	465	30.1%
	31 - 40 years	592	38.3%
	41 - 50 years	341	22.1%
	51 - 60 years	98	6.3%
	61 years +	49	3.2%
Gender	Female	791	51.2%
	Male	754	48.8%
Marital status	Single	470	30.4%
	Married	756	48.9%
	Separated	121	7.8%
	Divorced	85	5.5%
	Widowed	113	7.3%
Monthly income	₦10,000 or less	284	18.4%
	₦11,000 - ₦25,000	284	18.4%
	₦26,000 - ₦75,000	599	38.8%
	₦76,000 - ₦100,000	167	10.8%
	More than ₦100,000	211	13.7%
Level of education	No formal education	126	8.2%
	Prim. School completed	236	15.3%
	Sec. School completed	502	32.5%
	Diploma/ATC completed	504	32.6%
	BSc/MSc/ PhD completed	177	11.5%
Motor vehicles owned	None	509	32.9%
	One vehicle	580	37.5%
	Two vehicles	274	17.7%
	Three vehicles	135	8.7%
	Four vehicles +	47	3.0%
In-vehicle travel time	Not Applicable	822	53.2%
	5 minutes or less	238	15.4%
	6 - 15 minutes	250	16.2%
	16 - 25 minutes	155	10.0%
	26 minutes +	80	5.2%
Transport fare in a week	Not Applicable	822	53.2%
	Less than ₦600 per week	284	18.4%
	₦600 - ₦1000 per week	87	5.6%
	₦1000 - ₦1600 per week	215	13.9%
	More than ₦1600 per week	137	8.9%
Public transport safety	Very satisfied	148	9.6%
	Satisfied	273	17.7%
	Undecided	822	53.2%
	Unsatisfied	203	13.1%
	Very Unsatisfied	99	6.4%
Total		**1545**	
Subpopulation		771[a]	

a. The dependent variable has only one value observed in 659 (85.5%) subpopulations.

Table 2 Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	**-2 Log Likelihood**	**Chi-Square**	**df**	**Sig.**
Intercept Only	3299.700			
Final	2370.103	929.597	99	0.001

P<0.05

Table 3: Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	4145.801	2211	0.001
Deviance	2124.696	2211	0.904

P<0.05

Table 4: Pseudo R-Square

Cox and Snell	0.452
Nagelkerke	0.495
McFadden	0.245

Table 5 shows the likelihood ratio tests indicating the contribution of each variable to the model. It was found that all variables except public transport safety have significance less than 0.05. Therefore, it can be concluded that all the variables used in the model have significant contribution toward predicting the mode choice behaviour of commuters. Among the variables; age, gender, marital status, household income, level of education, vehicle owned, in-vehicle time and transport fare are found to be the most significant.

Table 6 shows prediction accuracies that is 'overall goodness of fit' of the MNL model developed. It was found for each case that the predicted response category was chosen by selecting the category with the highest model-predicted probability. Cells on the diagonal are correct predictions. Cells off the diagonal are incorrect predictions. It was observed that out of the 544 commuters who are found to use motorcycles, the MNL model predicted the total number of motorcycle commuters as 408 and wrongly predicted that 111 motorcycle commuters used cars, 24 used buses, and 1 used other means of travel. Therefore, the accuracy of prediction for motorcycles was 75.0 %. Similar analysis on cars gave a prediction accuracy of 65.9 %, bus prediction accuracy of 55.0 % and other means of travel of 3.4 %. The model had an overall accuracy of 63.2 %.

Table 5: Likelihood Ratio Tests

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Intercept	2370.103[a]	0.001	0	.
AGE	2434.726	64.623	12	0.001
GEND	2407.266	37.163	3	0.001
MARST	2634.797	264.693	12	0.001
HINC	2449.813	79.709	12	0.001
EDLEV	2569.365	199.262	12	0.001
VEHOWN	2461.833	91.729	12	0.001
INVHTP	2394.626	24.523	12	0.017
FARE	2453.915	83.812	12	0.001
SAFE	2381.148	11.045	12	0.525

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table 6: Prediction Accuracies

	Predicted				
Observed	Motorcycle	Car	Bus	Other	Percent Correct
Motorcycle	408	111	24	1	75.0%
Car	131	390	71	0	65.9%
Bus	69	75	176	0	55.0%
Other	36	41	9	3	3.4%
Overall Percentage	41.7%	39.9%	18.1%	0.3%	63.2%

4.1 MNL Regression Model of Bus Relative to Motorcycle, Car and Other Mode in Benue State

The significant parameter estimates that summarise the effect of each predictor for commuters' choice of bus relative to motorcycle, bus relative to car and bus relative to other modes are expressed in Tables 7, 8 and 9 respectively. B values are the estimated MNL regression coefficients for the models. Parameters with negative coefficients decrease the likelihood of that response category with respect to the reference category. The Exp(B) values are odds ratios for the various categories of the predictors/dependent variables. The odds ratio of a coefficient indicates how the risk of the outcome falling in the comparison group compared with the risk of the outcome falling in the reference group changes with the variable concerned. The odds ratio value for each category of the predictors was computed with reference to a category of the same predictor, chosen by default. In this study, the third category of each predictor was chosen as reference by default.

Table 7 indicates that the MNL model estimates a unit increase in each variable affecting commuter's choice of bus relative to motorcycle when the other variables in the model are held constant.

i) Gender. Choice of mode, namely bus relative to motorcycle based on gender revealed that females have been found to have 0.383 times more chance of choosing motorcycle compared with bus.

The reason for their choice of motorcycle was that motorcycles travel faster even on poorly maintained roads and can drop passengers closer to their destinations rather than by bus as in Figure 7.

Figure 7: Poorly maintained Road in Otukpo Town

ii) Marital Status. MNL regression revealed the influence of marital status on choice of mode between motorcycle and bus. Those belonging to a single group have 93.223 times the chance of choosing motorcycle over bus, whereas those that are married have 250.702 times the chance of choosing motorcycle over bus, those that are separated have 87.930 times the chance of choosing motorcycle over bus and those that are divorced have 295.998 times the chance of choosing motorcycle over the bus. It shows that the more married and divorced persons, the more chances of switching from bus to a personalized mode that is motorcycle increases. The reason may be easier manoeuvring ability.

iii) Monthly income. MNL regression revealed the influence of income on choice of mode between motorcycle and bus. Those belonging to low monthly income group '₦10,000 or less' have 4.633 times the chance of choosing motorcycle over bus, whereas those with higher income level 'between ₦11,000 - ₦25,000' have 3.297 times the chance of choosing motorcycle rather than bus and those with higher income level 'between ₦26,000 - ₦75,000' have 3.894 times the chance of choosing motorcycle over bus. It shows that the lowest income group has a greater chance of switching from motorcycle to bus. It can be seen from Table 7 that among income categories, there was a substantial decrease in odds ratio between the three significant income groups. The reason for this could be the fact that commuters, especially middle and high-income groups could not reveal their actual monthly income. This could be a strategy to avoid being attacked by the criminals. Therefore, a specific logistic regression trend could not be maintained.

iv) Education level. Regarding the level of education attained over mode choice, the MNL regression model revealed that when compared with reference category, the respondents with secondary school education have 0.120 times more chance of choosing motorcycle over bus. The preference for motorcycle relative to buses could be due to the better manoeuvrability and accessibility of motorcycles.

v) In-vehicle travel time. The influence of in-vehicle travel time by a commuter over his/her mode choice behaviour, the MNL regression model revealed that when compared, in-vehicle travel time of commuters '16 - 25 minutes' have 4.248 times more chance of choosing motorcycle over bus. This could be because motorcycles could be used for fairly long trips as in Figure 8.

Figure 8: Commuter Patronise Motorcycle due to Better Manoeuvrability in Katsina-Ala Town

Table 7: Parameter Estimates of Choice between Bus and Motorcycle in Benue State

Mode of travel		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Motor - Cycle	Intercept	-5.110	1.467	12.133	1	0.000			
	[Gend=1]	-0.959	0.247	15.057	1	0.000	0.383	0.236	0.622
	[Marst=1]	4.535	0.770	34.699	1	0.000	93.223	20.616	421.545
	[Marst=2]	5.524	0.672	67.525	1	0.000	250.702	67.131	936.247
	[Marst=3]	4.477	0.742	36.349	1	0.000	87.930	20.517	376.836
	[Marst=4]	5.690	0.867	43.061	1	0.000	295.998	54.096	1619.621
	[Hinc=1]	1.533	0.353	18.886	1	0.000	4.633	2.320	9.250
	[Hinc=2]	1.193	0.334	12.762	1	0.000	3.297	1.713	6.344
	[Hinc=3]	1.360	0.328	17.181	1	0.000	3.894	2.048	7.407
	[Edlev=3]	-2.120	0.433	23.984	1	0.000	0.120	0.051	0.280
	[Invhtp=4]	1.446	0.593	5.951	1	0.015	4.248	1.329	13.580

The reference category is Bus.

Table 8: Parameter Estimates of Choice between Bus and Car in Benue State

Mode of travel		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Car	Intercept	2.933	1.272	5.317	1	0.021			
	[Age=1]	-1.544	0.605	6.505	1	0.011	0.214	0.065	0.699
	[Age=2]	-1.419	0.600	5.586	1	0.018	0.242	0.075	0.785
	[Marst=2]	1.115	0.449	6.170	1	0.013	3.049	1.265	7.350
	[Marst=3]	-2.545	0.677	14.136	1	0.000	0.078	0.021	0.296
	[Marst=4]	2.097	0.678	9.563	1	0.002	8.143	2.155	30.763
	[Hinc=1]	1.206	0.328	13.510	1	0.000	3.342	1.756	6.358
	[Hinc=2]	1.049	0.322	10.619	1	0.001	2.854	1.519	5.361
	[Hinc=3]	0.684	0.308	4.922	1	0.027	1.981	1.083	3.624
	[Hinc=4]	-0.947	0.348	7.406	1	0.007	0.388	0.196	0.767
	[Edlev=3]	-1.884	0.418	20.359	1	0.000	0.152	0.067	0.344
	[Edlev=4]	-1.773	0.441	16.187	1	0.000	0.170	0.072	0.403
	[Vehown=1]	-0.332	0.491	0.456	1	0.500	0.718	0.274	1.880
	[Fare=2]	-1.047	0.404	6.704	1	0.010	0.351	0.159	0.775
	[Fare=3]	-1.187	0.474	6.284	1	0.012	0.305	0.121	0.772
	[Fare=4]	-0.762	0.396	3.711	1	0.054	0.467	0.215	1.013

a. The reference category is: Bus.

Table 8 indicates that the MNL model estimates a unit increase in each variable affecting commuter's choice of car relative to bus, when the other variables in the model are held constant. These observations were made based on the parameters estimated through MNL regression.

i) Age group. MNL regression analysis of those who choose car relative to bus observed that commuters of age group '18 - 30 years' has 0.214 times as much chance of choosing a car rather than bus and age group '31 - 40 years' have 0.242 times as much chance of choosing car rather than bus. It can be seen that the choice of car over to bus is prevalent lower age groups.

ii) Marital status. Regarding the influence of marital status over choice between car and bus, married people have 3.049 times more chance of switching to a car from a bus, separated persons have 0.078 times more chance of switching to car from bus and divorced people have 8.143 times more chance of switching to car from bus The reason may be that the people have to conserve their resources for other uses, therefore, they prefer bus to car.

iii) Monthly income. MNL regression revealed the influence of income on choice of mode between car and bus. Those belonging to low monthly income group '₦10,000 or less' have 3.342 times the chance of choosing a car over the bus, whereas income level 'between ₦11,000 - ₦25,000' have 2.854 times the chance of choosing car over bus, those that on income level 'between ₦26,000 - ₦75,000' have 1.981 times the chance of choosing car over bus, and those with higher income level 'between ₦76,000 - ₦100,000' have 0.388 times the chance of choosing car over bus irrespective of maintenance costs as in Figure 9. It shows that the lower income group that has access to private cars may be faced with huge car maintenance charges and to avoid car maintenance charges, they indicated a greater chance of switching from car to bus to cut costs.

iv) Education level. The preference for car relative to bus is lower for those with secondary school certificates than for those with higher educational background like university graduate certificate holders. Commuters with secondary school certificates have a 0.152 times chance of choosing car over bus, and respondents with higher certificate like degree have 0.170 times as much chance of choosing car rather than bus. The reason may be that respondents with higher certificates like degrees have families and dependents.

Figure 9: Use of Car by High Income Group in Gboko Town

v) Vehicle ownership. In general, captive riders have many choices to make. Multinomial analysis reveals that captive riders using buses have a 0.718 times chance of choosing car to bus. The MNL model has correctly predicted captive riders as their odds ratio is not up to one.

vi) Transport fare. The analysis revealed that the commuters' group spending 'less than ₦600 per week' has 0.351times chance of choosing car

rather than bus, the group spending '₦600 - ₦1000 per week' has 0.305 times as much chance of choosing car to bus and the group spending '₦1000 - ₦1600 per week' have 0.467 times greater chance of choosing a car to bus. As the spending on transport fare increases, commuters prefer cars over buses and abandon use of bus as in Figure 10. An increase in transport fare may be indications of fuel hike, and traffic congestion. Therefore, it can be concluded that as congestion increases, commuters switch from bus to car abandoning commercial bus.

Figure 10: Commercial Bus waiting for Passengers in Makurdi Town

Table 9 indicates parameter estimates of choice between bus and other modes. The MNL model estimates show unit increase in each variable affecting commuter's choice of other means of travel mode relative to bus when the other variables in the model are held constant.

i) Age group. MNL regression analysis shows that those in the age group '18 - 30 years' have 0.099 times chances of choosing other mode rather than bus and the commuters of age group '41 - 50 years' have 0.022 times as much chance of choosing other mode rather than bus. It can be seen that the preference for other modes relative to buses is higher for higher age groups. This is apparent as mature men often drive heavy-duty vehicles when compared to young people.

ii) Marital status. The influence of marital status on choice between other mode and bus, when compared with widowed, married people have 6.577 times more chance of switching to other mode from bus. The reason may be that not many married people are comfortable using other modes due to loss of prestige, and therefore they prefer buses to other modes of travel.

iii) Monthly income. The income group '₦26,000 - ₦75,000' has a 2.558 times chance of moving from other mode to bus. This may be due to an increase in the financial position of the commuter.

iv) Education level. The switching ability from other modes relative to bus is lower for university degree holders and higher for secondary school certificate holders. The secondary school certificate holders group have 0.269 times greater chance of switching from other mode to bus, while University degree holders group have 0.211 times greater choice from other mode to bus.

v) Vehicle ownership. The MNL reveals that commuter groups with one vehicle have 0.252 times the opportunity to switch from other mode to bus. It can be seen that people with one vehicle are bound to make another choice during the breakdown of their vehicle.

vi) Transport fare. The MNL shows that commuter groups spending '₦1000 - ₦1600 per week' have 4.892 times more choice to switch from other mode to bus, probably due to fuel hike.

Table 9: Parameter Estimates of Choice between Bus and Other Modes in Benue State

Mode of travel[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Other mode	Intercept	0.568	1.908	0.089	1	0.766			
	[Age=1]	-2.315	0.844	7.526	1	0.006	0.099	0.019	0.516
	[Age=3]	-2.141	0.937	5.217	1	0.022	0.118	0.019	0.738
	[Marst=2]	1.884	0.875	4.636	1	0.031	6.577	1.184	36.534
	[Hinc=3]	0.939	0.478	3.856	1	0.050	2.558	1.002	6.534
	[Edlev=3]	-1.313	0.566	5.385	1	0.020	0.269	0.089	0.815
	[Edlev=4]	-1.556	0.619	6.330	1	0.012	0.211	0.063	0.709
	[Vehown=2]	-1.380	0.684	4.072	1	0.044	0.252	0.066	0.961
	[Fare=4]	1.588	0.591	7.225	1	0.007	4.892	1.537	15.568

a. The reference category is: Bus.

4. Conclusions

Critical thought based on users' socio-economic conditions and mode choice of travellers is vital for planning a sustainable transportation system. This study has provided an idea about the urban commuter mode choice in Benue State. Age, gender, marital status, household income, level of education, vehicle ownership, in-vehicle time and transport fare are found to be attributes that have the most significant contribution towards predicting the mode choice behaviour of commuters in Benue State.

The age-wise comparison revealed that motorcycles are often used by lower age groups, whereas preference for cars is higher among higher age groups. It could be concluded that the working class make more trips using motorcycles, businessmen groups (traders) generate more trips using car mode of transport, high-income earners use motor cars more than other means of transportation. Motorcycles are generally patronised by low-income commuters as an economic means of travel because it saves time and can drop passengers in remote areas. This study agreed with Ashalatha *et al*., (2013) that cars are preferred among higher age groups and, Kolawole and Afolabi (2017) that low-income commuter's patronised motorcycles since it save time.

The use of MNL modelling in this study informed the policymakers of the commuter's mode choice and their preference for public transport system. It is recommended that there is a need to improve the existing public transport system so that it can be made more attractive. This will ensure that more commuters shift from personalised mode to the public transport system. Such a shift is highly recommended for a developing country like Nigeria, since it will ensure large reduction in traffic volume along already congested urban routes, and will reduce traffic delay, and save fuel consumption.

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