Journal of Inventive Engineering and Technology (JIET)
ISSN: 2705-3865
Volume-6, Issue-3, pp-54-67
www.jiengtech.com
Research Paper Open Access

Mode Share Modelling of Trip Making in High Density Residential Area of Kano City-Nigeria

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ABSTRACT : The purpose of this study is to find the mode share between public transport and private car by investigating factors that affect mode choice and developing utility models for various modes in the study area Kurna Asabe, Kano city. The methodology involved administering 500 questionnaires to collect data with particular interest to socio-economic characteristics and level of service in the study area, out of which 461 questionnaires were fully completed and returned for analysis. Data was analyzed using Statistical and Logical inferences. Multinomial Logit model was developed to determine the main indicators of travel for the study area. The result of regression analysis shows that there is a strong relationship between the dependent and the independent variables. From the Statistical analysis conducted, various p-values obtained were lower than the significance level of 0.05 and t-values greater than the critical t-value of 1.96 at 95% confidence level. From the Utility model developed, the mode share was found to be 3,828 (16.4%) for personal car, 3,519 (15.0%) for Bus, 3,131 (13.4%) for Taxi, 3,428 (14.6%) for Tricycle. This indicate that 9,886 (42.3%) trip makers have preference for private transport mode while, 10,078 (43.0%) for public transport in the study area. The car mode shares of 42.3% is considerable therefore, to persuade travelers by car to switch to public transport mode there is need for efficient and reliable public transport system. Mode share of Tricycle could also be transferred to the other public transport modes especially the Bus mode if the users are encouraged by making provision of public transport modes. The study recommends that; Private car usage should be discouraged by the policy makers through provision of effective and reliable public transport system in order for users to shift to public transport or non-motorized modes of travel.

***KEYWORDS*:** *Mode Share, Public Transport, Car, Tricycle.*

Date of Submission: 25-12-2024 Date of acceptance: 30-12-2024

I. INTRODUCTION

A trip from an origin to a destination for a specific reason that requires unique trip planning is referred to as transportation. Vehicle and passenger excursions from one origin to a different destination are the outcome of these decisions. Basic knowledge of transportation requires an awareness of trip characteristics as well as the infrastructure and services that support them. The infrastructure and services that enable movement make up transportation networks. The relationship between travel patterns (individual trip making behavior) and the facilities and services that support them are the features of this travel. [1].

Most transportation analyses and policy decisions are based on transportation facilities and the regional economic, social, and environmental context. It is evident that a greater number of people than ever before live and work in cities, and that a greater number of people and things will travel through metropolitan areas [2].

Long-distance travel became a major transportation issue in the city as the population and geographical area of the city grew.

In many cities throughout the world, one approach to addressing this issue is the development of road transportation infrastructure, which in turn promotes the dispersion of metropolitan areas and lengthens and complicates intra-city travel. Around the world, a lot of work has gone into managing urban transportation, particularly in wealthy nations. As a result, numerous research on urban family travel have been conducted in an effort to quantify the scope and nature of the issues related to urban travel [3].

Kano urban center today is very complex in nature, covers large expanse of land, and accommodates varied activities. It is also growing fast, both in population and in spatial terms. An outcome of this development is that the urban center generates and attracts very large number of person trips daily. However, increase in the volume of personal vehicles plying intra-urban road in the state and the inadequacy has accentuated transport problems in Kano. The public transport system in Kano is largely in private hands and appears to be uncoordinated and ineffective. It is therefore important to understand the modal split pattern in the state. Present economic condition has made it difficult for the high-density communities to comfortably and reliably commute from one point to another. Transport authorities can only assist if the character of these movements can be identified. Therefore, the need for studies to examine the factors that influence trips will provide the basis for comparing trip characteristics of different areas within the State metropolitan and also will provide transportation policy makers with information for transport policy decisions. Transportation planners must also be familiar with modal split information which is currently not available because they define the substance and scope of transportation problems, as well as provide useful indications of possible solutions. The changing pattern in the lifestyle of urban residents requires that data on households' characteristics be collected and analyzed on regular basis with a view to identifying the effects of these changes on the travel in urban centers especially in large cities like Kano. This research will assist in developing a comprehensive understanding of the trip characteristic behavior of individuals in the study area. It will provide information on the relative importance of different modes of transport choice in high density communities. Modal split assessment will point to a direction for transportation planners to deal with public transport issues. The study can provide the transport needs of specific interest groups such as school children, female, the disabled etc. [4].

II. METHODS

A. Study Area

Kurna residential area under Dala LGA of Kano State is a densely populated area located on Latitude 12 01'N and Longitude 8 29'E in the North – West part of the Kano metropolis. Among the prominent areas within the locality include; Kurna Babban Layi, Kurna Tudun Bojuwa, Kurna Tudun Fulani and Kurna Makaranta. The entire area is popularly referred to as KurnaAsabe. KurnaAsabe is endowed with economic and commercial activities amongs which include Dyeing, Blacksmith, Shoe making, retailing businesses and other commercial undertakings. Besides these Kurna Asabe is a residential area. As a result of these commercial activities, various modes of transportation such as Taxi, Bus, Private cars, Tricycle, Motorcycle and Bicycle operate in the area. Kurna residential area is predominantly low-income community while, middle class income and high income also formed part of the community. Kurna residential area is occupied by low-income groups. The characteristics of the area meet the objectives of the research. The entire Kurna area is about 3.96 sqkm but the surveyed area is only a portion with approximately 0.40 sqkm of the total area. The chosen study area as indicated in the demarcated portion of the image is Kurna Tudun Fulani and Tudun Bojuwa all under Kurna A. The population of each area as well as the population of the entire local government area was obtained from the Population Commission (NPC) and projected for year 2017 at a growth rate of 3.2% (NPC) as presented in Table 1.

Table 1: Population of the Study Area

Area	Population Fig. (2006)	Projected Fig. (2017)
Dala LGA	418,777	592,188
Kurna A	16,548	23,400
Kurna B	9,937	14,052
Kurna C	16,256	22,986

Source: (National Population Commision, 2006)

B. Data collection

For the purpose of this study, a survey was conducted through a structured questionnaire and interviews for commuters, the following variables were considered;

1. Level of Service variables
a. In vehicle Travel Time
b. Cost
2. Socio economic variables
a. Income level
b. Car ownership
c. Age
d. Gender
e. Mode of travel choices (Personal car, Taxi, Bus, Tricycle, Motorcycle, Walking).

III. RESULTS AND DISCUSSION

A. Influence of Age on Mode

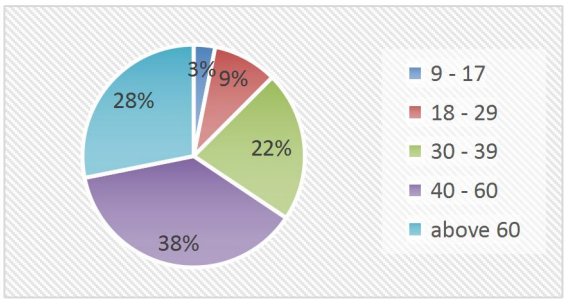

Fig. 1: Percentages of Age Categories using car

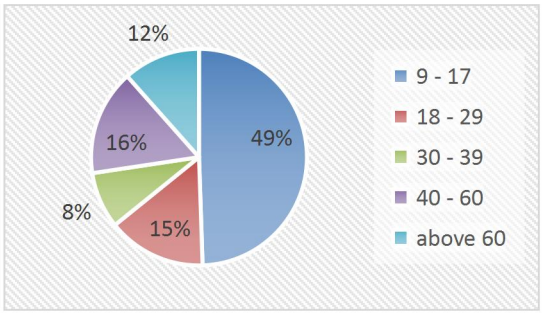

Fig. 2: Percentages of Age Categories using bus

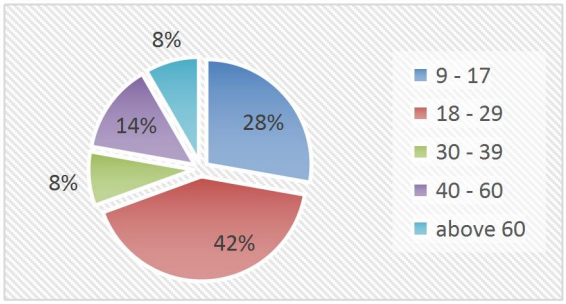

Fig. 3: Percentage of Age Categories using Taxi

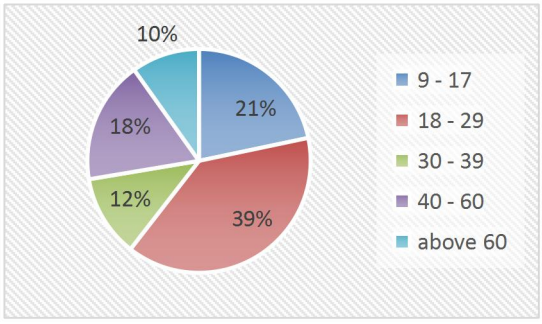

Fig. 4: Percentage of Age Categories using Tricycle

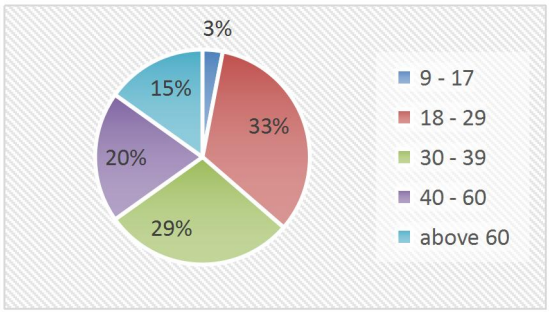

Fig. 5: Percentage of Age Categories using Motorcycle

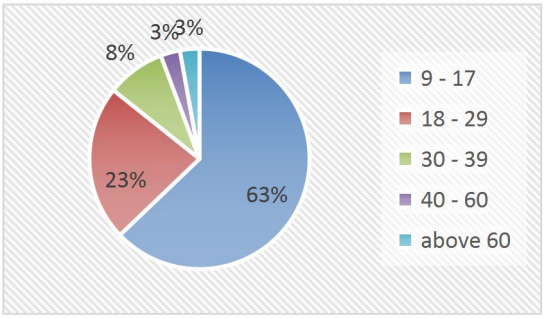

Fig. 6: Percentage of Age Categories using Bicycle

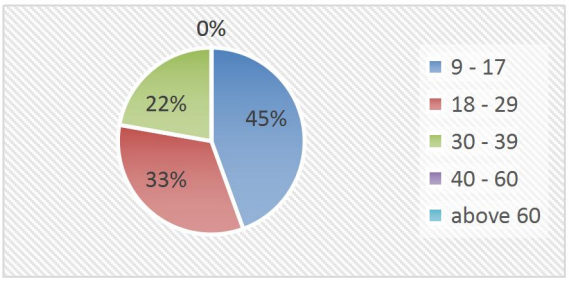

Fig. 7: Percentage of Age Categories for walking

Results obtained from Fig.1 indicate that, respondents aged 40 - 60 years and above 60 prefer the car mode and this constitute 66%. Certain number of middle age group 30 -39 years also use car as means of trip making in the study area. While, age group between 18 – 29 considered as active age with percentage of 9% use personal car as means of trip making. Young persons in the age brackets of 9 – 17 years are the least in the use of car for travel purposes. This may be due to their inability to buy cars because of their economic status. Furthermore, respondents in these age brackets may be dependent on their households that own more than one car. The Bus mode age distribution shown in Fig. 2 points to the younger respondents as the main users of the mode in making trips and constitute 49% of the members. The active age groups between 30 – 39 shows to be the least respondents and have a share of 8%. The elderly group 40 -60 and above 60 years make up 28% of the bus mode share users. The taxi mode share by age has the distribution as shown in Fig. 3. The young respondents in the age group of 9 – 17 years and 17 – 29 years are dominant in the use of this mode with combine share of 70% leaving 30% for the other age groups. The elderly respondents above 60 and the active age group of 30 – 39 years are the least with 8% mode share each. Tricycle mode in Fig.4 is dominated by the young respondents 9 – 17 years and 18 – 29 years' group, their combined mode share is 60%. The least age categories using Tricycle as means of trip making are age group above 60 years. The chart on Fig.5 illustrates a similar pattern of motorcycle usage among the young age group of 18 – 29 and middle age group 30 – 39 as well as the elderly group. The combined proportion of motorcycle usage clearly implies that the younger group 9 – 17 years hardly find the means of possessing personal motorcycle by virtue of their age and income. The chart on Fig. 6 points to the younger respondents as the main users of bicycle as the mode in making trips and constitute 63% of the members. The walking age categories is dominated by the young respondents in the age group 9 – 17 and group age 18 – 29 and their combined mode share is 78% as presented in Fig.7.

B. Influence of Income on Modes

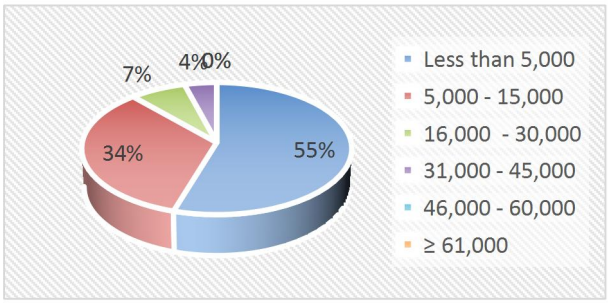

Fig. 8: Income/month of respondents for Bus

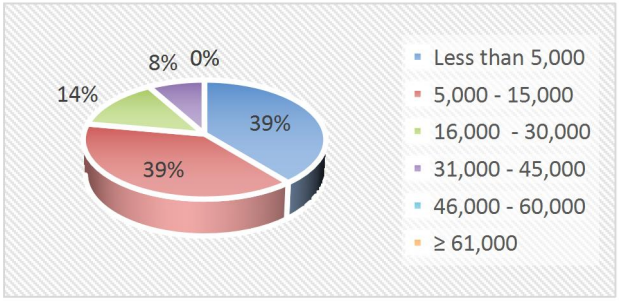

Fig. 9: Income/month of respondents for Taxi

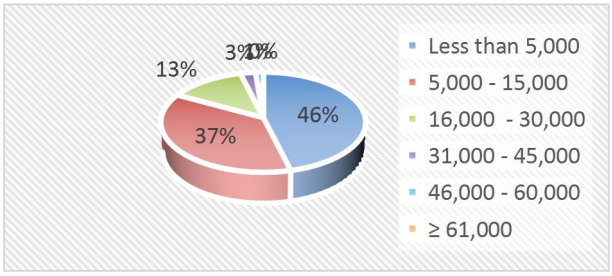

Fig. 10: Income/month of respondents for Tricycle

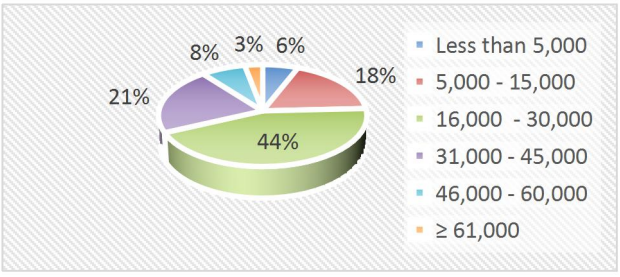

Fig. 11: Income/month of respondents for Motorcycle

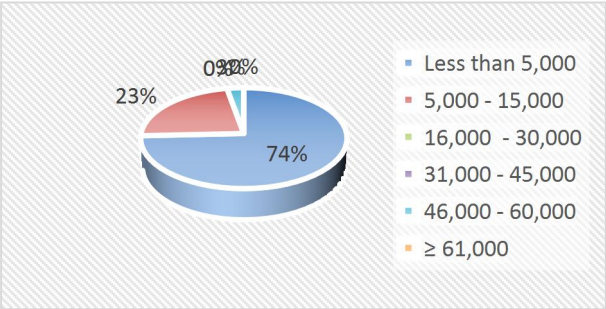

Fig. 12: Income/month of respondents for Bicycle

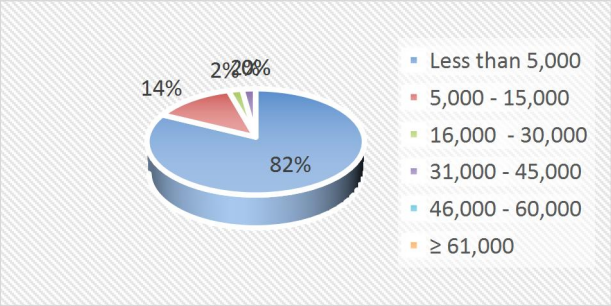

Fig. 13: Income/month of respondents for walking

Fig.8 illustrates the respondent's income status in the use of bus mode for trip purpose. Bus mode is relatively cheap compare to other means of trip making except walking for a short distance trip. This implies why the unemployed group and the low-income respondents constitute the highest among those who prefer bus mode for trip making with combined proportion of 96%. However, the middle class who can rather afford a much better and convenient mode constitute only 4%. High income group who prefers using personal mode were not reported to use bus mode in the study area. Similar pattern of bus mode choice by income level is also shown for the taxi mode in the Fig.9. Taxi mode is also another means of trip making having a cheap fare like that of bus mode. The unemployed group and the low-income class proved to be the highest users of taxi mode for trip purpose in the study area with combined percentage of 92% while, the middle-income class has only 8% representation. The high-income group did not employ taxi as a mode in trip making. Tricycle mode share by income has the distribution as shown in Fig.10. Unemployed group and the low-income group are the dominant in the use of this mode with combine share of 96%. Tricycle mode is a bit high in fare compared to the taxi and bus mode but, it is more readily available and can access areas where the latter cannot reach. Middle income class also uses the tricycle mode with very few respondents reported in the study area. No respondents were reported from the high-income group in the study area. This could be due to the ability to afford personal mode for their trip making. The mode share distribution by income for motorcycle mode shown in the Fig.11 illustrates interesting features. Low-income class and unemployed group account for the highest percentage (68%) of the respondents using motorcycle for trip purpose in the study area. Income of (16,000 – 30,000) among the low-income class shows to dominate the use of motorcycle and can comfortably maintain the mode at their income level. The Fig.11 also illustrate that the 3% of the high-income group using motorcycle in the study area, may be mostly at their leisure time or avoiding traffic congestion on a particular day and reducing running cost on their personal car. The users of the bicycle mode have income distributed as in Fig.12. The unemployed group and the low-income group dominate in the use of bicycle and have combine share of 97%. Bicycle is the cheapest non-motorized mode that can be used with little maintenance and running cost. However, it is also a good means of exercising the body and help in decongestion of roadway if the other road user can switch to the mode. The middle-income class also recorded only 3% which may be considered to be for leisure. The large proportion of unemployed respondents using walking mode in the Fig. 13 depict how critical the economic condition of the area. The low-income group having combine share of 16% are pedestrian. However, high income group who can afford better means of trip making shows zero record of trip making by walking. When pedestrian facilities and cycling facilities are promoted, respondents in the higher income bracket could be encouraged to switch to walking for health and leisure purpose. This will promote liveability in neighborhoods.

C. Influence of Income on Modes

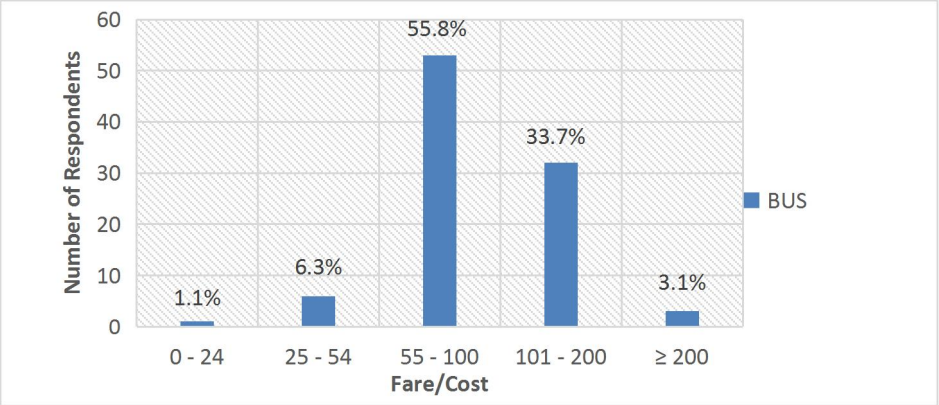

Fig. 14: Percentages of fare for respondents using Bus mode

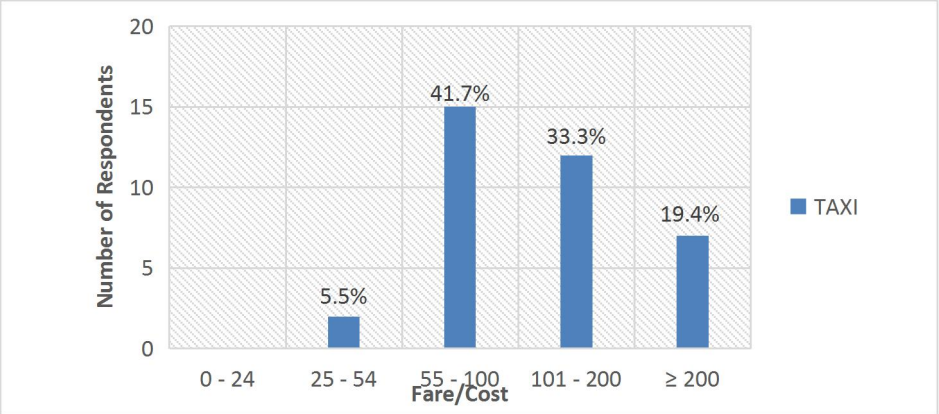

Fig. 15: Percentage of fare respondents using Taxi mode.

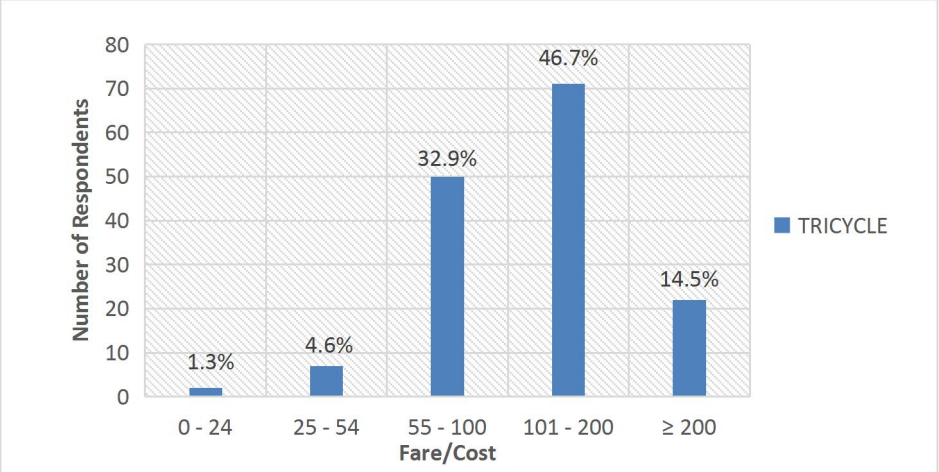

Fig. 16: Percentage of fare respondents using Tricycle mode.

Generally, trip making at lower fare (₦0 - ₦54) recorded very low respondents with combine percentage of 7.4%. This could be due to the current economic situation and the hike in the price of petrol. Considering the fact that bus mode is relatively cheap compare to other commercial mode, the least acceptable fare for a considerable trip length is within (₦55 – ₦200) with combine percentage of 89.5% as shown in Fig. 14, while it is very rare to have bus fare above ₦200. This implies that, government intervention is highly required in the

transportation system especially in the provision of affordable transit bus for low-income communities. Taxi mode share distribution by fare is presented in the Fig. above. Taxi mode shows to be relatively higher in fare than bus mode as indicated in the distribution. No taxi mode can accept the least fare of (₦0 - N24) as shown in the Fig. 15. The percentage of respondents here spending above ₦200 is much compare with that of bus mode which implies that taxi mode charge high transport fare in this study area when compare with bus mode. Tricycle mode distribution in relation to fare is as presented in Fig. 16. The distribution pattern clearly indicates how tricycle mode is higher in fare compare with other two modes earlier discussed. Transport fare distribution between ₦101 – ₦200 and above for tricycle mode reported 46.7% which is higher than that reported for bus and taxi as 33.7% and 33.3% respectively. This implies that tricycle mode is higher in fare in relation to the other two commercial modes (bus and taxi) in the study area. However, tricycle can deliver door step service which the other two modes cannot. Table 2 presents the influence of in time vehicle travel time for the different modes of trip.

Table 2: Influence of In-vehicle (IVT) Travel time on the Modes

In-Vehicle Time	Personal car	Bus	Taxi	Tricycle	Motorcycle	Bicycle	Pedestrian	Grand Total
≤15	1	24	9	40	18	7	33	132
16 – 30	25	63	22	90	42	25	12	279
≥30	6	8	5	22	6	3		50
Total	32	95	36	152	66	35	45	461

In-Vehicle time has a very strong influence on modes in any residential settings. It is one of the key factors that determine how reliable a mode is to a trip maker. The In-Vehicle time is the time spent by a traveler from when the vehicle moves to the time he arrives at his destination.

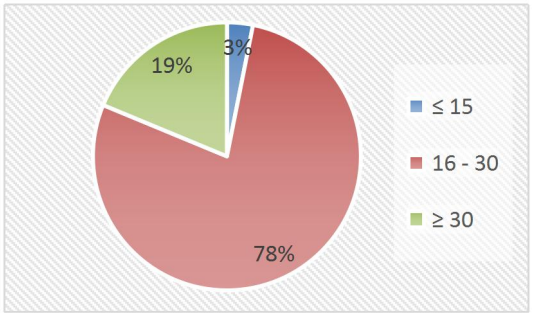

Fig. 17: Percentage of IVT on Personal Car

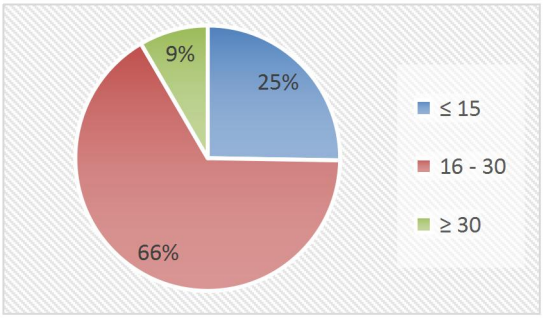

Fig. 18: Percentage of IVT on Bus

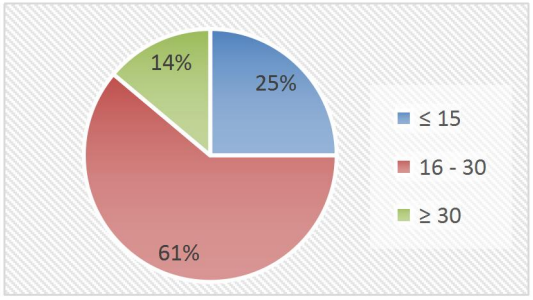

Fig. 19: Percentage of IVT on Taxi

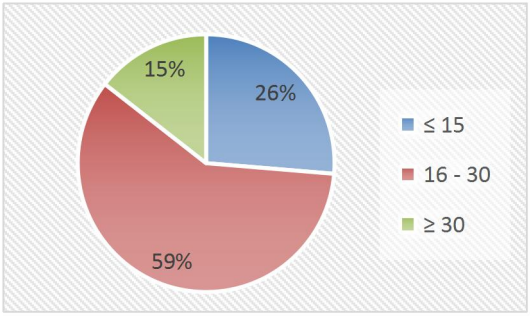

Fig. 20: Percentage of IVT on Tricycle

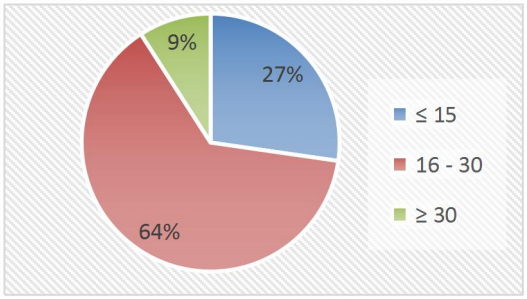

Fig. 21: Percentage of IVT on Motorcycle

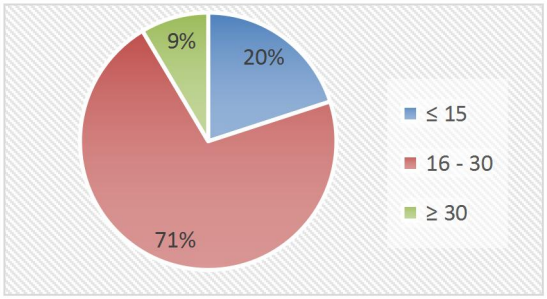

Fig. 22: Percentage of IVT on Bicycle

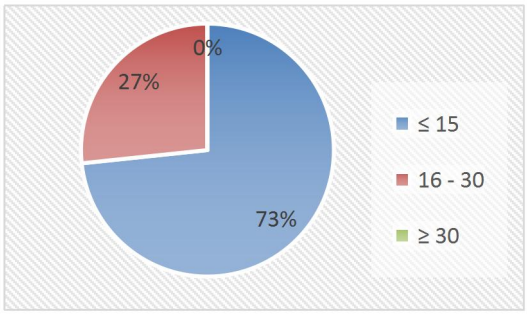

Fig. 23: Percentage of IVT on Pedestrians

Fig. 17 illustrate the influence of In-Vehicle time on personal car in the study area. Majority of the respondents in the study area reported spending 16 – 30 minutes in-vehicle travel time from home to their respective destinations. 3% spent at most 15 minutes in-vehicle trip time. The combine proportion of respondents that spend between less than 15 minutes and 30 minutes is 34% which is less than those that spend between 16 – 30 minutes in-vehicle time. Fig. 18 and 19 shows similar proportion of respondents spending maximum of 15 minutes and minimum of 30 minutes in-vehicle time were observed for both bus and taxi mode. Bus and Taxi mode both share same station in the study area indicating that people have to walk or board tricycle mode to the station before departing to their various destination. This increases the frequent usage of tricycle in the study area. Majority of the respondents reported spending between 16 -30 minutes in-vehicle travel time before reaching their destination. The combined proportion of respondents spending between less than 15 minutes and 30 minutes has 41% as shown in Fig.20, which is less than respondents spending 16 – 30 minutes in-vehicle travel time. Combine proportion of the respondents spending between 16 – 30 minutes and above reported 73% while, only 27% of the respondents reported 15 minutes at most. Majority of the residents of the study area have similar in-vehicle travel time characteristic. Cycling is sometimes regarded as means of deriving leisure for high income earners while it a necessity for a low-income earner who can afford the means. Fig. 21 shows the In-vehicle time for motorcycles with a proportion of the respondents spending 16 – 30 minutes is 64%. The trend in Fig.22 of the time spent for Bicycle riders implies it is mostly used for a short distance trip for a period between less than 15 minutes and 30 minutes. While, very few travel for between 30 minutes and above this period. Household members who spent less than 15 minutes walking to their destination reported 73% as shown in Fig.23, while 27% for those who spent 16 – 30 minutes walking while, no respondent who walk for 30 minutes and above was reported. This indicates that household members who choose to walk as means of trip making do that only for a short distance trip.

D. Modeling Mode Choice and Utility Function

Therefore, the value of a trip can be formulated as

$$\prod = A + IVT + IC + W \quad (1)$$

Where A = Age

Table 3 – 9 presents the model outputs for all the mode share trip in the study which are, Taxi, Car, Bus, Tricycle, Motorcycle, Bicycle and Walking.

Table 3: Model output for Taxi

Variables	Coefficients	T-Statistics	P-Value
Intercept	0.1873	1.9526	0.0650
Age	0.0104	3.7166	0.0014
Income	9.81E-07	0.3223	0.7506
Cost	0.0004	0.8252	0.4190
In-Vehicle time	-3.81E-05	-0.0117	0.0990

IVT = In-vehicle travel time in minutes

IC = Income/month

W = Cost/Fare (Running cost for personal modes/Transport fare for commercial modes)

The analysis was carried out at a confidence level of 95% (significance level of 0.05). The resulting model's outputs are presented in the following tables.

Table 4: Model output for Personal Car

Variables	Coefficients	T-Statistics	P-Value
Age	0.0212	3.0652	0.0084
Income	1.67E-06	0.5017	0.6227
Cost/Fare	-0.0012	-1.2504	0.2316
In-Vehicle time	-0.0008	-0.0814	0.9363

Table 5: Model output for Bus

Variables	Coefficients	T-Statistics	P-Value
Intercept	0.6053	5.7939	7.86E-07
Age	0.0012	1.4466	0.0658
Income	1.06E-6	1.6089	0.8729
Cost	-0.0009	1.3644	0.0179
In-Vehicle time	0.0010	0.2045	0.8389

Table 6: Model output for Tricycle

Variables	Coefficients	T-Statistics	P-Value
Intercept	0.5897	8.0387	8.5E-12
Age	-0.0044	2.4592	0.0162
Income	4.77E-6	2.4343	0.0172
Cost	0.0003	0.8323	0.4078
In-Vehicle time	0.0012	0.4489	0.6548

Table 7: Model output for Motorcycle

Variables	Coefficients	T-Statistics	P-Value
Age	0.0134	3.3779	0.0022
Income	8.68E-10	0.0003	0.9997
Cost	-0.0002	-0.2935	0.7713
In-Vehicle time	0.0062	1.5704	0.1276

Table 8: Model output for Bicycle

Variables	Coefficients	T-Statistics	P-Value
Intercept	0.2659	1.3191	0.2099

Age	-0.0075	-1.6702	0.1188
Income	9.14E-5	2.7421	0.0167
Cost	-0.0003	-0.3667	0.7197
In-Vehicle time	0.0008	0.1692	0.8683

Table 9: Model output for Walking

Variables	Coefficients	T-Statistics	P-Value
Intercept	-0.0498	-0.0989	0.9259
Age	-0.0209	2.4134	0.0733
Income	9.8E-05	3.5571	0.0236
Cost	-0.0133	-1.3066	0.2614
In-Vehicle time	0.0400	1.1717	0.3064

The calibrated models are as given below:

- $U_{PC} = 0.021\text{A} - 0.0012\text{W} - 0.0008\text{IVT}$
- $U_{BUS} = 0.6053 + 0.0012A - 0.0009W$
- $U_{TAXI} = 0.1873 + 0.0104A - 3.81x10^{-5}\,IVT$
- $U_{TRICYCLE} = 0.5897 - 0.0044A + 4.77x10^{-6}\,IC$
- $U_{MOTORCYCLE} = 0.0314A - 0.00024W$
- $U_{BICYCLE} = 0.2659 + 9.14x10^{-5}IC$
- $U_{WALKING} = -0.0498 - 0.0209A + 9.8x10^{-5}IC$

E. Validation

This is a very important process to evaluate the performance of the calibrated model and its ability to predict mode choice for data other than that use for calibration process. The validation was conducted using about 40 households which is equivalent to 1/3 of the data obtained and use in the calibration. The models obtained in the calibration process were used to calculate the utility of each mode in the validation process. The predicted utility values for the respective modes are calculated using the validation data obtained from another study area (Dorayi, Gwale LGA) by substituting the data into the above respective functions. Average predicted value for each mode was obtained as presented in Table 10.

Table 10: Chi-Square Test (Average Predicted and Observed Utility)

Modes	Observed Utilities	Predicted Utilities	O – P	$(O - P)^2$	$(O - P)^2/P$
Personal Car	0.7609	0.6268	0.1341	0.0180	0.0287
Bus	0.4450	0.5427	-0.0977	0.0095	0.0176
Taxi	0.3733	0.4256	-0.0523	0.0027	0.0064
Tricycle	0.4788	0.5161	-0.0373	0.0014	0.0027
Motorcycle	0.6000	0.4243	0.1757	0.0309	0.0727
Bicycle	0.5125	0.3596	0.1529	0.0234	0.0650
Walking	0.4686	0.5185	-0.0499	0.0025	0.0048
				Calculated Chi Square =	0.1979
				Df =	6
				Chi Square Table Value =	12.59

Chi Square test was also conducted to further determine whether this difference is significant between the observed and predicted utilities. The null hypothesis stated that there is a significant difference between the observed utility and predicted utility. The alternative hypothesis states that there is no significant different. The test was carried out and presented in Table 10. The utility values are all positive signifying the preferences shown by the trip makers towards the available modes in the study area. The utility function generally talks about the satisfaction that is derived from making a choice from set of different alternatives. From the result presented in Table 10 each utility value depending on its magnitude indicate the proportion of trip maker going

for the particular mode while the sign of the utility value (positive) shows extent of the preference. A negative utility may likely indicate an alternative choosing but not necessary the prefer choice. Table 11 presents the mode share probability distribution for all trips mode in the study.

Table 11: Mode Share Probability Distribution

Modes	Attributes	Utility Functions	Average Predicted Utility	Exponential Of Probability	Probability
Personal Car	Age (A) Cost (W)& In-Vehicle Time (Ivt)	0.021A 0.0012W - 0.0008IVT	0.6268	1.8717	0.1636
Bus	Age (A) Fare (W)	0.6053 + 0.0012A - 0.0009W	0.5427	1.7206	0.1504
Taxi	Age (A) In-Vehicle Time (Ivt)	0.1873 + 0.0104A - 3.81E-05IVT	0.4256	1.5305	0.1338
Tricycle	Age (A) Income (I)	0.5897 - 0.0044A + 4.77E-6IC	0.5161	1.6754	0.1465
Motorcycle	Age (A) Fare (W)	0.0134A - 0.00024W	0.4243	1.5286	0.1336
Bicycle	Income (I)	0.2659 + 9.14E-5IC	0.3596	1.4327	0.1253
Walking	Age (A) Income (I)		0.5185	1.6795	0.1468

F. Proportions of Mode Choice in the Whole Kurna Tudun Bojuwa and Kurna Tudun Fulani

The probability distribution for the study area calculated above was used to obtain the population with their respective preferred modes in the whole Kurna A. The projected population Fig. for the study area is 23,400 and is used to compute the volume of people using each of the modes.

Table 12: Mode Choice Proportion for the Entire Study Area

Mode	No Of People	Percentage %
Personal car	3,828	16.4
Bus	3,519	15.0
Taxi	3,131	13.4
Tricycle	3,428	14.6
Motorcycle	3,126	13.4
Bicycle	2,932	12.5
Walking	3,435	14.7

The population Fig. indicated personal car as the predominant preferred mode having highest utility value as obtained in Table 12 above. Bicycle mode shows to be the least means of trip making in the study.

Table 13: Mode Choice Proportion by Public Transport and Personal Mode for the Entire Study Area

Mode	No Of People
Private Mode (Personal car, Motorcycle and Bicycle)	9,886
Public Transport Mode (Bus, Taxi and Tricycle)	10,078
Walking	3,435

The mode choice proportion presented in Table 13, indicates that the proportion of people using commercial mode are in large quantity.

G. Implications of the Model

I. The model developed is able to predict the choice behavior of a high-density residential area as they are valid at 95% confidence level.
II. Identifying the sensitivity of the trip makers to various factors affecting mode choice enables transportation planners to make better demand forecast for each mode of transportation.
III. The model indicates that Age, Income and Fare are common factors that mostly affect trip making in the study area.

H. Limitations of the Model

I. The model developed in this study cannot be used widely to cover other settings different from the study area. Care will have to be exercised in the use of the utility models in other areas, as the attributes and utility functions may differ.
II. The model specification developed for this research did not consider specifying trip purpose of household for modeling purpose.

IV. CONCLUSIONS

The socio-economic indicators of trip making in the study area are age, gender, position in household, income, car ownership, In-Vehicle travel time, household size and Transport fare. The young and the active age group between 9 – 29 (55.3%) of the respondents dominate the use of commercial modes, Bicycle and walking mode while, respondents above the age of 40 prefer personal car and this constitute about 25.6% The low-income group prefers commercial mode as it is more affordable and they constitute about 70% while, the high-income group about 30% of the respondents shows preference toward personal modes. Trip makers by commercial modes (Bus, Taxi and Tricycle) predominantly pay between ₦55 – ₦200 which is relatively high for low-income group. Influence of In-Vehicle time indicates that trip making in all the available modes last between 16 – 30 minutes. The preferred mode choice is; 16.4% personal car, 15.0% Bus, 13.4% Taxi, 14.6% Tricycle, 13.4% Motorcycle, 12.5% Bicycle and 14.7% Pedestrian. This indicates that 42.3% prefer trip making by private modes, 43.0% by public transport modes and 14.7% pedestrians.

B. Recommendations

To persuade travelers by car to join public transport there is need for effective and reliable public transport system. Trip making by Bicycle and walking are important in the study area. Facilities for them should be provided which will also help in reducing large number of other modes on the road. In view of the health benefit associated with walking, communities in the study area should be considered for sustainable transport scheme. The tricycle component of public transport is high 14.6%. Their activities need to be closely monitored in other to minimize their impacts on traffic. The demand for travel by disable persons has not been specifically addressed in this study, but a considerable number of them are sighted in the area. Therefore, facilities for easy access to transport for the physically impaired should be provided. Private car seems to attract interest in the study area from result of the modal share, the use of it is among the contributors towards congestion, pollution and other ecological footprint. Thus, a major concern for decision makers is to reduce the usage of private car in order for users to shift to public transport or non-motorized modes of travel.

LIST OF ABBREVIATIONS

IVT In vehicle time

DECLARATIONS

AVAILABILITY OF DATA AND MATERIALS

THE DATA USED IN THIS STUDY CAN BE MADE AVAILABLE UPON REQUEST FROM THE CORRESPONDING AUTHOR. THE DATASETS ARE NOT PUBLICLY AVAILABLE DUE TO CONFIDENTIALITY AND ETHICS.

COMPETING INTERESTS

THE AUTHORS DECLARE NO CONFLICT OF INTEREST.

FUNDING

THIS RESEARCH RECEIVED NO EXTERNAL FUNDING OR SCHOLARSHIP.

AUTHORS' CONTRIBUTION

ALL AUTHORS CONTRIBUTED TO THE STUDY'S ANALYSIS. DATA COLLECTION WAS CARRIED OUT BY ABB. NY PERFORMED THE TRAFFIC ANALYSIS AND MY WROTE THE MANUSCRIPT. ALL AUTHORS HAVE READ AND AGREED TO THE PUBLISHED VERSION OF THE MANUSCRIPT.

ACKNOWLEDGMENTS

AUTHORS ACKNOWLEDGE THE ENTIRE STAFF MEMBERS OF THE FACULTY FOR THEIR SUPPORT.

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