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Determination of Tricycles proportion in Northern and Southern parts of Kano Metropolis

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ABSTRACT

A tricycle is a three-wheeled motorized vehicle that is different from a motorcycle. The increase in the number of tricycles in the Kano metropolis has resulted in their use in public transportation. Accident rates and other related transportation issues among road users are continually linked to the increasing number of tricycles. A traffic volume study was conducted along specified corridors which are Maiduguri Road, Murtala Muhammad Way, Zaria Road, and Sheik Ja'afar Road, within the study area utilizing a Manual Counting method within 3 days (8-11th December, 2023. A twelve-hour traffic volume count was conducted from 7:00 am to 6:00 pm at an in interval of one hour on mentioned roads from the Northern and Southern parts of Kano and established the peak hour volume (PHV) for a periods of 7 days (12-19th December, 2023), with a weather condition of 31^{0}C. Our findings indicated that the tricycle proportion ranges from a minimum of 46% to a maximum of 68%, this represents a maximum tricycle proportion increase of 48% in the last 10 years. Purely commercial areas such as Murtala Muhammad and IBB Road have a peak period tricycle proportion that ranges from 52% to 68% while the tricycle proportion during off-peak periods ranges from 46% to 68%. Manual count was conducted within 3 days (8-11th December, 2023), and traffic Volume Count Sheet for Peak and Off-Peak Periods for a 7 days (12-19th December, 2023), with a weather condition from 29-31^{0}C as shown in the appendix.

Keywords: *Highway Transportation · Kano Metropolis · Traffic Volume · Tricycle proportion.*

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1. Introduction

Transportation is vital for the socio-economic development of nations. Essential in towns and cities is passenger transportation which caters to the movement of people for different human activities [1]. It is small version of a vehicle but with three wheels [2]. The increase in the number of tricycles in the Kano metropolis has resulted in the use of these modes in public transportation and introduced varying dimensions of issues including traffic accidents, congestion, and safety on the road [3]. The types of public transport available include taxis, buses, trains, boats, motorcycles, and of course tricycles. Each type of public transport has its peculiar technical characteristics as well as its investment implications [4].

According to [5,6], most urban centers in Nigeria are faced with transport problems manifesting in the shortage of vehicles, bad roads, and traffic congestion, which are common features in cities like Lagos, Kano, Ibadan, and Kaduna. Tricycles are suitable for intra-city commuting and commercial passenger carriage with low fuel consumption of 38km per liter [7].

According to [8, 9], the most common modes of public transport modes are grouped into 2 types namely motorized and non-motorized groups. These include walking, bicycles, Motorcycles, public buses, taxis, and tricycles. Tricycles are a form of new urban public transport used in both developed and developing countries. They are often described by different names in different countries; in Nigeria they are called Keke Napep (or just *keke*) , while in Thailand they are called auto-rickshaws [10].

According to [11], the justifications for the distribution of *Keke* nationwide include:
(i) To ensure mass gainful employment for the idle workforce;
(ii) To sustain wealth creation;
(iii) To provide affordable mass transit services;
(iv) To provide opportunities for the growth of other ancillary services such as vending, portal water, mobile food canteens, mobile grocery shops, post-delivery, etc.
(v) To facilitate technical entrepreneurs and related small businesses that will in turn facilitate the transfer of technology;
(vi) To facilitate other subsidiary businesses such as the sale of tricycle spare parts, operators, mechanics, and building of local contents, among others.

The development of the tricycle mode of transportation and indeed other modes is invariably associated with accident rates and other related transportation problems among road users [12]. Public transport modes contributed to high noise levels and poor safety standards in urban areas. With the introduction of tricycles as the mode of public transport in the Kano metropolis, there are different opinions from both the government and the individuals regarding their proportions, particularly on major corridors of the Kano metropolis [13, 14]. Kano state government has been trying to control the number of these tricycles in the entire city, but there is limited information on the relative proportion of tricycles operating on the metropolitan roads, especially on the major corridors [15].

This study aims to determine the proportion of tricycles on selected corridors in the Northern and Southern parts of Kano Metropolis. The objectives are to determine peak and off-peak periods of the selected locations, to determine the traffic volumes corresponding to peak and off-peak periods, and to determine the tricycles' proportion among the studied corridors.

The roads in Kano metropolitan requires enormous attention because of their contribution to economic, commercial, and socio-political activities. The roads constitute the basic infrastructure for the daily movement of people, goods, and services within the metropolis. Tricycle is one of the modes of public transportation in the Kano metropolis and its proportion contributes a lot to the total traffic volume, safety, and comfort on the road within the city. The result obtained in this study would provide useful information on the current proportion and variation of tricycles. This will assist policymakers and planners in the state in the provision and management of roads to ensure safety and comfort on the roads of the metropolis.

This research is peculiar and significant to the current situation of the Kano state metropolis due to the lack of the specific proportion of the tricycle proportion at the current situation since from 2019 [1]. The authors in [1] conducted their study within Tarauni local government area, Kano state.

2. Methods

2.1 Study Area

Kano metropolis is geographically located within Latitudes of 12°35ˡN to 8°45ˡ N. It is the most developing and urbanizing city and commercial center of northern Nigeria. Kano metropolis population is projected to reach 5,724,000 people by 2025 [5]. It is highly crowded with 1000 people per square kilometer (km^2). Kano Metropolis consists of the following local governments, Dala, Municipal, Gwale, Fagge, Nassarawa, Tarauni, and the surrounding settlements of Ungoggo and Kumbotso. The area according to the 2006 census has an estimated population of about 3,802,216 with an estimated total land area of 212 square miles. Kano Metropolis is the main focus of commerce and industry in the state. This is because of the availability of basic economic, social, and industrial infrastructure. There is also a concentration of industries and business enterprises in the area. Thus, the site has quite several small, medium, and big industries, with numerous commercial business enterprises in the different corners of the city. Kano metropolis plays a domineering role, over the rest of the state in administrative, commercial, economic, educational, industrial, and all other sectors.

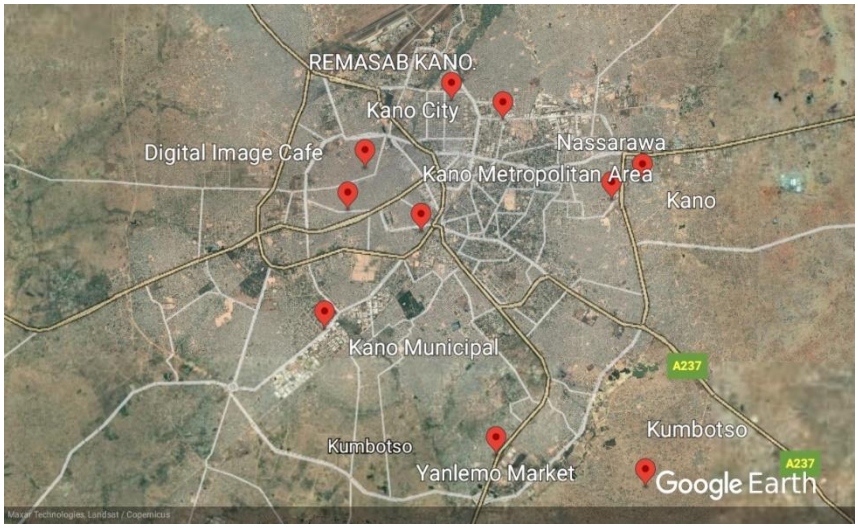

Figure 1. Map of Kano Metropolis

Figure 2. Tricycles operating in Kano Metropolis

2.2 Data Collection

The materials used include a Tally manual counter, record Sheets, and stopwatch. The total number of Vehicles on the corridor means the volume of vehicles that pass the road section at any given time. The volume of traffic here is based on peak and off-peak periods of a particular day. A traffic volume study was conducted along specified corridors within the study area using a Manual Counting method. A twelve-hour traffic volume count was conducted on a representative major road in each of the northern and southern parts of Kano City to establish the peak hour volume (PHV). PHV is the maximum number of vehicles that pass a point on a highway for 60 consecutive minutes. Manual counting involves two or more people recording observed vehicles using a counter. With this counter, both the turning movements at the intersections and the types of vehicles were recorded. The counter was in the form of an electronic tally used to record the observed traffic volume. We recorded the traffic volume and frequency of a particular vehicle (Passenger cars, Trucks, tricycles, Motorcycles). After the completion of the twelve-hour count for each road within each region (Northern and Southern), the morning and afternoon Peak and Off-Peak periods were taken to represent the Peak and Off-peak for every other road within that region respectively. Then a Morning and Afternoon Peak and Off-Peak hour traffic volume was conducted for 3 days to capture the trend in the traffic data for those roads. Table 1. Indicated the Tricycle Proportion in Northern and Southern of Kano Metropolis. Table 2 shows the Traffic Volume Count Sheet conducted within 3 days (8-11th December, 2023), and Table 3 shows the Traffic Volume Count Sheet for Peak and Off-Peak Periods for 7 days (12-19th December, 2023) as shown in Appendix I.

2.3 Data Analysis

To determine the proportion of tricycles on major corridors in the eastern and western parts of the Kano metropolis; Equations 1 to 3, and Table 3 were used in the analysis. These equations and table were employed to determine the proportions of tricycles on major corridors in the northern and southern part of Kano metropolis.

$$PoT = \frac{TV}{TTV} \times 100\% \quad (1)$$

Where: PoT = Proportion of Tricycle, TV = Tricycle Volume, and TTV = Total Volume

$$AV = \frac{TVV}{NoD} \quad (2)$$

Where: AV = Average volume, TTV = Total volume of vehicles, and NoD = Number of Days

$$AvT = \frac{AT}{AV} \times 100\% \quad (3)$$

Where: AvT = Average tricycle proportion, AV = Average Volume, and AT = Average tricycle

3. Results and Discussion

Table 1. Tricycle Proportion in Northern and Southern of Kano Metropolis

Corridor	Average peak period of tricycle proportion		Average off-peak period of tricycle proportion		Land use Characteristics	Region
	Morning (%)	Afternoon (%)	Morning (%)	Afternoon (%)		
Maiduguri Road	49	57	59	62	Mostly Residential Partly Commercial	Northern
Murtala Muhammad Way	52	59	46	47	Mostly Commercial	
IBB Road	57	68	59	68	Mostly Commercial	
Zaria Road	52	53	56	51	Mostly Residential and Institutional	Southern
Sheik Ja'afar Road	57	60	60	58	Mostly Residential Partly Commercial	

We observed that major roads in the Northern part of Kano Metropolis are mostly commercial and Residential such as Murtala Muhammad Road and IBB Road. The southern part consists of Institutional and Residential land use, which consists of Zaria Road, and Sheik Ja'afar Road. From our study, the tricycle proportion ranges from a minimum of 46% to a maximum of 68%, this represents a maximum tricycle proportion increase of 48% in the last 10 years.

Author [16] revealed that the tricycle constitutes about 15-20% of the total traffic composition in the Kano metropolis, this *is due to the fact that the location was too congested with vehicles especially tricycles due to the high demand of commercial activities along the case study.* It was also observed that commercial land use areas such as Murtala Muhammad Way and IBB road have a maximum peak and off-peak tricycle proportion of 68% which is the maximum tricycle proportion observed in our study. This supports the theory that transportation and land use are related, although the exact relationship is still ambiguous.

4. Conclusion and Recommendation

From the study conducted the following conclusions are drawn:

(i) The morning peak and off-peak periods range from 9:00 AM to 12:00 AM and 7:00 AM to 8:00 AM respectively. The afternoon peak and off-peak periods range from 6:00 PM to 7:00 PM and 1:00 PM to 5:00 PM respectively in both the northern and southern parts of Kano.

(ii) The morning peak tricycle proportion ranges from 48.5% to 57%. While the morning off-peak tricycle proportion ranges from 46% to 68%. The afternoon peak tricycle proportion ranges from 52% to 61%. While the afternoon off-peak tricycle proportion ranges from 47% to 68%.

(iii) From the variations of the tricycles' proportion among the studied corridors concerning land-use characteristics, in mostly residential and partly commercial land-use areas, peak period tricycle proportion ranges from 49% to 60%, while at off-peak tricycle proportion ranges from 59% to 62%. Purely commercial areas such as Murtala Muhammad and IBB Road have a peak period tricycle proportion that ranges from 52% to 68% while the tricycle proportion during off-peak periods ranges from 46% to 68%. Areas having a fair share of institutional and residential land use characteristics such as Zaria Road and BUK Road have a peak tricycle proportion ranging from 52% to 61% and an off-peak tricycle proportion ranging from 51% to 58%.

Based on the study conducted and its findings, the following recommendations are made:

(i) To establish a more accurate relationship between transportation and land use. It is recommended that more data is collected for a year. Tricycle proportion is not only affected by land use, it can also be influenced by changes in the season of the year, religious festivals, school holidays, price of fuel, industrial action, etc.

(ii) Traffic observers should conduct a reconnaissance before selecting a study location. This could be due to the construction or rehabilitation of neighboring roads which renders them of no use to traffic users hence the generation of traffic on the 'supposed' major corridor.

(iii) Automatic traffic counting and classification systems should be employed in the Traffic counting process. Manual counting is energy-draining, error-prone, and cannot be sustained for a long period. Artificial Intelligence and deep learning technologies can be employed that utilize computer vision and a camera to conduct traffic counting and classification of vehicle types.

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Appendix I

Table 2. Traffic Volume Count Sheet

Road					Day: 3 days		
Traffic Direction					Date: 8-11th December,2023		
Observation Point					Weather: 29^0 C (Sunny)		
	Vehicle Classes				Total		Remark
Hour	Passenger Car, Pick-Up And Minibus	Medium Trucks, Heavy Truck And Bus	Tricycle	Motorcycle	With Motorcycle	Without Motorcycle	
7:00-8:00 am							
8:00-9:00 am							
9:00-10:00 am							
10:00-11:00 am							
11:00-12:00 am							
12:00nn-1:00 pm							
1:00-2:00 pm							
2:00-3:00 pm							
3:00-4:00 pm							
4:00-5:00 pm							
5:00-6:00 pm							
6:00-7:00 pm							

Table 3**.** Classified Traffic Volume Count Sheet for Peak and Off-peak Periods

Road					Day: 7 days	
Traffic Direction					Date: 12-19th December,2023	
Observation Point					Weather: 31^0 C (Sunny)	
	Vehicle Classes				Total	
Period	Passenger Car, Pick-Up and Minibus	Medium Truck, Heavy Truck And Bus	Tricycle	Motorcycle	With Motorcycle	Without Motorcycle
Morning Peak Hour						
Morning Off-peak Hour						
Afternoon Peak Hour						
Afternoon Off-peak Hour						