

Spatial Distribution of RTA Frequencies Along Kaduna-Zaria Expressway, Nigeria

Mamman Saba Jibril, Ph.D.^{1*}, Jediel Wabundani^{1, 2}

Department of Geography, Faculty of Arts and Social Sciences, Nigerian Defence Academy,
P.M.B 2109, Kaduna-Nigeria.

Patrol Department Federal Road Safety Corps, Kaduna, Nigeria.

*E-mail: dumamana2@yahoo.com

Abstract

This paper evaluates the spatial spread of road along the study route for the period of 2007-2010 with a view to bring to lime light the environmental factors of road transport accidents in the study area. Also, the entire study route has been segmented into three; Kaduna- Katabu (km18.41), Katabu- Jaji (km17.02) and Jaji-Zaria (Km38.51). Spatial data were generated from the field, satellite imagery and previously generated road accidents data from the Federal Road Safety Corps (FRSC) and Nigeria Police Force (NPF) along Kaduna-Zaria express way of Kaduna State. The results partly revealed that Rigachuku, National Teachers Institute (NTI), Tollgate and Maraban Jos (Katabu) have recorded high frequency of Road Traffic Accidents (RTA) along Kaduna-Katabu especially in 2009 and 2010. To reduce these accidents to barest minimum, it is here, recommended that the degree of bends on Kaduna-Zaria expressway should be minimized through appropriate engineering designs by the Federal Ministry of Works.

Keywords: Spatial Data, Segment, Crash, Significance difference, Menace of RTAs

1. Introduction

The word spatial, relates to occupying or happening in space. It can be categorized into three dimensional (3D) models. The three dimensions are commonly referred to as length, width and depth (height) of a physical universe in which humans live.

Richard (1986) opined that space is a boundless; three dimensional extents in which object and events occur and have a relative position and direction. Physical space is often conceived in linear dimension in which road transportation can be related to. Benjamin (1975) pointed out that road transportation is that part of economic activity, which is concerned with increasing human satisfaction by changing the geographical position of people and goods. Hence, it creates opportunity to ease public services.

Road transportation being one of the most important human activities worldwide has become an indispensable component of the world economy and plays a major role in spatial relations between locations. It creates valuable links between regions and economic activities and between people and the rest of the world (Umar, 2009). Road transportation bridges the gap between production and consumption zones.

However, the five modes of transportation- road, rail, water, air and pipeline complement each other. Motorized vehicles (road transportation) are the most common means of passengers and freight conveyance in Nigeria. Road transportation is therefore, the major transportation system that connects all rural and urban environments in the country. It is central to the flow of knowledge, information, and commercial activities.

Nigeria has the largest road networks in West Africa, with an estimate as at 2007, of 194,394km out of which 130,000km are tarred. A total of 34,120km (17.6%) constitutes federal roads with 30,694km (15.9%) made up of the state roads and 129,580km {66.7%} local and rural roads (CIA World fact book 1999). The broad aim of road transportation is to fulfil and ease the demand for mobility since transportation exists if only it moves people, freight and information from one point to another; otherwise it has no purpose. This movement of people, freight and services is usually associated with events such as traffic congestion and road traffic crashes (accidents).

There is a consensus among the general public in Nigeria and other parts of the World that human elements are the key causal factors of road traffic accidents. However, apart from human factor, there are mechanical and environmental (spatial) factors that cause road traffic accident over time.

According to Stutt and Hunter (1999), high proportion of road traffic accidents are caused by unsafe human act and drunken drivers of motorcycles. Hajar et al (2000) identified reckless and dangerous driving linked to alcohol and drug consumption and faulty pedestrian attitudes as the major cause. Also, PIARC (2003) depict three significant factors of road accidents causation as human 53%, road 34% and vehicle 13% respectively.

The quarterly publication of NEMA magazine of June, 2007 reflected reconnaissance survey conducted by the agency on some major roads in Nigeria and noticed that risk is increased by lack of attention to safety both in planning and design of new road, user's behaviour and risk through speed that drivers perceive as appropriate and detailed design factor such as curve, gradient and road markings. From the forgoing, it is clear that little emphasis has been placed on the other factors that cause road traffic accidents, particularly the spatial (environmental) factors. These neglected areas of safety from planning, road design and road condition are related to spatial phenomenon over time that make road accident frequent along the high ways which has been a great concern to Nigeria governments and general public. This paper therefore, aims at emphasising the spatial and/or environmental factors that cause road accidents along Kaduna-Zaria Expressway. Secondly, this effort will at long run complement the popular human factors of road accidents. Thirdly, the effort will also put governments on their toes in caring for environmental factors of road accidents.

2. Location of the Study Area

The study route is in Kaduna State of Nigeria and passes through three local government areas of the state: Kaduna North, Igabi and Zaria. It cuts across latitudes $10^{\circ}30'N$ and $11^{\circ}10'N$, and longitudes $7^{\circ}20'E$ and $7^{\circ}50'E$. The whole area through which the expressway passes is in the northern part of Kaduna state, Nigeria and equally shares boundaries with Kaduna South, Chikun, Soba, Kajuru, Giwa and Birnin Gwari local government areas of the state (figures 1 and 2).

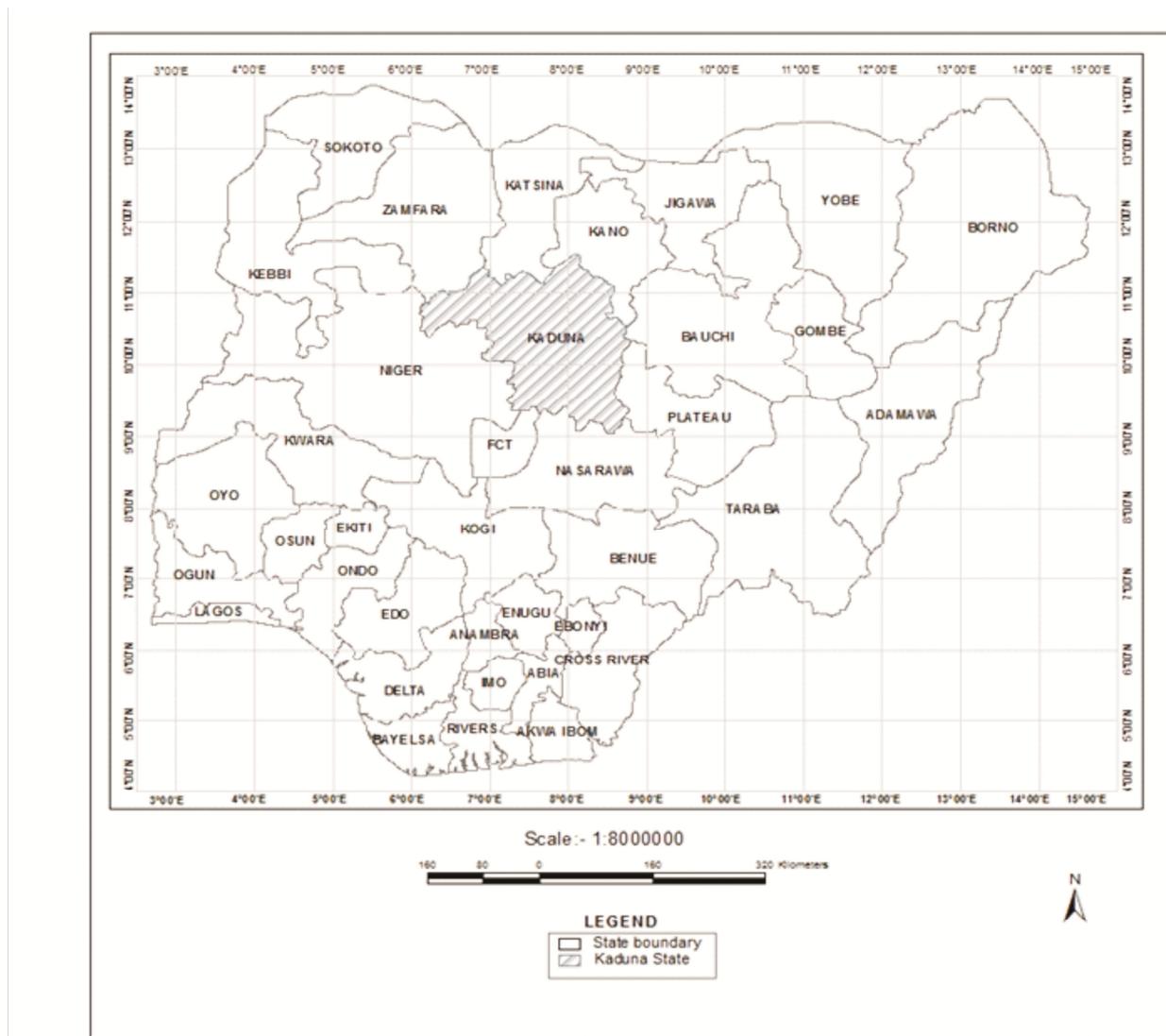


Figure 1: Nigeria Showing Kaduna State

Source: KEPA (2006)

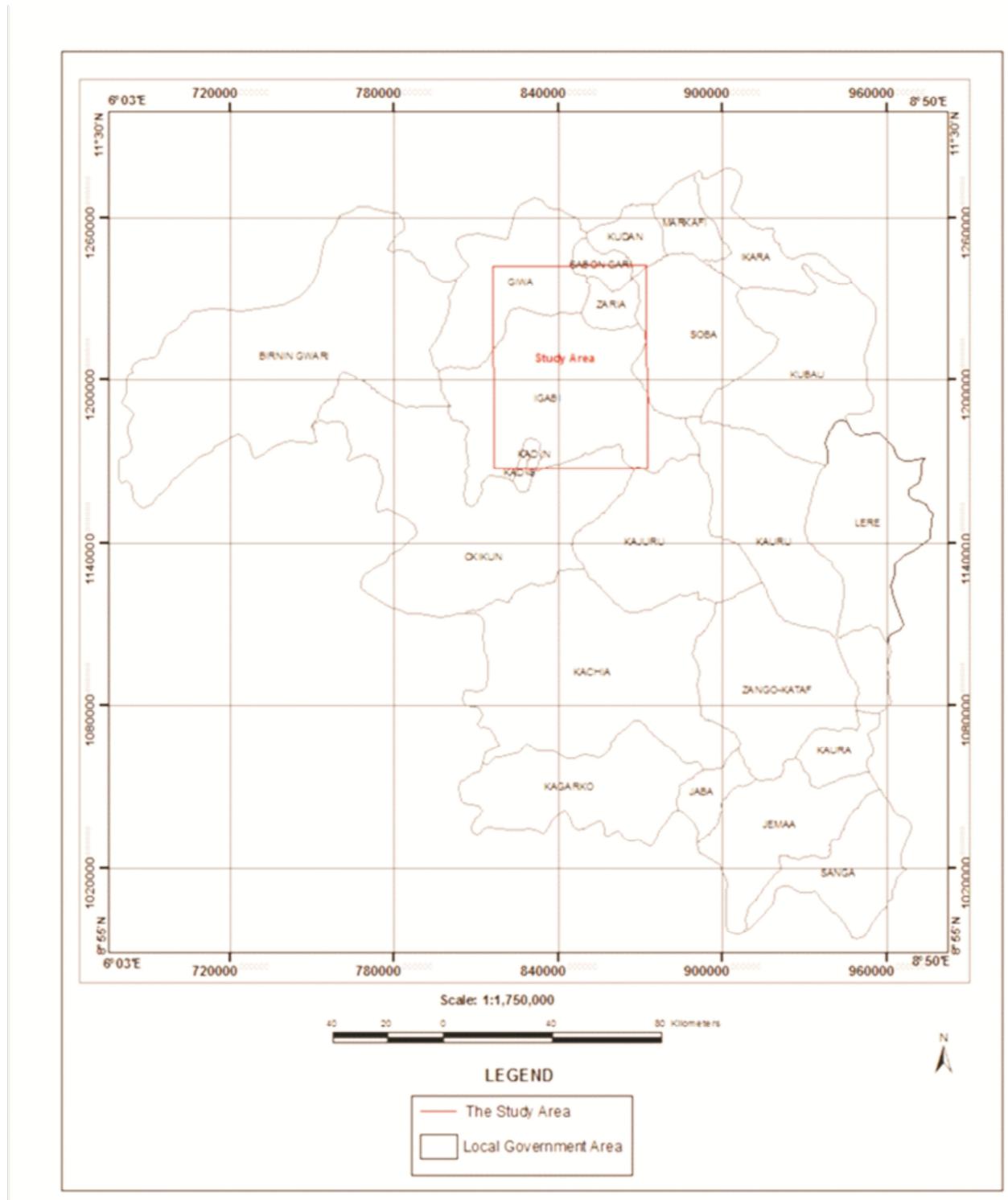


Figure 2: Kaduna State Showing the Study Area

Source: KEPA (2006)

The area is underlain by Precambrian and/or lower Paleozoic migmatite gneiss and porphyritic biotic granite. Intruded into this terrain are series of younger granites comprising of mainly biotic and alkaline granites, syenites, porphyries and rhyolites. Basement complex rocks occupy 70% of the area and rocks of younger granites series occupy the remaining 30% comprising of gneiss, schist and quartzite (Kogbe, 1989). Generally, the area has an extensive and almost level to gently undulating and highly deserted land, broken in few places by rocky outcrops and hilly features (Inselberg) that vary in size and height (Parkman International in Association with Parkman Nigeria Ltd. 1997).

The climatic classification of the study route is the tropical continental climate. It is characterized by two distinct alternating wet and dry seasons. The rainy season usually begins from March/April and runs through September/October. The rainfall amounts falls between 1100 - 1300 mm. The rainfall type is convectional with a single regime of maximum peak, which usually occurs in August/September at a stretch (Parkman International Studies, 1997).

The rainfall is absent or very unusual from November to February due to occurrence of the southwards movement of the ITD in October – November, which signals the dry season with low relative humidity and cooler air temperature from December to February. This extension spells of hammattan , a seasonal air current that begins with dust from the Sahara.

2.1 Road Network of the Study Area

The road network of the study area is classified as major road. It was duallized between 1988 and 1992 by President Gen. Ibrahim Badamasi Babangida led military government. There are several feeder roads linking the expressway at various locations. Notable amongst these feeder roads are the Zangon Aya roads, Kangimi, Sabon Birni roads. The study route, which extends up to 73.96km long has several characteristics such as sharp bends, bridges, undulation and U-turns. The study route is depicted in fig 3 below.

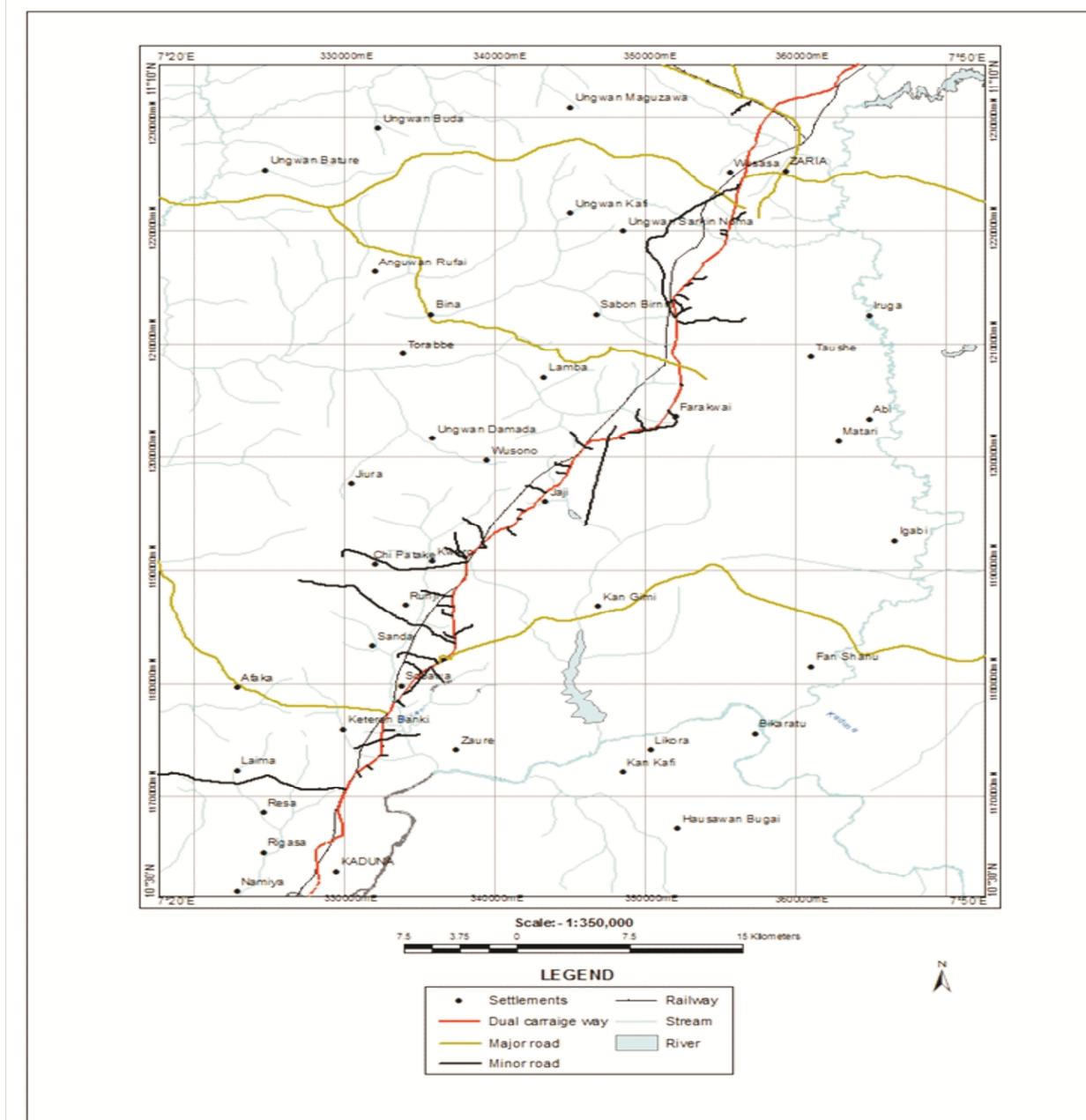


Figure 3: The Study Area
 Source: Authors' Analysis of
 SPOT 5 imagery 2005

3. Methodology

Data on road traffic accidents were sourced from relevant documents such as daily accidents report from the Federal Road Safety Commission (FRSC), and the Joint State Security Operative in Kaduna State; such as; Nigeria Police Force (NPF) and Operation Yaki. Also, hospital data on road traffic accidents from Barau Diko and Saint Gerald Catholic hospitals in Kaduna metropolis had been sought. Data from these sources were harmonized and used for the analysis. Structured questionnaire administration was used to derive factors that were responsible for RTAs. Furthermore, one way analysis of variance was also used to examine the significance difference between the three segments of the study route.

3.1 Satellite Image Characteristics

The satellite image data used is SPOT 5 imagery of 2005 of the study area. It has spatial resolution of 5m and 3 bands with swath width of approximately 60x 60 km ground coverage. Projection is UTM zone 32. Two of the

Image scenes were used and each contains 2340 rows and 3240 columns stored in an 8 bits (0-255) data file. Temporal resolution of the image used spans once in every 16days with a revisit period of every three days.

4. Results and Discussion

Data on road accidents from the FRSC and NPF in Kaduna state were computed, giving a total of 490 RTCs that occurred within the study period. From the figure, 35, 145, 115 and 195 occurred in 2007, 2008, 2009 and 2010 respectively. In the same vein, the spread of the menace of RTAs along the three segments of Kaduna- Katabu, Katabu- Jaji, and Jaji- Zaria were analysed from the total cases across the period of study and it is reflected thus; 154, 110 and 226 within km18.41, km 17.02 and km 38.96 respectively. This is presented in Table 1 below.

Table 1: Distribution of Road Traffic Accidents along the Three Segments of Kaduna –Zaria Expressway

Year	Kaduna- Katabu	Katabu- Jaji	Jaji- Zaria	Total
2007	0	0	35	35
2008	35	50	60	145
2009	47	0	68	115
2010	72	60	63	195
Total	154	110	226	490

Source: Field Work

The spatial presentation of RTA within each of the segments of Kaduna-Katabu, Katabu-Jaji, and Jaji-Zaria can be seen in figures 4 to 6 below and the data from which the graphs were produced is shown in Table 3.

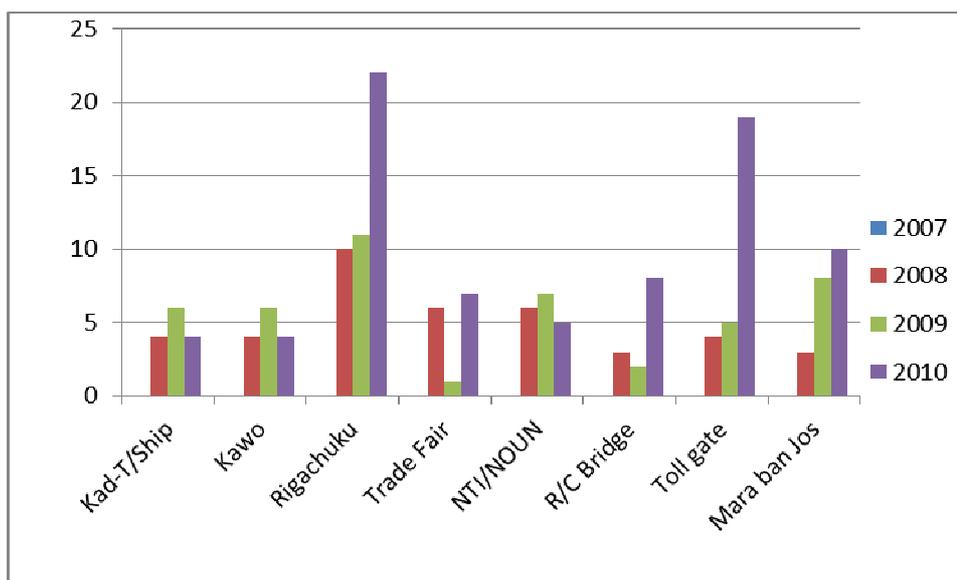


Figure 4: Road Traffic Accidents Black Spots between Kaduna- Katabu.

Figure 4 above revealed that Rigachuku, NTI, Tollgate and Maraban Jos (Katabu) have recorded high frequencies of RTA along Kaduna-Katabu especially in 2009 and 2010. While in 2007, no RTA was recorded. This is as a result of inadequate record of data on road traffic accidents by the relevant authorities within the period.

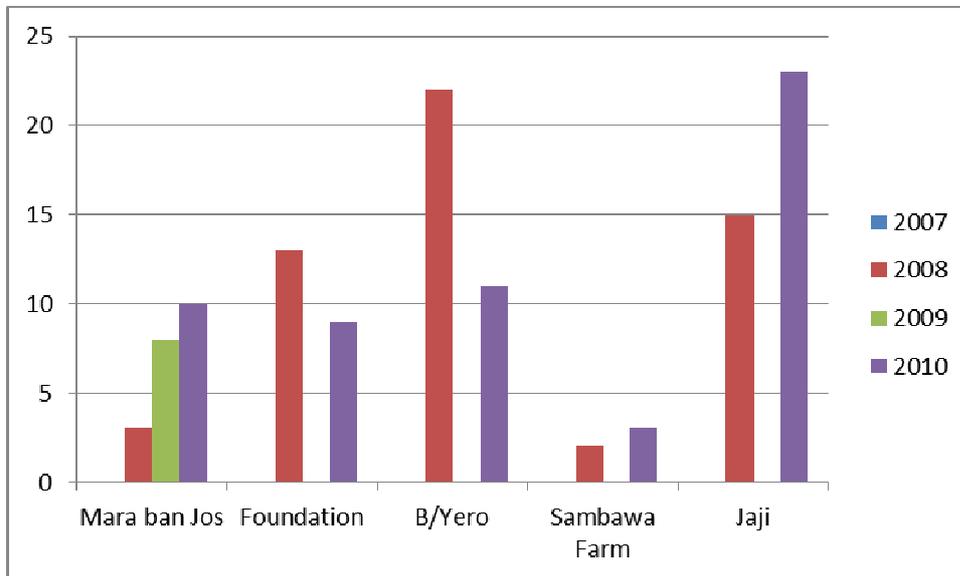


Figure 5: Road Accidents Black Spots between Katabu-Jaji

The above presentation (i.e. Fig 5) depicts almost all the places along Katabu- Jaji road accident prone areas. In 2008 and 2010, RTA was high at Foundation, Birnin Yaro and Jaji areas. In 2009, only Maraban Jos (Katabu) area has an indication of high RTA, while 2007 is completely absent from the chart. As earlier pointed out, this was due to inadequacy of data. However, the available data that were used are presented in Table 3.

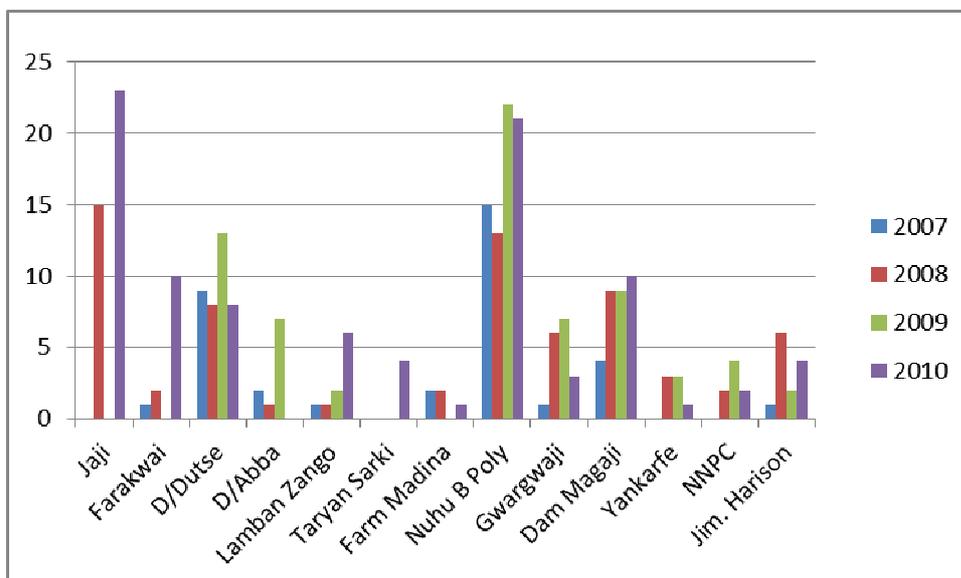


Figure 6: Road Accident Black Spots between Jaji-Zaria

In figure 6 above, the graph depicts areas with high RTA frequencies along Jaji-Zaria segments as; Jaji, Dumbi Dutse, Nuhu Bamali Polytechnic, Gwargwaji and Dam Magaji in almost all the years of study with significant high frequency in 2009 and 2010. In 2008, the record was high in Jaji and no RTA record was shown in 2007. But, the record appeared in all the years at other places of the segment.

After examining the significant difference between the three segments of the study route via the use of one way analysis of variance, the test result reveals that the range of the following segments of Kaduna-Katabu, Katabu-Jaji and Jaji-Zaria were 25 and 42, 21 and 62, and 23 and 69 minimum and maximum respectively. The mean values of these areas are 34.75, 39.00 and 48.83 respectively. The calculated value was arrived at 0.475 and since the calculated value is greater than 0.05 level of significant, the hypothesis is hereby rejected hence, there is no significance difference in the frequency of road traffic accidents between the three segments of Kaduna-Katabu, Katabu-Jaji and Jaji-Zaria. The summary of test statistics is shown in Table 2 below.

Table 2: Test Result of the differences in Road Traffic Accident Frequencies between the Three Segments of the Study Route

Accident freq.	Sum of squares	df	Mean square	F	Sig
Between Groups	412.167	2	206.083	.818	.472
Within Groups	2267.500	9	251.994		
Total	2679.667	11			

Significance difference at 0.05 at 95% confidence interval

Source: Field Work

Table 3: Spatial Distribution of RTA Based on Area Location.

S/N	Area	2007	2008	2009	2010
1	Kad-T/Ship	0	4	6	4
2	Kawo	0	4	6	4
3	Rigachuku	0	10	11	22
4	Trade Fair	0	6	1	7
5	NTI/NOUN	0	6	7	5
6	R/C Bridge	0	3	2	8
7	Toll gate	0	4	5	19
8	Mara ban Jos	0	3	8	10
9	Foundation	0	13	0	9
10	B/Yero	0	22	0	11
11	Sambawa Farm	0	2	0	3
12	Jaji	0	15	0	23
13	Farakwai	1	2	0	10
14	D/Dutse	9	8	13	8
15	D/Abba	2	1	7	0
16	Lamban Zango	1	1	2	6
17	Taryan Sarki	0	0	0	4
18	Farm Madina	2	2	0	1
19	Nuhu B Poly	15	13	22	21
20	Gwargwaji	1	6	7	3
21	Dam Magaji	4	9	9	10
22	‘Yan karfe	0	3	3	1
23	NNPC	0	2	4	2
24	Jim. Harison	1	6	2	4
	Total	35	145	115	195

5. Questionnaire Administration

With reference to figure 7, 47% of the respondents to the structured questionnaire held the view that poor road condition has been responsible for frequent RTAs along the study route. According to them, factors for poor road conditions were potholes, sagging, sharp bends and emerging feeder roads.

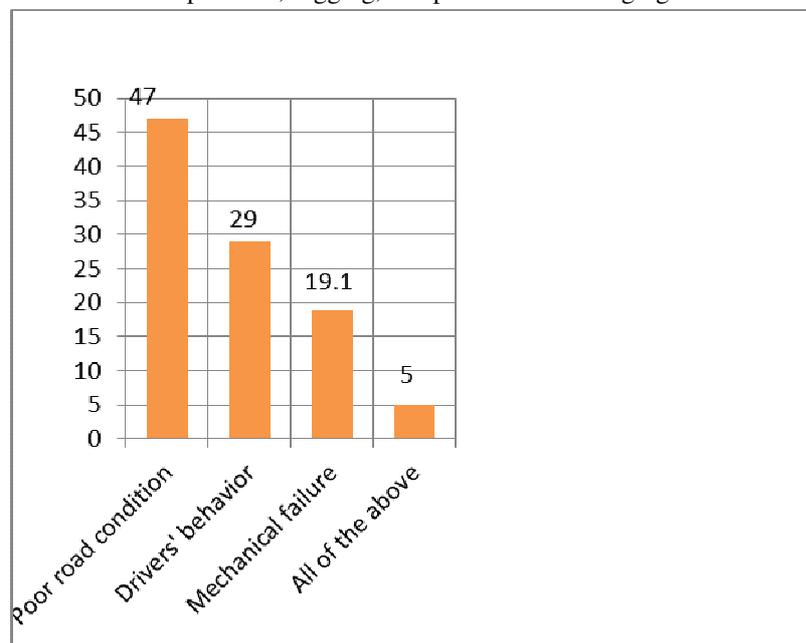


Figure 7: Major Causes of Road Traffic Accidents along Kaduna- Zaria Expressway

The figure also revealed that 29% opined that the drivers' behaviour causes accidents most. Such respondents argued that over speeding, use of cell phone while driving and the use of drugs and alcohol are habit of many drivers. However, mechanical failure had the support of 19.1% of the respondents.

On the other hand, the oral interviews (i.e. group discussion) conducted revealed that 67% of the interviewees blamed drivers for the cause of accidents in the study area. Only 23% of the respondents attributed the accidents to poor road conditions. Mechanical failure had the support of just 7% of the respondents. (Figure 8)

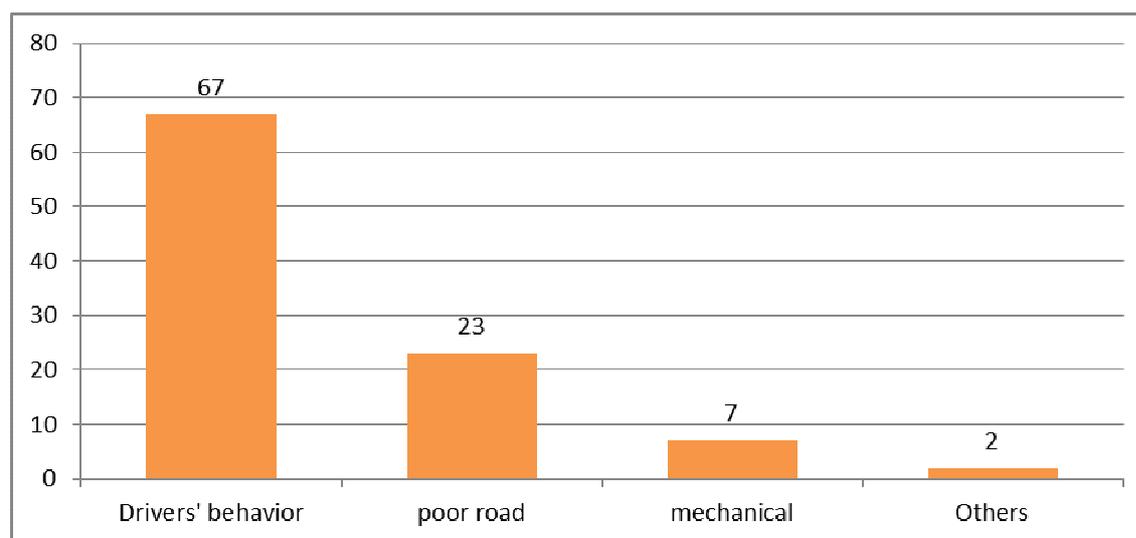


Figure 8: Interviewees factors of RTAs on Kaduna- Zaria Express Way

On the basis of these findings, it is the position of this paper that the degree of bends on Kaduna- Zaria Expressway should be minimised through appropriate engineering design by the Federal Ministry of Works. Curbing the occurrence rate of environmental factors of RTAs require proper identification of areas with such characteristics for mending and/or new construction of structures. More so, drivers should be educated from

time to time by the major stake holders in traffic management such as FRSC, NPF and Nigeria Union of Road Transport Workers (NURTW), on how best to behave themselves in the course of their duty.

6. Conclusion

The word spatial relates to occupying or happening in space. Road transportation being one of the most important human activities worldwide has become an indispensable component of the world economy and plays a major role in spatial relations between locations. It creates valuable links between regions and economic activities and between people and the rest of the world. Road transportation bridges gap between production and consumption zones. Against this backdrop, there is need for the governments to minimise causes of RTAs, such as dangerous and/or sharp bends in the study area so as not to hamper the most popular road transport system in the area. More so, dilapidated road infrastructure should be mended as rapidly as they give way.

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