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An analysis of the effect of land use on road traffic accidents in Zaria

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Abstract

This study examines the effect of land use on road traffic accident in Zaria. Both primary and secondary data were used for this study. In the primary method, questionnaires were purposively administrated to respondents along six selected major roads in urban Zaria area. Whereas, in the secondary method, the State Urban Development Board provided information on land use. Also the Federal Road Safety Command Zaria unit provides record of accidents along the six selected roads, which were referred to as identified accidents routes (IAD). The accessibility index together with crude capacity and potential generation rate of vehicular traffic were used to analyze the data obtained. The result showed a high and moderate utilized roads in Urban Zaria, and that more accidents occur in the high utilize roads. While the product moment correlation result revealed that there is a strong relationship between the traffic flow and the occurrence of road traffic accident. It was also discovered that the six major roads referred to as identified accident routes (IAR)) produced large number of trip and have high accident rates due to the intensive and complex land use. The implication of the result is that land use is not the only approximate determinant of road traffic accident. It was found out that factors like increased traffic flow, recklessness, poor road condition, refusal to obey traffic rules and mechanical faults are also contributory factor to the occurrence of road traffic accidents in Zaria area. Even though the rate of occurrence of accident is very high on the identified roads, it is generally moderate in urban Zaria area when compared to major towns was like Kano, Kaduna, Benin and Port Harcourt. It was recommended that the authorities concerned should ensure that efficient land use are developed and enforced according to plan while leap frog growth pattern of urban areas should be discouraged.

Keywords: Land use effect; Road traffic; Accident; Zaria

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1. Introduction

The interrelationship between transportation and land use been known for quite a long time, especially with references to the fundamental concept that traffic is the joint product of land use activity levels and transport capacity. This was why Rimmer (1986), complained that the relationship between transport and land use was little explored because transportation geographers got themselves bogged down with network analysis.

In recent years, there has been growing concern in studying the relationship between growth of land use and transportation in towns, metropolis, and cities and in urban areas (Onakala, 1995; Sule, 1981; Vivian, 1983; Olayemi 1976; Filani et al., 1976). These studies revealed that the physical development and shape of urban areas are dependent on the available network and transportation facilities. Also, those transportation facilities exist in order to make it possible for people to carry on their different activities on land use at different locations. They also agreed that trips originating from or are attracted to a particular land use influence the volume of traffic attracted to it, which is also believed to be associated with the occurrence of road traffic accidents.

The spatial location of urban communities and the existence of land use in them is a reflection of socio economic and ecological forces (Main, 1985). Similarly, in urban Zaria area, the growth of urban communities facilitated by increase in population and accompanied by the growth of different land use. These have lead to the arrangement of people's activities, building and commercial points in different locations along the transport routes, which produces different trips on a daily basis. The conflict between the potential for population increase, growth of land use results in the increase of daily trips which produces road traffic accident in urban Zaria area. This is well supported by some studies such as Fonseca (1976) and Banjo (1984) reported that the relationship between transportation and land use in Nigeria is complicated by the bazaar of tradition of mixed land use intensity, as well as the diversity of life style. Duru (1981) have reviewed as problematic cities, they reported that higher order of residential land use are often found next door to major commercial and industrial land use even though their functions may be incompatible.

In urban Zaria area, the effect of land use on road traffic accident is better appreciated as problem of growth and rigidity in the distribution of complex land use and the crisis crossing trips to and from various land use for variety of reasons. The trips generated tend to be high in one place and moderate to low in some places. And the continuous movements of people on two and four wheel vehicles create accidents. This study examines and provides explanation on how land uses generates road traffic flow and consequently create accidents in urban Zaria , Nigeria.

2. Methodology

The primary and secondary methods of data collection were used to obtain information for this study. The six major roads, PZ, Bank road, Gaskiya/Poly road. Ahmed Makarfi dual road, Lagos street/Aminu road, Sokoto/Samaru road and Shehu Idris road, Zaria-City are referred to as identified accident routes (IAR), by the federal road safety command in Zaria were used as main study areas. One hundred and twenty designed

questionnaires were purposively administered to respondents to elicit information on the relationship between land use and transportation as it relates to the occurrence of road traffic accidents in the study area. The secondary information which has to do with road pattern and land use development were obtained from the Kaduna state Urban Development Board. While the accident data was collected from the Federal Road Safety Commission (FRSC) Zaria Command.

The accessibility index was calculated to show the high and moderate utilized roads as it relates to the occurrence of road accidents in urban Zaria area. It was used together with the crude capacity rate and potential generation index (as measured by the short period counts). The formula used is:

$$\text{i.} \quad \text{Accessibility} = \frac{\text{crude capacity}}{\text{Potential generation}} \times \frac{100}{1}$$

where:

ii. Crude capacity - The measured road width

iii. Potential generation - Short period count that is achieved by using the formula

where:

- Eij = actual 'E' Factor at site i and day j
- E = mean 'E' factor over all sites and all days
- Fij = short period flow at site i and day j

iv. 100 = constant

To achieve potential generation rate, the short period traffic flow count was conducted at established points on the six identified accidents routes in urban Zaria area. The continuous counting of traffic vehicles on selected sites was done by trained research assistants for a period of six hours in 5 days (excluding Saturdays and Sundays, which were public holidays).

This method is statistically independent and current; it was used in estimating traffic flows as it relates to the occurrence of accidents by Gwarwyn and Philip, 1980; Evans and Philip, 1978 and Bellamy, 1978 in related studies different areas in United Kingdom, in Nairobi and in South Africa. The product moment correlation was performed to produce the relation between traffic flow and road traffic accident in urban Zaria area.

3. Result and discussion

Attempt is made in this study to examine and explain the relationship between the continuous growth and development of various land use and occurrence of road traffic accident in urban Zaria area, Nigeria. The result showed that land use generates different kinds of movements which is done using different modes of

transport to various activity centers. The disagreement between traffic flow and land use produce road accident in urban Zaria area, which occur when the interaction between vehicles, road user and the roads become defective.

Table 1 shows the short period count of traffic vehicles on identified accidents routes urban Zaria area.

Table 1. Average Vehicle Traffic Census on Selected Roads in Urban Zaria area

Identified major accidents	Total daily traffic (6hrs census for five days)	Average daily traffic census for five days	Width of roads
Samaru/Sokoto road	9.889	1,977.80	18.2 meters
P.Z Junction/Bank road	16.105	3,341.00	16.4 meters
Tudun wada; Ahmed Makarfi dual carriage road	7,551	1,510.20	18.2 meters
Gaskiya/Polytechnic road	8,250	1,650.00	9.1 meters
Sabon Gari: Aminu road/Lagos street	11,289	2,257.80	9.0 meters
Zaria City; Shehu Idris road	8,569	1,713.80	18.0 meters
Total	61,653	26,042.60	_

Source: Field Work 2008

This result of the traffic census was recorded for six hours for five days and it produced the average daily vehicular traffic (A.D.V.T) for each of the identified major accident routes (IAR) is presented in Table 1. The results showed that P.Z. junction/Bank road and Lagos street/Aminu road in Sabon gari have the highest volumes of traffic flow daily, followed by Samaru/Sokoto road. The main reasons for high traffic flow include the patronage of commercial, educational and administrative land use which attract many people in need of their services. Also, important is the "through traffic movements" to other types of land use along the road or located in different urban communities.

The accidents data used in this study were obtained from Federal Road Safety Commission, Zaria Command for the year 2007. The summary for each of the six identified accident routes in urban Zaria, the types of accidents (fatal, minor and serious), type of vehicles involved, average number of death and causes of the accidents are shown in Tables 2-7.

Table 2. Road traffic accident on samaru (sokoto road)

S/N	TYPE OF VEHICLE	TYPES OF ACCIDENTS			AVERAGE NO OF DEATHS	NO OF ACCIDENTS	TYPES OF ROAD	CAUSE OF ACCIDENT	TIME OF DAY
		FATAL	MINOR	SERIOUS					
1	Peugeot/Bus	_	_	7	_	1	Single carriage	Bad road	13:29hrs
2	Nissan/Motorcycle	9	_	5	9	1	Single carriage	Bad road	10:30hrs
3	Honda/Motorcycle	01	_	_	1	1	Single carriage	Obstruction on road	11:50hrs
4	Toyota/Bus	_	_	1	_	1	Single carriage	Dangerous driving and over speeding	6:45hrs
5	Nissan/Bus/M.Bens/Tipper	_	_	1	_	1	Single carriage	Dangerous driving and over speeding	9:30hrs 23/12/07
	Total	**10**	_	**14**	**10**	**5**			

Source: FRSC, 2007

Table 3. Road traffic accident on PZ (bank road)

S/N	TYPE OF VEHICLE	TYPES OF ACCIDENTS			AVERAGE NO OF DEATHS	NO OF ACCIDENTS	TYPES OF ROAD	CAUSE OF ACCIDENT	TIME OF DAY
		FATAL	MINOR	SERIOUS					
1	Nissan Bus/ Honda	_	_	2	_	1	Single carriage	Break failure	18:49hrs
2	Peugeot (504)	_	_	2	_	1	Single carriage	Break failure	31/3/07hrs
3	Opel/Motorcycle	_	_	1	_	1	Single carriage	Driving dangerous	9:00hrs
4	Bus/ Mercedes Benz	_	1	_	_	1	Single carriage	Mechanical fault	11:30hrs 25/08/07
5	Motorcycle/Motorcycle	_	_	2	_	1	Single carriage	Dangerous driving	16:30hrs 14/10/07
6	Wheel chair, Motorcycle/Bus	_	1	_	_		Double carriage	Break failure	02/11/2007
7	Honda accord/motorcycle	_	_	1	_		Double carriage	Dangerous driving	8:15hrs 4/11/07
8	Truck/saloon	_	_	_	_		Round about	Dangerous driving	21:15hrs 9/1107
9	Motorcycle/Vespa Motorcycle	_	_	1	_		Round about	Dangerous driving	17:30hrs 15/11/07
	Total	_	**3**	**10**	_	**9**			

Source: FRSC, 2007

Table 4. Road traffic accident on Zaria city (Shehu Idris Road)

S/N	TYPE OF VEHICLE	TYPES OF ACCIDENTS			AVERAGE NO OF DEATHS	NO OF ACCIDENTS	TYPES OF ROAD	CAUSE OF ACCIDENT	TIME OF DAY
		FATAL	MINOR	SERIOUS					
1	Nissan car/ Tipper	–	–	13	–	1	Single carriage	Bad road/ Dangerous driving	10:45hrs 5/4/07
2	Motorcycle/ Motorcycle	9	–	5	9	1	Single carriage	Over speeding	13:00hrs 7/4/07
3	Ford	–	1	–	–	1	Round about	Dangerous driving	11:50hrs 14/4/07
4	Pick up	–	–	–	–	1	Round about	Obstruction on road	12:40hrs 26/08/07
5	Volkswagen/ Honda Accord	–	3	2	–			Over speeding	9:00hrs 27/08/07
	Total	**2**	**4**	**15**	**2**	**5**			

Source: FRSC, 2007

Table 5. Road traffic accident on Tudun Wada (Ahmad Makarfi Road)

S/N	TYPE OF VEHICLE	TYPES OF ACCIDENTS			AVERAGE NO OF DEATHS	NO OF ACCIDENTS	TYPES OF ROAD	CAUSE OF ACCIDENT	TIME OF DAY
		FATAL	MINOR	SERIOUS					
1	Bus/motor cycle	–	–	1	–	1	Single carriage	Break failure	14:20hrs 12/4/07
2	Honda Accord/Nissan	–	1	–	–	1	Single carriage	Over speeding	10:34hrs 4/6/07
3	Honda Civic/Bus	–	–	2	–	1	Single carriage	Dangerous driving	11:30hrs 13/08/07
4	Truck/Bus	2	–	–	1	1	Single carriage	Break failure	12:40hrs
	Total	**2**	**1**	**3**	**1**	**4**			

Source: FRSC, 2007

In this study the road on which a total of 38 traffic accident were reported to have occurred in 2007 are referred to as identified accident routes (IAR) the names and location of the roads was presented in Table 1. The result in Table 3 revealed that P.Z. junction/Bank road had the highest number of accidents with nine cases. This is due to the existence of complex land use, such as commercial, educational, residential and transport, attracting high trips which inadvertently leading to traffic accidents. Tables 2, 4 and 6 shows a

total of 5 and 7 accidents cases for the year 2007 on Sokoto road in Samaru and Shehu Idris road, Zaria city. These roads have educational and residential land use along them, there attracting large daily movements. Where as in Tudun Wada along Ahmed Makarfi dual carriage road generate moderate trip and low accident rate because of the existence of few economic activities. Again, Table 7 showed 8 different accidents for the year 2007 on Aminu road and Lagos Street. This is high because of high volume of vehicles that patronize a major daily market in Sabon Gari.

Table 6. Road traffic accident on Tudun Jukun Gaskiya/Polytechnic Road

S/N	TYPE OF VEHICLE	TYPES OF ACCIDENTS			AVERAGE NO OF DEATHS	NO OF ACCIDENTS	TYPES OF ROAD	CAUSE OF ACCIDENT	TIME OF DAY
		FATAL	MINOR	SERIOUS					
1	Trailer/DAF	_	_	1	_	1	Single carriage	Tyre burst	07:00hrs 20/2/07
2	Honda civic	1	_	2	1	1	Single carriage	Tyre burst	11:00hrs 28/4/07
3	911	_	_	2	_	1	Single carriage	Robbery	5:00hrs 01/6/07
4	Toyota Car/Bus	_	_	1	_	1	Single carriage	Dangerous driving	12:00hrs 01/6/07
5	Toyota Car Saloon	_	_	1	_	_	Single carriage	Lost control	23:00hrs 4/7/07
6	Toyota/Bus/ motorcycle	_	_	4	_	_	Single carriage	Over speeding	16:30hrs 29/10/07
7	Motorcycle	_	_	2	_	_	Single carriage	Over speeding	7:59hrs 13/11/07
	Total	**1**	_	**14**	**1**	**7**			

Source: FRSC, 2007

Table 8 shows a summary of the types and characteristics of land use along the identified accidents routes. They include commercial, educational and residential land use, all producing complex services which attract large movements. These movements create high traffic, wrong and parallel parking of vehicle and major traffic hold up points which jointly create road traffic accidents due to growth of unplanned land use along the routes.

Table 8 shows that P.Z. junction; Park road and Bank road with 14.3 as index accessibility is the most accessible and highly utilized. While Aminu road and Lagos Street do not well connected but are highly used. Gaskiya/Polytechnic road and Aminu road/Lagos Street in Sabon Gari identified as accidents routed have more unplanned land-uses with complex characteristics attracting different movements and as such have high potential for the occurrence of road accidents than the others.

Table 7. Road traffic accident on Sabon Gari (Lagos Street/ Aminu Road)

S/N	TYPE OF VEHICLE	TYPES OF ACCIDENTS			AVERAGE NO OF DEATHS	NO OF ACCIDENTS	TYPES OF ROAD	CAUSE OF ACCIDENT	TIME OF DAY
		FATAL	MINOR	SERIOUS					
1	Peugeot	–	–	1	–	1	Single carriage		2:30hrs 12/01/07
2	Honda civic/ Motorcycle	1	–	–	–	1	Single carriage	Over speeding	3:00hrs 3/03/07
3	Bus/Toyota Saloon	–	2	–	–	1	Single carriage		4:00hrs 4/03/07
4	Toyota Bus/Bus	–	–	2	–	1	Single carriage	Obstruction on road	12:20hrs 12/05/07
5	Nissan/Bus/M . Benz	–	1	–	1	1	Single carriage	Dangerous driving	5:00hrs 24/07/07
6	Bus/motorcyc le	–	–	1	–	1	Single carriage	Break failure	23:00hrs 4/10/07
7	Toyota Bus/ Toyota Bus	1	–	–	–	1	Single carriage	Dangerous driving	2:10hrs 27/11/07
8	Nissan Bus/ Honda	–	–	1	1	1	Single carriage	Dangerous driving	2;40hrs 10/12/07
	Total	1	_	5	1	7			

Source: FRSC, 2007

Table 8. Characteristics land uses along identified accident routes in urban Zaria

Identified accidents routes	Land uses through which road passed	No. of accidents	Road width (in meters)	Accessibili ty index	Over/under utilized IAR
Samaru (Sokoto road)	Semi-public/residential/commerci al land uses	5	18.2	8.4	+
PZ Bank road	Commercial/transportation/ residential and public uses	9	16.4	14.3	+
Zaria City (Shehu Idris ssroad)	Residential/commercial land uses	5	16.4	5.6	-
Tudun Wada (Ahmed Makarfi road)	Residential/commercial land uses	4	9.1	7.1	+
Gaskiya (Polytechnic road)	Residential/educational and administrative land use	7	9.1	7.7	+
Sabon Gari Lagos Street/Aminu road	Commercial/residential/tran sportation land uses	8	9.1	12.8	+
	Total	**38**			_

Source: Field Survey, 2008

The implication of these findings showed that land use is not the only determinant of road traffic accident, others like increased traffic flow, dangerous driving, lack of concentration, refusal to obey traffic rules and mechanical faults are also major causes of road traffic accidents in urban Zaria area. The result of the accessibility index showed that P.Z junction/Bank Road, Aminu Road/Lagos Street and Gaskiya/Polytechnic roads are highly utilized and they recorded the high number of accidents, contributing 63% of the total road traffic accident cases in urban Zaria area. This is attributed to the fact that they experience heavy vehicle traffic flow, most of which are attracted by land use located in them or as a result of through traffic flow. The result of the product moment correlation came up with a correlation coefficient of 0.62, meaning that there is a relationship between increase in traffic flow as generated by land use and the occurrence of road accidents in urban Zaria area.

4. Conclusion

This study examines how land use generate crisis- crossing trips using different modes of transport to conveying people and provided explanation on how the relationship between land traffic flow creates road traffic accident in urban Zaria area Nigeria. It was discovered that the locational pattern of the various land use in urban Zaria area is a reflection of socio-economic and ecological factors. It was also discovered that the residential areas are the trip or traffic generating areas, while attracting areas are the activity or work places. The movements of vehicles carrying people and goods between these areas result in the crisis-crossing of traffic flows which inadvertently come up with road accidents along the identified accidents along the identified accident route on urban Zaria area. This study revealed that the rate of road traffic occurrence of accident varies on the identified roads, but it is generally moderate in urban Zaria area. It was recommended that building of activity places should be done based on plan and that committee responsible for the removal of unplanned building, other obstruction by the road side should be put in place.

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