Geographical Locations of Accident-Prone Areas in the Northern Senatorial District of Ondo State in Nigeria

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Abstract

The occurrence of accident irrespective of the cause seems to be concentrated on some particular points or areas on our roads. Such areas have witnessed accidents that have claimed lives and as a matter of fact, have left many families to be widowed, while the country has been drained of active manpower. It is in the realization of these facts that this paper aims at identifying accident prone areas in the Northern Senatorial District of Ondo State in Nigeria with a view to reducing road accident and at such identify accident vulnerable areas. A reconnaissance visit was made to study the area and thereafter, three hundred and ten (310) copies of questionnaires were purposively administered to ten (10) areas each: that is 31 copies of questionnaires in each sampled zone. The study identifies specific areas prone to road traffic accidents which account for various geographical characteristics of identified accident black spots. The study identifies Okia-Oka as the most prone accident area in order of magnitude from year 2010 to 2019. The black spots were identified and demarcated on a map to serve as a road guide for road users. The study recommends mounting of programmed traffic light for the management of traffic, particularly at notorious accident black spots in the study areas such as Akungba-Oka Junction, Benin-Ifon Junction and Owo-Ikare Junction. The erection of billboard at accident prone areas indicating speed limit of 30km per hour among others is also suggested.

Key Words: Accidents, accident prone areas, location, safety, road traffic.

Background

Road traffic accidents occur worldwide but the incidence is more in developing countries as attested to by Aderamo(2012). Annually, about 1.24million people die as a result of road traffic crashes (World Health Organisation-WHO), 2013). Road traffic injuries are the leading causes of death among young people, aged 15 – 29 years (Gungul, 2012). A report also indicated that half of those dying through road accidents are “vulnerable road users”: pedestrians, cyclists and motor-cyclists (WHO, 2015). Equally, findings revealed from a study that 91% of the world’s fatalities on the roads occur in low-income and middle-income countries, even though these countries have approximately half of the world’s vehicles (Emmanuel, 2016). Without action, road traffic crashes are predicted to result to the death of about 1.9 million people by 2020 (Aderamo, 2012; WHO 2013). The probable fear is that only 28 countries, representing 416 million people (17% of the world’s population) have adequate laws that address all risk factors

on road accidents (speed, drunk-driving, helmets, seat belts and child restraints) (Aderamo, 2012; and WHO, 2013).

Basic issues on road accident studies have been reviewed by the Nigeria Police, Federal Road Safety Commission (FRSC) and scholars. Prominent among such accident studies are: road accident causalities (Obinna, 2007, Aderamo, 2012 and Awe, 2012); factors influencing rate of road traffic accidents (Eze, 2009, Aworemi et al 2010, Atubi, 2012, Ogunbodede, 2012, Ohakwe et al 2012, Gungul, 2012, Agbeboh et al 2013, Agbonkhese et al 2013 and Afolabi and Gbadamosi 2017). Road safety and preventions (Onokomaiya, 1991, Dange 1998, Ogunbodede 1998, Adaramaja, 2002, Ogunbodede and Ilesanmi, 2007, Sheriff 2009, Sumaila 2013 and Emmanuel, 2016). Social and economic impacts of road traffic accident (Arosanyin, 1998, Ogwude, 2010, Oyedepo and Makinde 2015). Except in one recent study of Ogunbodede, Olurankinse, Olabode and Ale (2018) that examined road accident black spots and its implications for transportation planning.

The fore-going depict therefore the past studies on road accidents in Nigeria and show the trend and causes of road accidents such as road factors, environmental factors, human factors, and vehicular factors. Others include: safety control, economic and social factors. Thus, identification of the accident prone areas on our road system is very vital to identifying solutions to road traffic accidents.

In Nigeria today, hardly a day goes by without the occurrence of a road traffic accident, leading to increase in the incidence of morbidity and mortality rates as well as financial lost to the society and the individual involved (Eze, 2012). However, the causes of road traffic accidents are not just restricted to human error or driver negligence, but road related issues. Unfortunately, Nigeria highways are arguably one of the worst and most dangerous in the world (Bun, 2012). It is therefore a known fact that many factors have been seen responsible for accident occurrence at some specific points. Nigeria has been noted therefore to have the highest road accident rate as well as the largest number of death per 10,000 vehicles in the world (Eze, 2012). The implication of this is that travelers heave a sigh of relief each day they are able to make their journeys to their destination safely.

The aim of this study is to identify and examine geographic nature of specific points where road accident frequently occurs and determine the most prone accident areas in the study area.

The Study Area

The Ondo North Senatorial Region of Ondo State lies between latitudes $4^{\circ}35'1''$ and $7^{\circ}52'1''$ North of the Equator and longitude $6^{\circ}00'1''$ and $6^{\circ}05'1''$ East of Greenwich Meridian. Its land area is about 4,500 square kilometers. The region is bounded in the East by Edo State, in the West by Ekiti State, and in the North by Ekiti and Kogi States, and to the South by Edo State and Ogbese town (Dada, 2006. See Fig.1, Fig.2 and Fig.3). The rainy season lasts from April to October. The temperature of the region varies from mean minimum temperature from $22-24^{\circ}\text{C}$ and mean maximum temperature of $30-32^{\circ}\text{C}$ (Fatusin, 2012). From the record of 2006 population census

exercise, Ondo State Senatorial region has a population of 1.06 million. (NPC, 2006) The region's projected population stood at 1,193,908 in 2019.

Map of Nigeria incepts Ondo State with the Study Area shaded in Blue colour.

Conceptual Issues on Road Traffic Accidents

The geographical approach to the study of road traffic accidents relates to the concept of place, time and environment to accident occurrence. It is believed that land use, road element, width of the road, bending of road, hilly area, topography and regional distribution are important issues in academic discourse. According to Cutter (1993) cited in WHO (2013), geographical scale is important for impacts and their reduction in system risk such as road traffic accidents. Land use pattern, types of road network, local business and activity pattern influence the system risk in an area (Komba, 2006 and WHO 2013).

Although, there are many models of accident causation, the system-based model is the most prominent and it is now widely accepted that the accidents which occur in complex socio-technical systems are caused by a range of interesting human and systemic failures (Onakomaiya, 1988). Systems-based accident analysis and investigation, described also in the 'Swiss model', has been applied with significant success in a range of safety critical domains such as in road transport, aviation, process control, rail transport and in a range of other domains which they have been applied successfully (Ogunbodede, et al.2008). The components of the theory are the environment, the means of transport and the behavior of man (Komba, 2006).

In furtherance of this theory, a model for traffic accident as inspired by the ecological model of a disease was developed by Vitus (2014). The model for road accident is characterized by three

main components (Komba, 2006). These are the vehicle, the environment and the behavior of the population. The vehicle is described in terms of its composition, age, technical conditions and safety equipment like seat belts in a car. The environment comprises of the road system and the wider physical and built up environment. The physical environment splits further into different aspects such as daylight and climate; spatial conditions, settlement patterns, situation of areas of residence and working areas, principle of traffic separation, topography and road construction qualities. The behaviour of the population includes characteristics such as age and sex ratio as well as attitudes and general traffic behavior. Also included is driving behaviour, driving experience, driving style, risk compensation and risk driving relating to influence of alcohol and drugs. All in all, this study adopts system theory as its theoretical frame work.

Methodology

Reconnaissance survey was made to the study area to familiarize with the area and obtain first-hand information about the road guides, locations of some towns and villages in the region. The reconnaissance survey focused on the road transport services and the major land use types in the study area. Ten vulnerable accident prone spots were identified and selected. These include Oke-Oka, Okerigbo, Ayegunle-Oka bend, Arigidi-Okeagbe bend, Ogbagi single lane bend, Akungba-Oka Junction, Okia-Oka, Oba-Market town, Owo-Ikare Junction and Benin-Ifon Junction.

The primary data for the study which are information regarding identification of accident-prone areas and geographical characteristics of accident-prone areas were collected through the use of questionnaire. The identified areas where accidents often occur were measured and the dimension in terms of length taken as well as specific location, using hand held Global Positioning System (GPS) with a view to determining the actual black spots 'or absolute locations relative to the areas, while the secondary data included the road network of the study area collected from Ondo State Ministry of Works, Housing and Transport. On this map, the vulnerable spot of accidents was demarcated. Other secondary data were gathered from books and unpublished official records, articles, official reports of local and state governments, Federal Road Safety Commission (FRSC) Owo and Ikare, and the Nigeria Police Stations in each of the sampled accident prone areas of the study. Examples of such information included the records on accidents from 2010 to 2019.

A purposive sampling technique was adopted and employed to select accident prone areas for the study. These purposively selected accident prone areas form the sample frame work, while a total of three hundred and ten respondents (representing 0.1% of the study's population) formed the sample size for this study. Therefore, 31 respondents in each activity area of the study were interviewed. The data were summarized, using descriptive statistics.

Findings and Discussion

During the reconnaissance visit to the study area, a number of factors were noted to be the major causes of accident. Some of the causes were road related, environmental related, human related and vehicle related factors. The hand-held Global Positioning System (GPS) was used to identify

specific points where accidents were common and factors causing those accidents at specific points were also noted as presented in Table 2.0.

Geographical Nature of Accident Prone Areas for the Study

Geographical nature of accidents' prone areas for the study refers to the information regarding the specific locations of accident prone areas from the respondent as well as handheld global positioning system (GPS) readings recorded by the authors as shown in Table 1.0. The data on the geographical nature of accident black spots were equally presented in bar charts (See Fig, 4).

Okerigbo Accident Black Spot

In Okerigbo accident black spot, out of 31 respondents (100%), 30 respondents (96%) identified the accident prone area as the hilly area of Okerigbo. The study found out that 29 respondents (93%) established that the extended part of the same accident location included descending slope of the accident prone area. The study confirmed that accident prone area of Akungba-Ikare road axis was Okerigbo hill crest. It also included the descending part of the hill's slope area. The height of the accident black spot was 264 feet long and the height was 23 feet above the sea level. While the specific location relative to the area using GPS was $05^{\circ}4.081'$ Eastg and $07^{\circ}31.264'$ North. .

Oke-Oka Accident Black spot

The Oke-Oka accident black spot investigation had 31 respondents interviewed, and all the 31 respondents (100%) identified the black spot as the Oke – Oka hill crest. 30 respondents (97%) mentioned the same location accident black spot to include extended part of the hill's descending slope. Oke-Oka accident black spot was 250 long and 29 feet above the sea level. The GPS readings to determine the specific point of the accident black spot was $005^{\circ}47.5$ East and $00\ 07^{\circ}27.008'$ North in the area.

Table 1.0 Specific Location of Accident Black Spots in the Study Area

NAME OF ROAD'S BLACK SPOT	SERIAL NO	Nature of the Location of each Named Accident Black Spot on the Road Accident.										
	1	HILL	VALLEY	CORNER OR BEND	NARROW FREEWAY	NARROW BRIDGE	PLANE SURFACE	Descending slope	Northing	Easting	Height above sea Level in feet	Length in feet
OKERIGBO	2							29	07° 31.264'	005°45.081	22	264
AKUNGBA-OKA JUNCTION	3	31			30				07°27.726	005°44.004	19	170
AYEGUNLE OKA	4		31					30	07°24.926	005°43.546	22	174
ARIGIDI-OKEAGBE BEND	5	30		31	30			30	07°35.691	005°42.872	23	207
BENIN-IFON JUNCTION	6		28					31	06° 56.016'	005°45.847	19	624
OWO-IKARE JUNCTION	7	29							07° 17.335'	005°38.318	18	180
OBA MARKET TOWN	8		28	30				31	07° 22.265'	005°43.622	10	300
OGBAGI SINGLE LANE BEND	9	29		31				31	07°34.608	005°41.700	21	400
OKE OKA	10	30						31	07°27.051	005°46.623	29	340
OKIA OKA	11	30						31	07°27.051	005°46.623	23	250

Source: Author's Fieldwork 2019

Table 2.0 Factors Causing Road Accidents at Specific Locations of Accidents Black Spot

	NAME OF ROAD'S ACCIDENT BLACK SPOT	FACTORS CAUSING ROAD ACCIDENTS							
		Bend	Pot Holes	Sharp Descending Slope	Over Speeding	Over Loading	Over Taking	Road Poor Traffic Warning Signs	Night Travels/Poor Visibility
1	Okerigbo	✓	✓	✓	✓	✓	✓	✓	✓
2	Akungba-Oka Junction	✓	✓		✓	✓	✓	✓	✓
3	Ayegunle Oka	✓			✓	✓	✓	✓	✓
4	Arigidi-Okeagbe Bend	✓	✓		✓	✓	✓	✓	✓
5	Benin-Ifon Junction		✓		✓	✓	✓	✓	✓
6	Owo-Ikare Junction		✓		✓	✓	✓	✓	✓
7	Oba Market Town	✓	✓	✓	✓	✓	✓	✓	✓
8	Ogbagi Single Lane	✓	✓	✓	✓	✓	✓	✓	✓
9	Oke-Oka	✓	✓	✓	✓	✓	✓	✓	✓
10	Okia-Oka	✓	✓	✓	✓	✓	✓	✓	✓

Source: Authors' Fieldwork 2019

Okia-Oka accident black spot

Similarly, Okia-Oka accident black spot shared geographical nature where accidents frequently occur to be Okia-Oka hill's crest. The extended part of the accident location was the attached slope in the area. All the respondents (31) interviewed identified the accident black spot as road's bend located on the hill. The accident black spot was 340 feet long and 23 feet above the sea level. The GPS readings to determine the specific location of this black spot was 005°46.623' East and 07°27.051 North.

Akungba-Oka Junction Accident Black Spot

All the respondents 31(100%) interviewed at the surrounding location of Akungba-Oka Junction identified the accident prone spot as the road junction located on the hill crest, while 30 respondents (97%), included the construction defect of the road's narrow freeway. The

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geographical nature of the accident prone spot is therefore described as hill combined with narrow freeway. The length of this prone spot is 170 feet long and 19 feet above sea level. The specific location of the accident black spot was 005⁰44.004' East and 07⁰27 726' North.

Ayegunle-Oka Accident Black Spot

Out of thirty-one (31) respondents interviewed in Ayegunle–Oka settlement, about 30 respondents (97%) identified the accident black spot as the hill crest. 30 respondents (97%) included the extended part of the hill's slope. The accident-prone area of Ayegunle-Oka by geographical nature could be described as location on the hill crest with the attached descending slope. The length of this accident black spot is 175 feet and 22 feet above the sea level. The GPS readings was 0050 45.081 East and 070 24.926 North as the specifics of the accident black spot in the study area.

Arigidi-Okeagbe Accident Black Spot

The specific location of accident prone area of Arigidi-Okeagbe accident prone spot was identified as a hill by 30 (97% respondents. All the 31 respondents (100%) included corner and the hill's descending slope. Geographically, this accident prone area exhibits three geographical features, namely: hill, bend and slope. The length of Arigidi-Okeagbe Bend accident black spot is 207 feet and 23 feet above the sea level; and the accident black spot specific location from GPS readings 0050 42.872' East and 070 35.691' North.

Ogbagi Single Lane Accident Black Spot

Similarly, at Ogbagi Single Lane accident black spot, all the 31 respondents interviewed (100%), identified this accident black spot of the settlement exhibited geographical nature of combination of hill, corner and descending slope. The situations observed in these two similar locations evidently accounted for accident occurrences in these accident black spots. Road related factors were largely responsible for accidents. It should be noted however that any bend of roads requires necessary caution to negotiate while driving. Equally and more- importantly, in descending or ascending a slope normally requires extra-ordinary care to ply by both vehicles of light weight and heavy duty. The location of Ogbagi Single Lane Bend accident black spot was 400 feet long and 21 feet above the sea level. The GPS readings to determine the specific location of the accident black spot recorded 0050 44.004' East and 070 34.608' North.

Fig.4: Map of Ondo North Senatorial District Showing Accident Black Spots with Its Attendant Graphs

Source: Authors Field Survey, 2019.

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Benin-Ifon Junction Accident Black Spot

The respondents interviewed – 31 (100%) at Benin-Ifon Junction identified the accident prone area of the town as descending slope of Benin-Ifon Junction, while 30 (97%) respondents included narrow freeway construction's defect impediments of the road to the frequent record of accidents at the location. Also, 28 (90%) respondents named the extended part to be the attached valley of the hill. The length of the accident prone area of Benin-Ifon Junction is 624 feet long and 19 feet above the sea level was 005⁰ 45.847' East and 06⁰ 56.016' North in the area.

Owo-Ikare Junction Accident Black Spot.

Ikare-Owo Junction accident black spot has a geographical nature of location called plateau, otherwise known as table land. The length of Owo-Ikare Junction accident prone area is 180 feet long and 18 feet above the sea level. The specific location was 005⁰ 38.318' East and 07⁰ 17.335' North in the study area.

Oba Akoko Market Town Accident Black Spot

In the survey of location of accident black spot at Oba Akoko Market town, all the 31 respondents interviewed (100%), identified the accident black spot to be the descending slope of the market area, while 31 respondents (100%), included the attached adjoining bend. The study discovered that the accident black spot extended to the Oba-Afo junction, a relative valley in the area. The accident prone area can be described by geographical nature as location that exhibits slope, bend and valley. The length of this accident prone was 300 feet long and 10 feet above the sea level, with 005⁰ 43.622 East and 07⁰ 22.265 North GPS records for the specific location of the accident black spot in the study area.

Ranking Order of Accident-Prone Areas for the Study Area

The degree of accident vulnerability at each identified accident black spot for the study was examined from 2010 – 2019. From Table 2.0 below, it revealed that accidents in the region occurred in almost the same magnitude with fairly negligible differences. For example, Okia Oka accident prone spot had 1172 cases (12.8%) vehicle accidents within the period of study. Oke-Oka accident prone area recorded cases of accidents of about 1159 cases (12.7%). The Owo-Ikare Junction accident prone area accounted for 1086 cases (11.9%) and Akungba-Oka junction accident prone area with (1018) cases (11.2%). The number of accidents also revealed that accident occurrence of some locations in the region followed similar range with fairly negligible differentials.

Findings from Table 3.0, revealed similar records of low accidents differentials, even though substantial in three different locations namely: Oba-Akoko Market town accident black spot with

recorded cases of 871 (9.5%), Benin-Ifon and Arigidi-Okeagbe accident prone areas had same record of (9.3%).

Consequently, Ayegunle Oka road accident prone area had 741 cases (8.1%) of accidents which did not differ much significantly from Okerigbo road accident prone area.

Table 3.0 Ranking Order of Accident-Prone Areas for the Study.

Area Prone to accident	Frequency	Percent %	Ranking	Cumulative Percent %
Okerigbo	704	7.7	9	7.7
Akungba Oka Junction	1018	11.2	4	18.9
Ayegunle Oka	741	8.1	8	27.0
Arigidi-Okeagbe Bend	850	9.3	6	36.3
Benin-Ifon Junction	846	9.3	6	45.6
Owo-Ikare Junction	1086	11.9	3	57.5
Oba Market Town	871	9.5	5	67.0
Ogbagi Single Lane	680	7.5	10	74.5
Oke-Oka	1159	12.7	2	87.2
Okia-Oka	1172	12.8	1	100.0
Total	9693	100.0		

Source: Authors Field Survey, 2019.

Fig. 5 Ranking of Accident Prone Areas of Ondo Northern Senatorial District

Source: Authors Field Survey, 2019

Accident Black Spots in the Study Area.

From the study's findings, Okia-Oka accident prone area (12.8%) was the most accident prone area, followed by Oke-Oka (12.7%). Owo-Ikare Junction ranked third in accident prone area (11.9%). The next below the range was Akungba-Oka Junction accident prone areas (11.2%) which ranked 4th. Oba Akoko market town accident prone area (9.5%) came as the fifth vulnerable accident scene. While in the same category of accident risk area was Benin-Ifon Junction (9.5%) as the sixth prone accident areas. Arigidi-Akeagbe accident prone area was the seventh (7.5%). Nevertheless, Ayegunle Oka accident prone area occupied the eighth position in less category of accident zone (8.1%) in the region. The least area compared to the above-mentioned accidents prone areas of the region was Okerigbo accident prone area (7.7%) taken to be the ninth, with Ogbagi single lane occupying the tenth position (7.5%). The information is as summarized in bar charts superimposed on the map in Fig. 5.

Conclusion

The field investigations have established the topographical natures of accident prone areas of Ondo Northern Senatorial District of Ondo State as a hilly crest adorned with several bends which make it highly susceptible to accidents. The geographical characteristics revealed by the study posed abundant dangers to road traffic safety in the region. The predicted result in the death of around 1.9 million people annually by 2020 (Aderamo, 2012; WHO, 2013) may be

assuaged through research of this kind to suggest directions for road safety efforts towards reducing the carnage on our roads. According to Agbebor, et al (2013), accident report requires precise geographical locations with a view to proffering lasting solutions to road traffic crashes.

Road safety efforts are however generally directed at a mixture of three components of accidents preventions such as the road, the vehicle and the driver factors. The environmental factors are taken to be natural hazards that can only be prevented through early warning mechanism such as weather forecast. In general, accidents prevention can be achieved through policy measures, law enforcement, road safety education and research funding.

Recommendations

The Table below shows the summary of recommendations for every accident prone areas in the study area.

Accident Prone Area	Recommendation
Okerigbo	Billboard erection of 30km p/h per hour enforcement and re-engineering of the existing roads constructions to reduce hill height.
Akungba - Oka Junction	Billboard erection of 30km p/h per hour enforcement, speed breakers construction and Road Traffic programme traffic light be mounted.
Ayegunle - Oka	Billboard erection of 30km p/h per hour enforcement and speed breakers construction.
Arigidi-Okeagbe Bend	Billboard erection of 30km p/h per hour enforcement and speed breakers construction.
Benin-Ifon Junction	Construction of fly over bridge and Road Traffic programme traffic light be mounted.
Owo-Ikare Junction	Construction of fly over bridge and Road Traffic programme traffic light be mounted.
Oba Market Town	Billboard erection of 30km p/h per hour enforcement and speed breakers construction.
Ogbagi Single Lane	Billboard erection of 30km p/h per hour enforcement and speed breakers construction.
Oke-Oka	Billboard erection of 30km p/h per hour enforcement and re-engineering of the existing roads constructions to reduce hill height.
Okia-Oka	Billboard erection of 30km p/h per hour enforcement and re-engineering of the existing roads constructions to reduce hill height.

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