Identification of Road Traffic Accident Hotspots in the Cape Coast Metropolis, Southern Ghana Using Geographic Information System (GIS)

Christian Kwesi Owusu[1], James Kweku Eshun[2], Clement Kofi Ohene Asare[3], Abigail Ayipeh Aikins[4]

- [1]*Christian Kwesi Owusu is a Teaching Assistant at the University of Cape Coast (UCC), Prime Geospatial & Research Group, Ghana and Projects Ambassador for IAYG-WA. *Corresponding Author's Email: christiankwesiowusu@gmail.com*
- [2]*James Kweku Eshun is a Senior Lecturer at the University of Cape Coast, Department of Geography and Regional Planning, Ghana. Email: james_eshun@ucc.gh*
- [3]*Clement Kofi Ohene Asare is currently working with the Western Regional National Disaster Management Organization (NADMO) and currently persuing a PhD Degree in Geography at UCC, Ghana. Email: gklementasare@gmail.com*
- [4]*Abigail Ayipeh Aikins is currently a student at the University of Cape Coast, Deparment of Sociology and Anthropology, Ghana. Email: aikinsabigaila@gmail.com*

Abstract— Road traffic accidents (RTAs) and its associated injuries are one of the major causes of death in developing countries. Some researchers blame illiteracy especially among commercial drivers while others mention the poor nature of the road as the cause of this menace. In recent years, road traffic accidents in Ghana have become a major social problem in the world as one writer put it "carriage without horses shall go and accident fill the world with woe". The main objective of this study is to analyze the pattern of road traffic accidents in the Cape Coast Metropolis. Non-spatial/secondary data collection was used to obtain information on the location, the vehicle type, casualties, time and causes of the road accidents. One common feature is to assess information on RTAs. This study is therefore committed to explore issues surrounding road traffic accidents in Ghana with much emphasis on the Cape Coast Metropolitan area using Geographic Information System (GIS). Secondary data was used in obtaining the sample data. Data was collected directly from the record books of the MTTU in Cape Coast, a branch of the Ghana Police Service. Data was analyzed and interpreted with the aid of SPSS v. 21 and Arc GIS 10.3 versions. After the analysis, the study revealed that, 9 hotspots locations which were identified were comparatively competitive to each order. On a scale, the highest of all the hotspot intensity is Pedu Junction which recorded 33 cases followed by UCC East Gate which is responsible for about 30 counts. Morree Junction together with Nkanfoa/Third Ridge Junction recorded the same counts which are 22 each while Yamoransa Junction, Kotokuraba and Siwdu accounted for 21, 20 and 18 respectively. Kingsway and Abura recorded 15 occurrences each on a range. Finally, it was found out that most of the vehicles involved in road traffic accidents were private vehicles which numbered up to 232 cars making a share of (50.5%) out of the total of 459 vehicles. Hotspot locations and road traffic accident fatalities were mapped using GIS ArcMap/View.

Index Terms— Road Traffic Accidents, GIS, Cape Coast, Hotspots, Mapping.

1. INTRODUCTION

Worldwide, in recent years, there is a growing concern in road traffic accidents. These accidents often result in fatalities, injuries or damages to people. Thus road traffic accidents are one of the leading causes of human death worldwide. [1].

According to the WHO, over 1.2 million people die each year due to road accidents, with about 20 and 50 million suffering from non-fatal injuries. The fascinating issue is that despite the increasing sensitization on roads safety worldwide, the epidemic of road accidents is still on the rise. In the last five years alone, most countries adopted the WHO report on the road safety guidelines [2]. But there are still increasing trends of road accidents. Urgent action is needed to achieve the ambitious target for road safety reflected in the newly adopted 2030 Agenda for Sustainable Development, of reducing by half the global number of deaths and injuries from road traffic crashes by 2020 [3].

Recently, Ghana has been experiencing an increasing spate of road accidents. It is worrying to note that road accidents in Ghana has become more or less a "death sentence". Mostly, the major causes of road accidents accounting for these deaths are over speeding and reckless driving including overloading, irresponsible driving, wrong over-takings, drink driving and extreme fatigue [4]. The escalating incidence of road traffic accidents in Ghana is not new to the ordinary Ghanaian. The rate at which accident occur on our roads are alarming. It is then logic to say that one of the major challenges that this Ghana is battling with is road traffic accidents. In Ghana, mechanical, human and environmental factors are being known to the causes of road accident in the country, most especially mechanical factor. Source (Motor Transport and Traffic Union [5]. It is reported that road safety in the African sub region is of major social and economic concern. Although the region has about 4% - 5% of the world's motor vehicles, 11% of the worlds report fatalities are due to Road Traffic Accidents [6]. In contrast, road traffic accidents or road fatalities in developed countries are on the decrease. This is as a result of improved safety measures and enforcement of road traffic laws

and regulations. There is an also improved method of data collection to arrive at the real cause of traffic accidents and development of interventions to solve a particular problem. The Motor Traffic and Transport Unit (MTTU) show that most accidents are caused by broken down vehicles on our roads. Their records also indicates that in the year 2004 in the Cape Coast Metropolis, the number of accident cases reported were 1290 where death cases were 316 and injured cases were 1734 with 1667 vehicles involved in these accidents. In 2005, 1025 cases of accidents were reported out of which 208 deaths occurred and 1436 injuries reported at which 1375 vehicles were involved in accidents in the metropolis. Hence, the main objective of this study is to analyze the pattern of road traffic accidents in the Cape Coast Metropolis. Non-spatial secondary data collection was used to obtain information on the location, the vehicle type, casualties, time and causes of the road accidents.

2. LITERATURE REVIEW

2.1. Trend of Road Traffic Accidents

Ghana has the second highest fatality rate of road traffic accident in West Africa [7]. From January 1992 to December 2001, a total of 104,420 accident cases were recorded representing an annual rate of 10,442 cases. The numbers of vehicle involved were 145331. The number of people and who lost their lives were 10,106 and 80,022 people were injured. Worldwide, there are about 50 million road traffic accidents per annum [8]. In 2002, nearly 1.2 million people globally died as a result of road traffic accident [2]. In addition to these deaths, as many as 50 million people are injured or disabled globally among the age group of 5 to 29 years and the third leading cause of death among people aged 30 - 45 years in the world. It is also estimated that if necessary measures are not to address or improve road safety, road traffic death will increase by 80 percent in low income countries such as Ghana by 2020. Road traffic accident in Ghana have become a serious major social problem as one writer put it "carriage without horses shall go and accident fill the world with woe" [9]. Reports on road traffic injury and prevention define a road traffic injury as fatal or non-fatal injuries that occur as a result of a road traffic crash. A road traffic crash is defined as the collision or incident that may or result in injury [2]. It is indicated that child pedestrians accounted for 78 percent of all road transport – related casualties fewer than 16 years of age. Again children, as pedestrians, were mostly at risk in mixed traffic situations in urban environment where the road space is often shared concurrently by many types of motorized vehicles, bicycles, vendors and transport carts as well as pedestrians [10]. Cape Coast metropolis is an example of the situation. From the above, it is indicated that road traffic accident in Ghana is very high and there is the need for political priority and commitment to reduce road traffic accidents.

2.2. Root Causes of Road Traffic Accidents in Ghana.

According to World Health Organization [2], "car accident or car crash is a situation which an automobile collides with anything that causes damage to the automobile including other automobiles, telephone poles, buildings or trees, or in which the driver losses control of the vehicle and damage it in some other way such as driving into a ditch or rolling over". According to [8], the causes of road traffic accidents fall into three (3) categories which are the vehicle, environments and human factors. A study done by [11] on travel behavior and road safety found that human error was the sole cause in 57% of the all cases and a contributing factor in over 90% of the accidents. According to [11] also stated that mechanical fault accounted for only 2.4% while an environment factor was 4%. The human factors that contribute to road traffic accidents are drunk-driving, excessive speeding, ignorance of road or Highway Code, lack of maintenance and careless driving. These are behavioral aspect of human beings and account for the major cause of road traffic accidents [12]. Vehicular defects that accounted for road accidents are tyre burst, break failure, broken parts, defective lighting system and wipers and this accounted for about 2.4% of the factors that causes road traffic accidents. The environmental causes of road traffic accident are the physical features such as the road condition; hilly, portable, sloppy and slippery. Weather conditions such as rainy, foggy and sunny are also some of the environment factors.

The framework adopted for this study was based on model about the perspective of traffic engineering and behaviour which lay emphases on the aspect of the road, vehicle designs and the attitudes and perceptions of road users as presented in Fig. 1.

The model represents the three (3) components and their characteristics, population, behaviour and habitat which are presented in a triangular form. The model was adapted and adjusted to a road traffic accident approach [8].

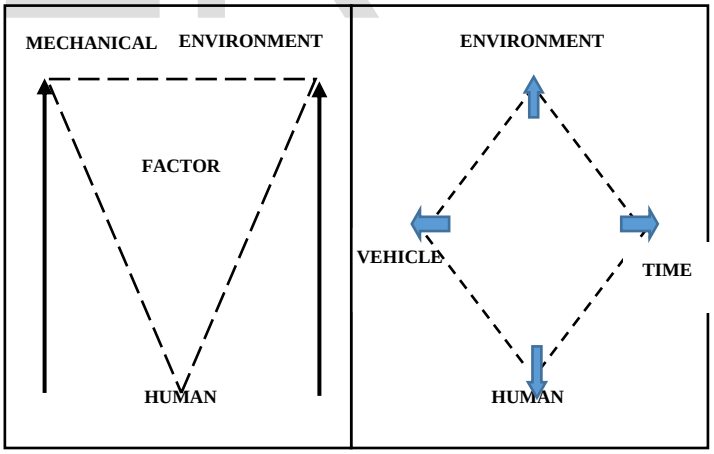

Fig. 1. Model framework for Understanding Road Traffic Accidents. Source: Adapted from Jorgensen and Abane [8].

These three elements are inter-linked through geo-referenced traffic events and provide the basis of road safety analysis in an attempt to reduce the occurrence and severities of road traffic accidents by the creation of maps and charts by the use GIS in order to locate any hotspots and other Road Traffic Accident (RTA) indicators with much ease. Two components of the model are vehicle and environment. The human factor is sub-divided into Behaviour and Attitude. Some

additions which is been made for the model are system of traffic laws, regulations and mode of enforcement that the population abide by the measure to put in place and regulations which will maintain security and safety on our roads.

Also important to the model is the attitudinal behaviour as a characteristic of the people which made it difficult for change. It directs the people's behaviour towards a particular direction. This 'attitude' is to lay emphases on the behavioural characteristics [8].

Based on figure 1, time was also considered as a pivotal component of Road Traffic Accident. Time in this case could be the time of the day, time of the week, time of the month and even time of the year as in seasons (festivities or occasions) [13]. Time is an integral component of road traffic accidents since it goes a very long way to determine traffic volumes-congestions which brings to the fore front risk factors and also behaviours of road users in general. This study intends use figure 1 to explain the assertion above. In this case instead of using the "triangle" as adopted by [14], it is appropriate in this concept to use or employ a diamond shape contained by an oval core. The arrows in the diagram are simply depicting the contribution of the following components; human factors, vehicle factors, environmental factors and also time factor. The four (4) proposed components together form the diamond shape [13].

The vehicle is made up of various parts and are joined together to form one component. It also comes in different sizes and makes. This brings out the different characteristics of vehicles throughout the world. In the study of road accident, the modal is very important. It determines the safety level of the people. In Ghana, the type of vehicles ranges from private cars, taxis and minibus popularly known as "trotro" [15]. There are few bigger buses operated by the state and private individuals and companies. The level of safety depends on the quality and maintenance of the working parts of the vehicles such as breaks, lighting systems, wipers and tyres among others. The physical construction of the vehicle such as smoothening of the edges of the body to prevent serious injuries to pedestrians and passengers in time of accident.

Another important aspect of the vehicle component of the model is to improve safety operational system such as seat belt, air bags and eliminating controls for clear vision in time of foggy or rainy weather.

The environment and road network are related in the safety of road uses or transportation. The environment would depicts the kind of road network and warning signals that would control, direct and enforce safety on our roads. The environment being urban and rural contributes significantly to the safety of roads. The urban areas have the problem of land use and high pedestrian traffic movement in the streets and results in traffic congestion [15], [16]. The condition of the road such as hilly, sloppy, slippery, curvature, intersections and narrow roads need careful consideration and planning as these points or spots contribute to high rate of accident. Initially, in the urban settings, the roads were very narrow and as the volume of traffic increases the road network ought to be expanded to meet its current demands however, there is no space for these expansions and this leads to high incidence of accidents. The culture of maintenance of road is poor and there are potholes which contribute to the high rate of traffic accidents.

The people's attitudes and behaviour can be seen in their age, sex, and education as well as training level [15]. Attitude of the population towards the manual technical operation of vehicles is highlighted here. The behaviour of the people adapting to changing situation according to time and technology is very low. There are new improved mechanisms and safety devices introduced in vehicles to reduce fatality rate. It is observed that these mechanisms such as the use of seat belt, automatic brake system (ABS), air bags and eliminating glass clearing systems are not regarded as important safety features. Whenever a deviant driver is challenged or questioned about his dangerous driving behaviour, he responds rudely and might get the support of passengers whose lives are in danger [16]. When the driver's rude behaviour results in an accident, they attribute it to super natural powers instead of the driver's attitude such as excessive speeding. Behaviour characteristics including age, sex, education and training in one way or the other may have influence on driving behaviour. The age below 18 years has high rate of accident (45%) as compared to the elderly (20%). The knowledge and training of the drivers constitute his or her driving skills and this have influence on his or her attitudes in traffic risk management. In developing countries, illiteracy is very high and this hinders the level of experience of the drivers and the knowledge of the Highway Code. Most drivers cannot read and interpret some road signs and this put them in danger. The deviant driver behaviour includes drunk-driving, excessive speeding and reckless driving. These are the major causes of accidents in developing countries [1], [16].

There are other obstacles on the road such as animals, broken down vehicles that may obstruct the driver without prior warning and may cause road accident. Inadequate regulation and enforcement of road traffic laws may also contribute to the high rate of accident on our road [17]. The level of pedestrian awareness of road traffic regulation may also increase or decrease accidents. This paper highlighted some potential causes of road accident.

2.3. Why GIS Application?

Geographic Information Systems have played an important role, enabling accurate geographically referenced data to be made available electronically to different highways and local authorities responsible for road safety. The London Accident Analysis Unit part of the United Kingdom governments research Centre, central to the work, operates an extensive GIS network. This enables the sharing of data among the police, different government bodies and local authorities. Details on each accident are entered into a database by the metropolitan police who use digital maps to pinpoint precise locations, matching grids and coordinated automatically to records [18]. By using GIS, each accident is assigned a node; link or cell associated with London's road network and data is improved to generate a complete and accurate accident dataset that can be distributed to the authorities responsible for implementing road safety measures. This has eventually reduced about 8000

Road Traffic Accident casualties. Japan realized in recent times that, software applications incorporating GIS have been developed on many fields and this permitted linkage between various types of data and maps. Hence, GIS – based system to analyze factors which contributed to road traffic accidents in Hokkaido and to device accident measures to fight against the accident situations. In view of this, the Traffic Engineering Division of Civil Engineering Research Institute developed a system in which digital maps were linked with data of traffic accident, roads and weather [19]. In Canada, GIS is applied to forestry plane, the volume of timber to cut, access to timber and other forestry reports. The tendency of Road Traffic Accident (RTA) to cluster or concentrate at a few points or spots on road sections usually hotspots or accident spots are common on our roads. These spots can be considered as sources of spatial information on traffic accident [20]. The field of transportation embraces the use of GIS quite recently and not much work has been done using it. GIS is such a technique which can be used as an efficient tool to store, process and analyze the spatial data in both quantitative and qualitative ways [21], [22].

3. MATERIALS AND METHODS

The number of Road Traffic Accidents (RTAs) cases and time of occurrence, location of accident, vehicle types were recorded and subsequently were tested and analyzed. The research design involved collection of data to answer the research objectives and research problem respectively. It is thus clear through this design that we are analyzing ways of accessing information on Road Traffic Accidents (RTAs). The research design was to obtain information on the hotspot locations and causes of road accidents in the Cape Coast Metropolis. Secondary data sampling was used for the study since the data description is factual, accurate, systematic, it gives an in-depth knowledge of the subject under study and it is worth seeking in establishing a causal relationship between road traffic accident and its impact on the individuals, families and the government. It was written directly from the accident record books of the Motor Traffic and Transport Union (MTTU) stationed in Cape Coast.

3.1. Study Area

The research was conducted in the Cape Coast Metropolis setting. It comprises Cape Coast and some of its environs. The Metropolis is the capital city of the Central Region of Ghana. As factored earlier it shares its boundaries with the Gulf of Guinea. It lies between the cities of Accra and Takoradi. The main Trans- West African highway passes through the Metropolis [23]. The Cape Coast Metroploitan area is shown in the figure 3 below.

Cape Coast is the capital town of the Central Region of Ghana. It is often referred to as the first capital town of the then gold coast. It was used to be referred to as Cabo Corso by and among the indigenous people meaning short cape. It is currently referred to as Oguaa or Igua (market place). The Cape Coast Metropolitan area is one of the most important districts in Ghana but yet it is the smallest in the country [24]. Cape Coast is found on the west coast of the Atlantic ocean and can be spatially located on latitude 5.10 North and on longitude – 1.25 West and has its altitude or its location in Degrees, minute and seconds as 5 degrees, 5 minutes and 60 N latitude and 1 degree, 15 minutes longitude with zero (0) altitude. It has 415.4 km² as the total land surface area and the metropolitan covers an area of 122 square kilometers. The Metropolis is bounded on the south by the Gulf of Guinea, on the east by the Abura-Asebu-Kwamankese District, to the west by Komenda - Edina- Abrem District and to the north by the Twifo-Hemang Lower Denkyira District (see figure 3.). According to the 2010 Population and Housing Census, Cape Coast has a population of about 169,894 with 82,810 males representing 48.7% and 87,084 females representing 51.3% [25]. **Source:** Department of Geography and Regional Planning, University of Cape Coast, Ghana, 2017.

3.2. Digital Road Network Map of Cape Coast Metropolis.

The digital road of Cape Coast shows the outline of road networks in the Cape Coast metropolitan area from the actual map of Cape Coast. It was captured using the GIS ArcMap/View 10.3 Version of Environmental Systems Research Institute (ESRI). The map of Cape Coast was edited in the software and the road network of Cape Coast was captured using the GIS toolbar (see Fig. 2).

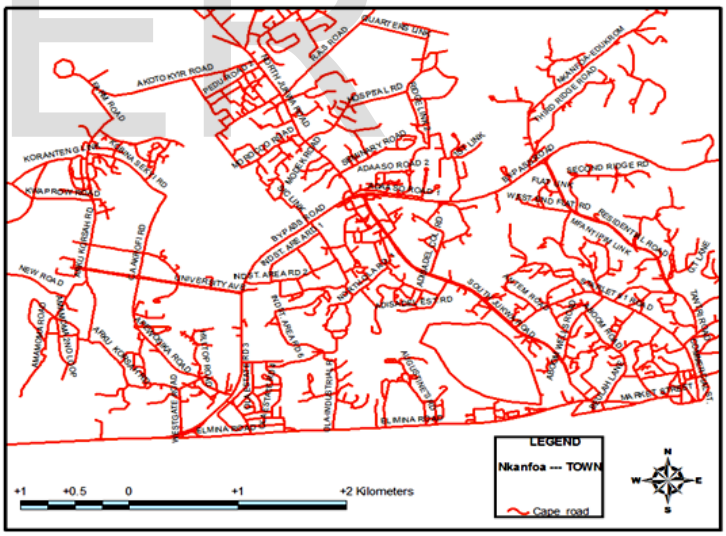

Fig. 2. Digital Road Network Map of Cape Coast.
Source: Researchers' GIS ArcMap Analysis, 2017.

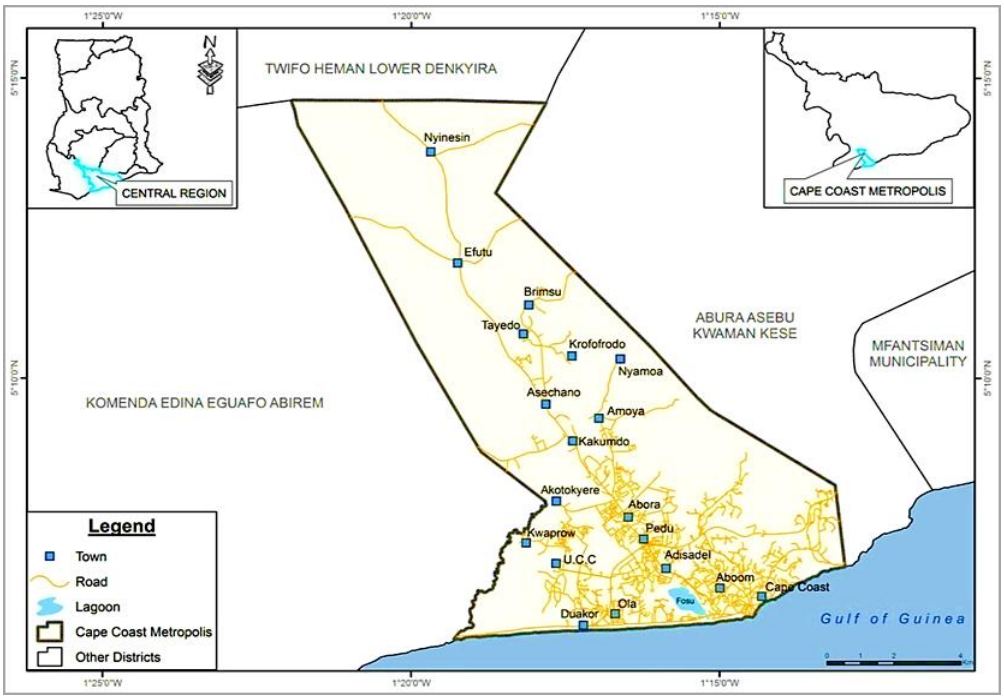

Fig. 3. Map showing the study area (Cape Coast Metropolis)

3.3. Study Population

The study population consists of all vehicles that got involved in road traffic accident within the Cape Coast Metropolis. The vehicles comprises both commercial and private ones which include taxies, tro-tro (minibus) while private cars include pajeros and pickups, bigger buses, motorcycles and bicycles.

3.4. Data Required and Data Source.

In this study, the geographic map, road map and road traffic accident data of Cape Coast obtained from both the Department of Geography and Regional Planning of the University of Cape Coast and the Cape Coast Motor Traffic and Transport Union (MTTU) are the main sources of data. The source of data collection is a secondary in nature. Non-spatial data from the year 2012 and 2017 road accident data was used for analysis. It comprises the Road Traffic Accident data (time and date of accident, vehicle involved, causes and accident factor as well as number of accident cases) from the Cape Coast the Motor Traffic and Transport Union (MTTU) office and digitized road map of Cape Coast obtained using GIS Software ESRI ArcView v.10.3 Version. Digital ancillary data include road shape files and banded themes of road in Cape Coast.

3.5. Sampling Technique

The year 2017 was chosen as the population size due to the study area and year of interest and time constraint. Concurrently, the year 2017 contained the required data for the study, as compared to other years. But in this study we compared the menace between the year 2012 and 2017. The year 2017, sampled out randomly, had 342 road accident cases in all as compared to 157 road accident cases in 2012, meaning there has being a 54% increase within a 10 year gap. It was observed from the data that human factors are the highest cause of road traffic accidents in the Cape Coast Metropolis. Due to the nature of the research, a data collection sheet was instrumented. This data sheet was used as a tool to collect data from Police (MTTU) and National Road Safety Commission (NRSC) offices all in Cape Coast. The RTA data collected was further used to create banded themes and attribute table of RTA categories mentioned in section 3.8.

3.6. Data Collection Procedure

The data was collected from the Road Traffic Accident (RTA) record book of the Cape Coast MTTU on 23rd and 24th May, 2017. The data was collected directly from the record books of the Police MTTU of the year 2012 and 2017 under the supervision of Supt. Paul Aduhene (Central Regional Commander of MTTU, Cape Coast).

3.7. Data Capture, Processing and Analysis.

The recorded data was categorized into date, place of accident, number of cases, vehicle type, casualties, and time of accident, registration number and lastly the causes and the classification of road accident on quarterly basis. Time or event of occurrence was sub-divided into three (3) groups including mornings, afternoons and evenings. Vehicle type was also distinguished into two (2): comprising commercial and private vehicles but in the MTTU record book bicycles were also sub-categorized under private vehicles. Fatalities, serious

and minor injuries were sub- categorized under casualties and the causes of road accident was categorized into twenty–three (23) causes (1-23) causes. The Ground Control Points (GCP) were collected with the help of hand held GPS in WGS1984 datum. The accident hotspot locations are converted into shape files using ArcGIS software. The accident hotspot locations are visualized by overlaying the accident location with the road network of Cape Coast Metrolpolis. The accident details were added as attribute data.

3.8. Creation of Banded Themes and Attributes Tables.

A theme can also be said to represent all the features of a particular feature class in a data source. The themes created for this project was the road shape file for all the roads in the Cape Coast Metropolis (road shape), the boundary of the Cape Coast Metropolis shape file (body file) and the Fosu Lagoon. The digitized road network was later named based on the naming on the original map of Cape Coast. The naming though cumbersome had to be done for analytic purposes. Some of the street names include; Ola, Duakor, University Avenue, Siwdu, Aboom, Kotokuraba, Adisadel, Pedu junction, Morree junction, Yamoransa Junction among others. It is clear to note that the naming of these roads was based on the names of the communities through which they pass. Though not appropriate it did not affect the quality of the data. These street names were created irrespective of the classes of the various roads as shown in Figure 2. Attribute tables of spatial data are based on tabular data sources, some spatial data sources such as shape file and ARC/INFO coverage have their own attribute tables containing descriptive information about the geographic features they contain. The attribute table describe in details the elements in the themes. Adding a theme representing one of these spatial data sources to a view, you can access this attribute table by clicking the Open Theme Table Button. GISArcView automatically manages the relationship between themes and their attribute tables. To access a theme's attribute table, select features on the view by selecting their records in the table, and the other way round. For the purpose of this study the table created was only for the road networks in the Cape Coast Metropolis. The road layers were based on the year 2016 and were created on quarterly bases; from January – March (1st Quarter), April – June (2nd Quarter), July – September (3rd Quarter) and lastly October – December (4th Quarter). Thus the attribute table comprise information from January to December on Quarterly bases (Three months intervals). On the attribute tables are information under the following categories:

1. Location or Place of Road Traffic Accident
2. Number of cases
3. Vehicle type
4. Casualties
5. Time of accident
6. Causes of Road Traffic Accident

4.0. Results and Discussion

4.1. Pattern Road Traffic Accident within the Cape Coast Metropolis between the Year 2012 and 2017 using Geographic Information System (GIS) Approach.

The analysis of data is aided with the use of SPSS v21 and Arc GIS 10.3 software. The SPSS is used to produce charts, graphs, and tables. The GIS ArcMap/View v.10.3 software is further used to map the hotspots locations within the Cape Coast Metropolis. It is also used to create other graphical representation for other variables such as the following:

- Casualties based on fatalities, serious and minor injuries of road traffic accidents in the metropolis.
- Vehicles involved in road traffic accidents in the metropolis.
- The various times in which road traffic accidents occur.
- Causes of road traffic accident in the metropolis.

4.2. Number of Road Traffic Accidents Cases Reported in the Cape Coast Metropolis

The total number of cases recorded was used as criterion to analyse and plot the hotspot areas in the Cape Coast Metropolis. Historically, some areas in Ghana has being noted as blackspot or hotspot areas for which Cape Coast also has. These areas are noted for the frequent occurrence of road traffic accident. This can be seen through the secondary data collected for this study by kind courtesy of MTTU, Cape Coast.

Table 1. Table showing accident cases for the year 2017

Area	*Quarter*	*Total no. of cases*	(%)
Cape Coast Metropolis	1st	73	21.3
	2nd	91	27
	3rd	84	24.5
	4th	94	27.2
TOTAL	**2017**	**342**	**100**

Source: Fieldwork (Police MTTU, 2017)

From the table 1, it can seen that the year 2017 recorded a total of 342 road traffic accident cases in which the first quarter recorded 73 cases representing 21.3%, followed by 91 giving 27% cases in the 2nd quarter of the year. Also in the third quarter 84 cases of road traffic accident were recorded while 94 cases were recorded in the last quarter of 2017 representing 24.5% and 27.2% much higher than cases reported for the year 2012 (also see table 8). This graphically represented in fig. 4 below.

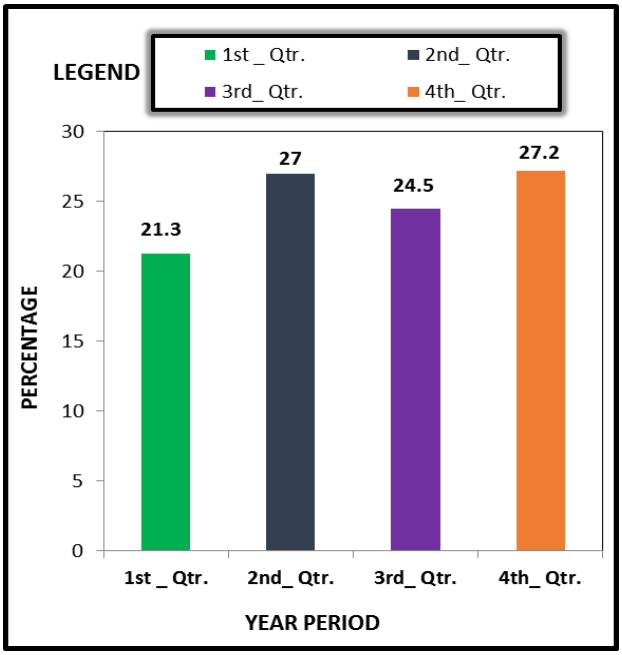

Fig. 4. Accident cases for the year 2017
Source: Fieldwork, 2017.

Fig. 4 above shows that in the year 2017, fourth quarter recorded the highest number of road traffic accident cases out of a total of 342 cases followed by second quarter, third quarter and first quarter respectively. However, a breakdown of the specific locations where accident occur most is shown in table 2 below.

4.2. Identification of Hotspots Locations within the Cape Coast Metropolis.

Identification of hotspot locations is a process to detect high density crash locations within a road network. Hotspot areas evaluation intends to help the determination of areas with high concentration of crash occurrence. For this analysis, the hotspots are places or a location where road traffic accident had occurred on more than three (3) consecutive times. We started with the hotspots located in the Cape Coast Metropolis, followed by number of vehicles involved, casualties involved in road traffic accident, time or event in which the Road traffic accident and lastly the causes of the road traffic accident in the Cape Coast Metropolis during the 2017 year period. At least nine (9) hotspot areas were analyzed and mapped for this study. The total number of cases recorded will be the criterion which was used to plot the hotspot areas in the Cape Coast Metropolis. Historically, some areas in Ghana has being noted as hotspot or hotspot areas for which Cape Coast also has. These areas are noted for the frequent occurrence of road traffic accident. This can be seen through the secondary data collected for this study by kind courtesy of MTTU, Cape Coast.

Table 2. Hotspots locations/areas within the Cape Coast Metropolitan area.

Location	*Number of Cases*	(%)
Pedu Junction	33	9.7
UCC East Gate	30	8.8
Kotokuraba	20	5.8
Siwdu	18	5.3
Moree Junction	22	6.4
Nkanfoa/Third Ridge	22	6.4
Yamoransa	21	6.1
Kingsway	15	4.4
Abura	15	4.4
Total	***342***	***100***

Source: Fieldwork (Police MTTU, 2017)

With the number of cases or the hotspots analysis, it is revealed that the first quarter alone recorded 9 hotspot areas which include University of Cape Coast Campus (East Gate), Pedu Junction, Siwdu, Nkanfoa/Third Ridge junction, Morree Junction and Ekon- Greenhill- Holy Child concurrently. The second quarter on the other side made a record of 6 hotspot areas within the Metropolis involving the same University of Cape Coast Campus, Pedu Junction, Siwdu, Nkanfoa/Third Ridge junction, Yamoransa Junction as well as Kingsway/Anafo/Ntsin while hotspot in the third quarter and fourth quarter tallying up to 5 and 8 respectively. This conforms to report published by [26].

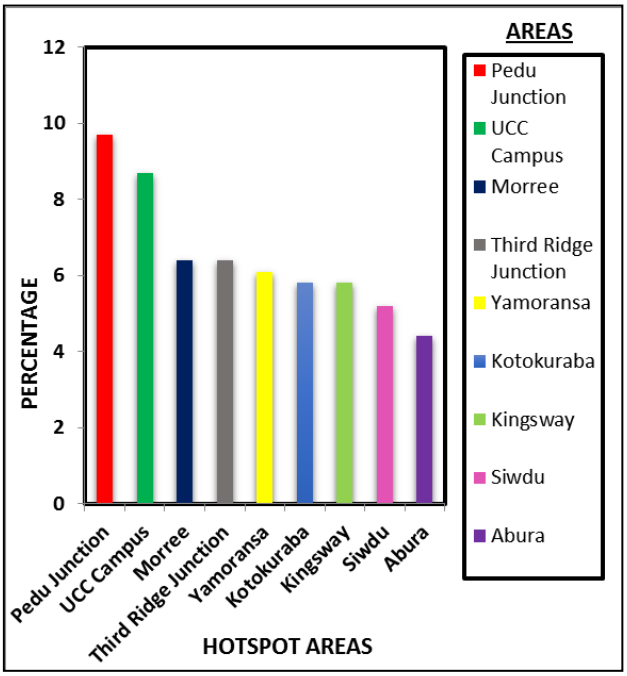

Fig. 5. Hotspot Areas within the Cape Coast Metropolis
Source: Fieldwork, 2017.

In summary, the 2017 accident hotspot locations in the metropolis as indicated in the record book of the Cape Coast Motor Traffic and Transport Union (MTTU) and NRSC revealed that there are about 9 historical hotspots areas where Pedu Junction recored the highest rate of road accident with a value of 33 cases. This is followed by University of Cape Coast Campus (30), while Morree Junction and Nkanfoa/Third Ridge Junction placing third on the hotspot area having a correlated total of 22 each. Yamoransa junction followed these two hotspot areas with a value of 21 with Kotokuraba, Siwdu and Abura recording a total frequency of 20, 18 and 15 cases respectively among others.

This is shown in the figure 5 and arranged in a chronological order from the highest to the lowest hotspot in the metropolis. Using Geographical Information System with the help of GIS ArcMap v.10.3 version software these hotspot areas within the Cape Coast Metropolis were be created on the road map of Cape Coast.

This is calculated with reference to the total of 342. Example for Pedu Junction (33/342*100) will give us 9.7% for the highest and as follows. This was used to plot hotspot graph in figure 5. There is no doubt that all areas can potentially be hotspot areas in the metropolis. But historically some areas in the metropolis had being attached commonly with this phenomenon. Some of these areas include Pedu Junction, University of Cape Coast Campus (notably West Gate, East Gate and, SSNIT junction), Third Ridge/ Nkanfoa Junction, Yamoransa Junction, Holy Child/ Greenhill/ Ekon Road as well as Abakam/Duakor/ Utere –Elmina Road.

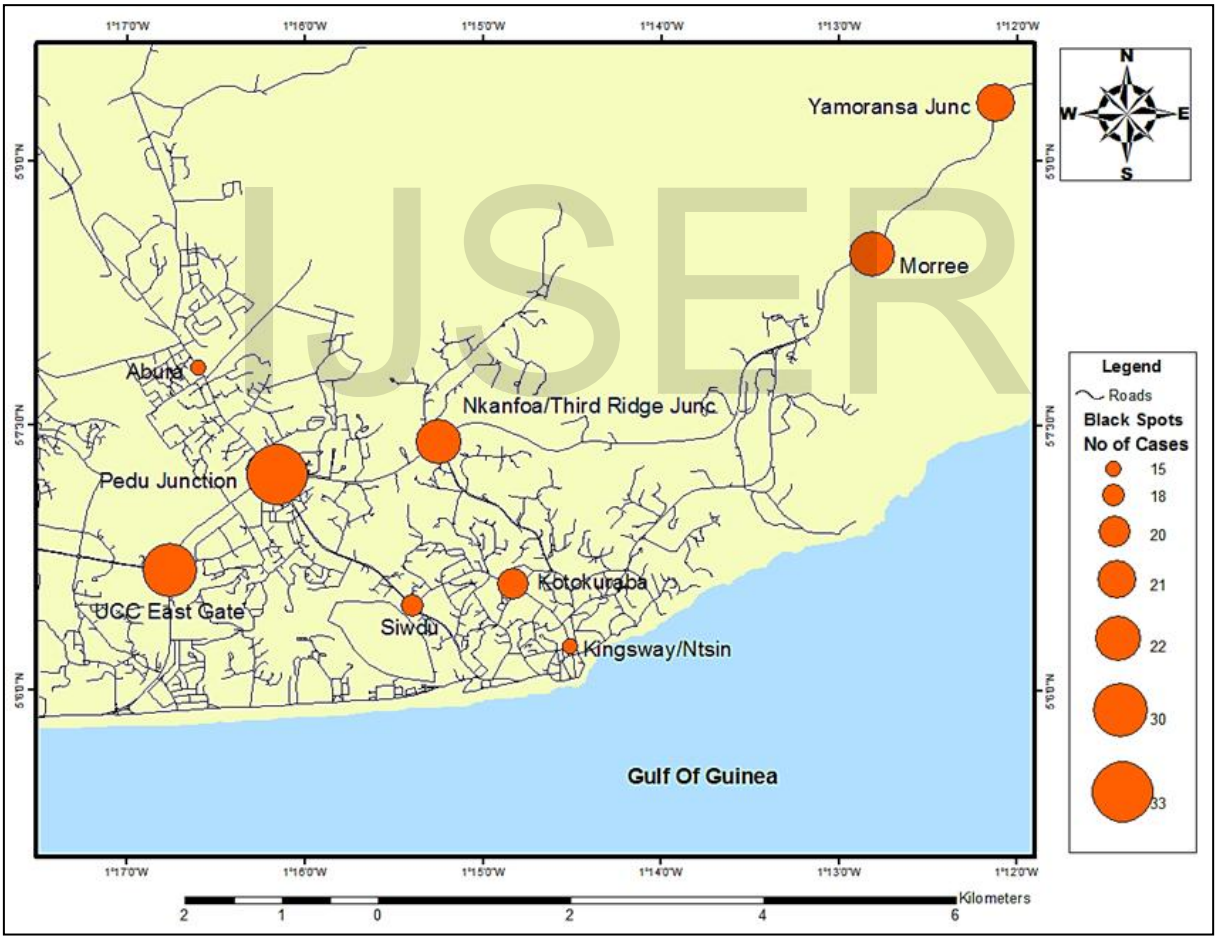

Fig. 6. Map showing frequencies and hotspot areas within the Cape Coast Metropolis, Ghana using GIS technique. Source: Fieldwork & Researchers' GIS ArcMap Analysis, 2017.

4.3. Number of Vehicles Involved in Road Traffic Accident and Vehicle Type in the Cape Coast Metropolis.

In this study the vehicle type were put into two categories or classifications. These vehicles were classified into private vehicle and commercial vehicles respectively. But commercial vehicles were in itself is divided into many. They comprises motor bikes, mini buses (trotro), trucks (articulated trucks, mini tracks), taxis, and other big buses which are inscribed with yellowish number plates. They all ply roads for commercial purposes. Private vehicles are on the other hand those vehicles which were purposely registered for non-commercial purposes. In Ghana these cars have whitish number plates which distinguish them from the commercial vehicles [26].

Under the Motor Traffic and Transport Union (MTTU) jurisdiction private cars involves those cars or vehicles that do run on the road network for non- commercial purposes while commercial vehicles are also those vehicles that run in road in the metropolis mainly for commercial reasons. These are computed on quarterly basis (First, Second, Third and Fourth Quarters respectively). Table 3 gives a well clear table view into the number of vehicles involved in road traffic accident.

Table 3. Showing the number of vehicles involved in road traffic accident.

Area	*Quarter*	*Commercial Vehicles*	*(%)*	*Private vehicles*	*(%)*
Cape Coast Metropolis	1st	45	20	48	20.7
	2nd	57	25	48	20.7
	3rd	60	26.4	61	26.3
	4th	65	28.6	75	32.3
TOTAL	***2017***	***227***	***100***	***232***	***100***

Source: Fieldwork, 2017.

4.3.1. Number of Commercial Vehicles Involved in Road Traffic Accident in Cape Coast Metropolis.

In totality, the number of vehicles that ply the road networks in Cape Coast and were involved in road accident was 459 out of which the sum of commercial vehicles was 227 deducing a percentage of 49.5%. In the first quarter of 2017, the total number of commercial vehicles that got involved in road traffic accident were 45 representing 20%, whiles in the second quarter it was 25% of the outcome of 57 vehicles. The rest were 26.4% and 28.6% respectively for an outcome of 60 and 65 respectively. This gives the possible outcomes and percentages of the total vehicles involved in road traffic accident in the Cape Coast Metropolitan area. The data in table 3 also conforms to findings of [1], [5] which shows an increase in number of vehicles (both commercial and private) involved in road accidents from first to fourth quarter (see also Figure 7 and 8).

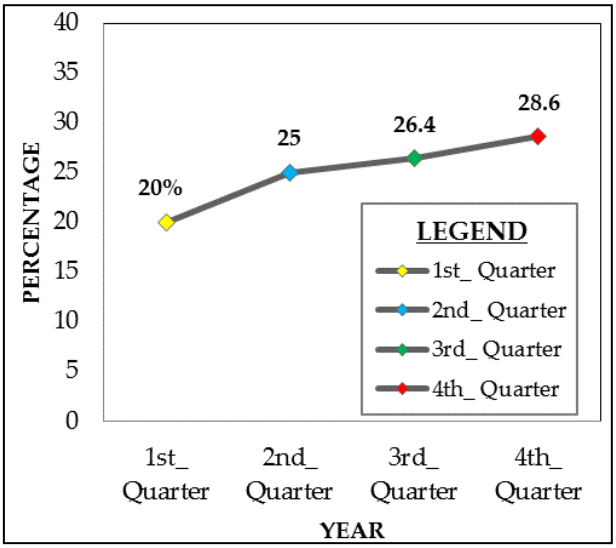

Fig. 7. The number of commercial vehicles involved in road traffic accident in Cape Coast metropolis. Source: Fieldwork, 2017.

4.3.2. Number of Private Vehicles Involved in Road Traffic Accident in Cape Coast Metropolis.

The total number of private vehicles involved in road traffic accident in the Cape Coast Metropolis is 232 out of 254 vehicles in 342 accident cases. As a result of this the first and second quarters recorded same cases of 48 vehicles representing 20.7% each, while the fourth quarter at this time again recorded the highest number of private vehicles that were involved in road traffic accident in the metropolitan area. It shows total case of 75 representing 32.3% and the third quarter showing 61 cases (26.3%). In this case a total of 232 (50.5%) private vehicles were involved in road traffic accident in the Cape Coast metropolis in the year 2017. The diagram below depicts the trends in the number of private that got involved in road traffic accident in the area.

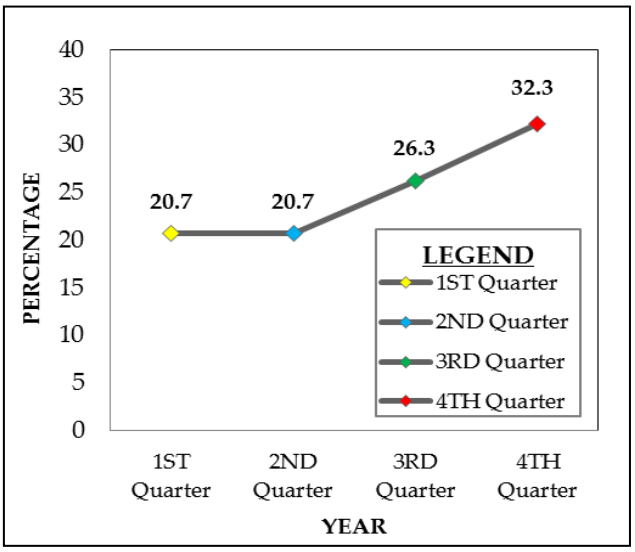

Fig. 8. The number of commercial vehicles involved in road traffic accident in Cape Coast metropolis. Source: Fieldwork, 2017.

4.4. Casualties Involved Road Traffic Accidents in the Cape Coast Metropolis (includes number of fatalities, serious and minor injuries respectively).

According to the National Road Safety Commission (NRSC), casualty refers to a crash resulting in injury, death, or property damage and which involves at least one vehicle on a public road. They explained further that it is also the resultant of any road traffic crash victim either injured (serious and minor) or killed (fatal) within 30 days of the crash. Thus the crash is event whilst the casualty is the effect on the individual.

It is noted that most crash or colliding happens at junctions or corners where more roads meet, whatever the angle of intersection of the road is. Hence casualties refers to the fatalities (persons killed), serious and minor injuries sustained as a result of road traffic accident [26]. See table 4 for more details.

Table 4. Specified Casualties Involved In Road Traffic Accidents in Cape Coast Metropolis.
Source: Fieldwork, 2017.

Quarter	*Fatal Injury*	*(%)*	*Serious Injury*	*(%)*	*Minor Injury*	*(%)*
1st	4	21	14	20	54	**18.4**
2nd	4	21	14	20	73	**24.8**
3rd	7	37	12	17	107	**36.4**
4th	4	21	30	43	60	**20.4**
2017	**19**	**100**	**70**	**100**	**294**	**100**

The year 2017 recorded a total case of 383 casualties with fatalities recording 19 of the occurences which represent 4.9% and those who were seriously injured due to road traffic accidents were 70 representing 18.3% and lastly 294 representing 76.8% for minor injuries (see fig. 9).
Fig. 9 shows the percentage of specified casualties involved in road traffic accident in the Cape Coast Metropolitan area where fatalities represents the lowest proportion on the graph followed by serious injuries and minor injuries respectively. This shows that minor injuries through road traffic accidents were at the increase during the 2017 year period [1].

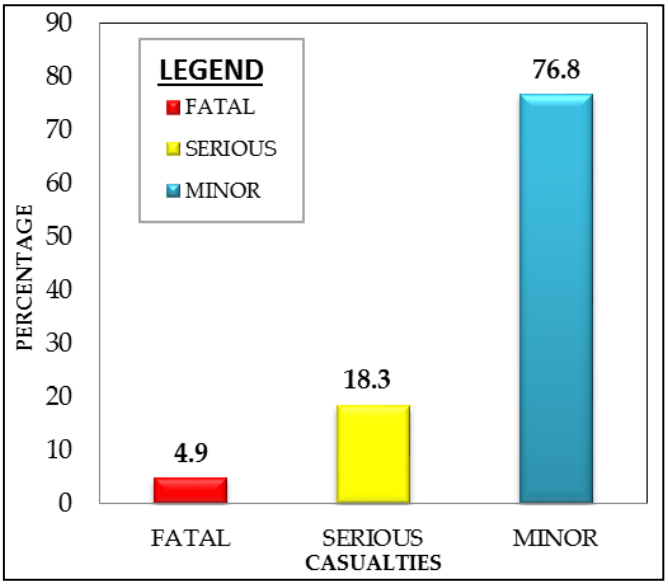

Fig. 9. Casualties involved road traffic accidents in the Cape Coast metropolitan area. Source: Fieldwork, 2017.

4.4.1. Fatalities Involved in Road Traffic Accident in the Cape Coast Metropolis in the year 2017

This shows and explains the number of persons killed in a road traffic accidents; be it minor or serious accident. The year 2017 recorded a total of 19 fatalities on some hotspot areas in the metropolis out of which 4 fatalities occurred within the first quarter (January to March) and the second quarter (April to June) recording 4 as well as fourth quarter (November to December) all representing 21% each. Interestingly, the third quarter of the year 2017 recorded a high rate of fatality of 7 representing 37% of road traffic accident in the area. On the whole 4.9% of casualties were fatal.

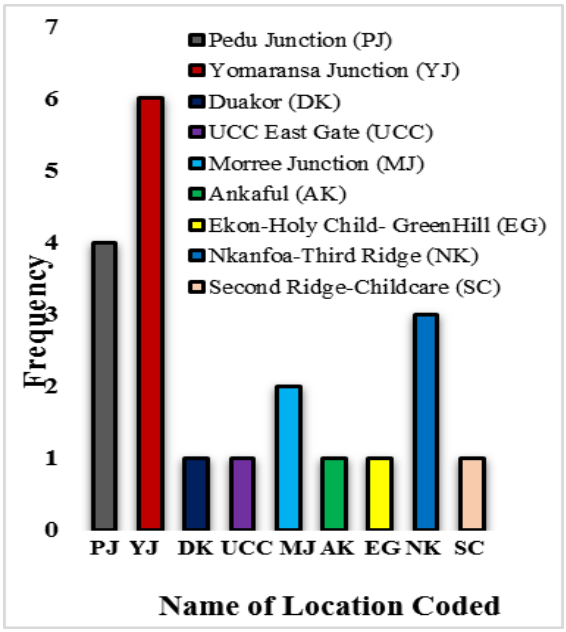

Fig. 10. Fatalities involved road traffic accidents in the Cape Coast metropolitan area. Source: Fieldwork, 2017.

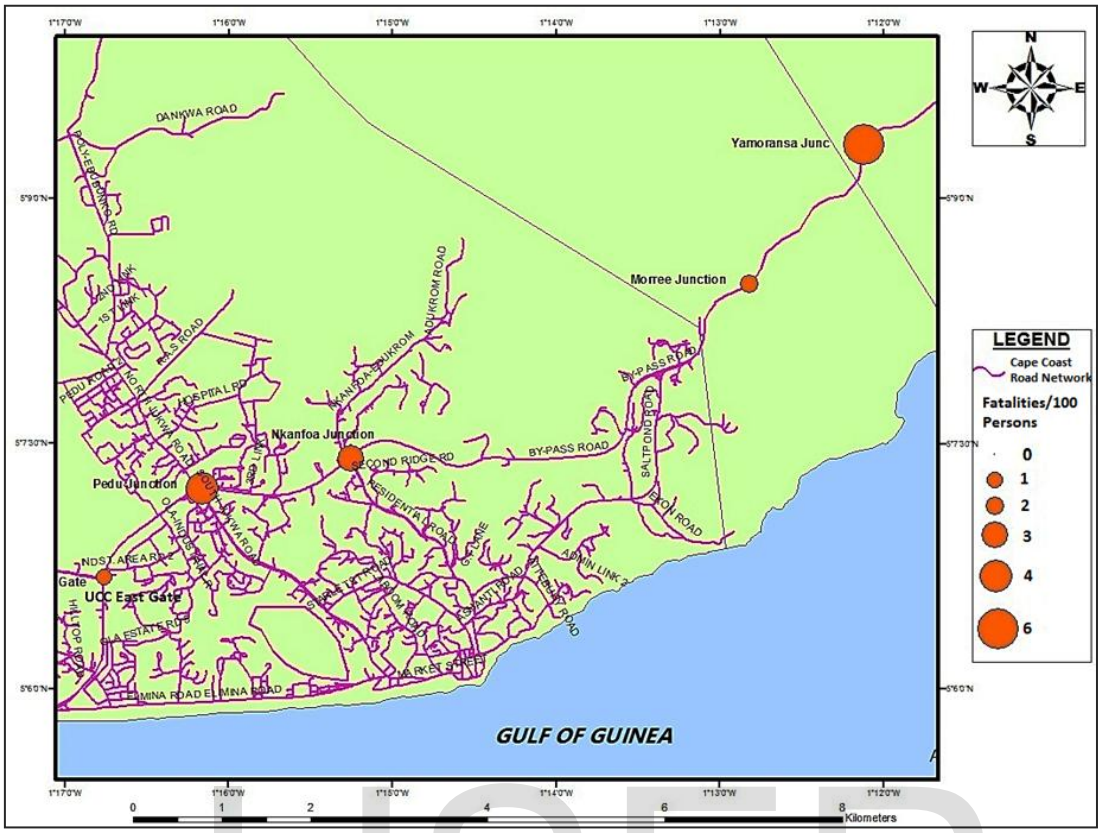

Fig. 11. Map showing frequencies of fatalities within the Cape Coast Metropolis, Ghana using GIS technique. Source: Researchers' GIS ArcMap Analysis, 2017.

Some areas within the metropolis that were noted for these fatalities include Yamoransa recording 6 fatalities, Pedu recording 4 whiles Nkanfoa/Third Ridge and Morree Junction registered 3 and 2 fatality cases each. Others include Abakam, Duakor, Abura/Ankaful, Second Ridge/Childcare, as well as Ekon/Greenhill/Holy Child making 1 case of fatalities each conforming the findings of [1]. This is transformed spatially into the GIS ArcView to show indications on a geographic map. That is from the highest rate of fatalities to the lowest rate as indicated above (see fig. 11).

4.4.2. Serious and Minor Injuries Involved in Road Traffic Accident in the Cape Coast Metropolis.

Serious injuries are placed next after fatality rate in the analysis of road traffic accident issues. It refers to the temporal or permanent incapacitation or disability of an individual which may lead to death as a result of a serious road accident. In this study the rate serious injuries vary from one location to the other.

Out of the 383 casualty cases recorded in the year 2017, the total number of serious injuries the Cape Coast Metropolis was 70 (18.3%) with the first quarter and second quarter registering 14 cases each giving a face value of 20%. The third quarter recorded the lowest serious injuries of 12 representing 17% while the fourth quarter topped the casualty table with 30 cas es which also represents 43% respectively (see fig. 12).

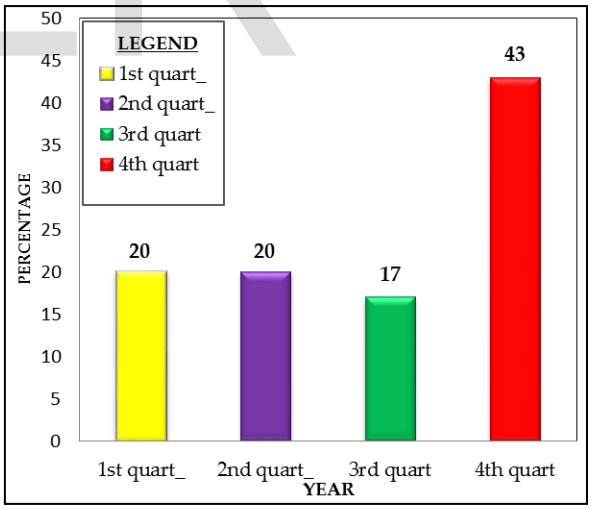

Fig. 12. Serious Injuries in Road Traffic Accident in the Cape Coast Metropolis. Source: Fieldwork, 2017.

On the other hand, minor injuries is when road traffic accident results in a little or few cuts and bruises suffered by the people involved. The first quarter recorded 18.4% out 54 cases while in the second quarter 73 cases of minor injuries were sustained representing 24.8%. The third quarter recorded the highest of minor injuries in the year 2017 having 107 cases, which is 36.4% and the last quarter showing off a value of 60 representing 20.4% (see fig. 13).

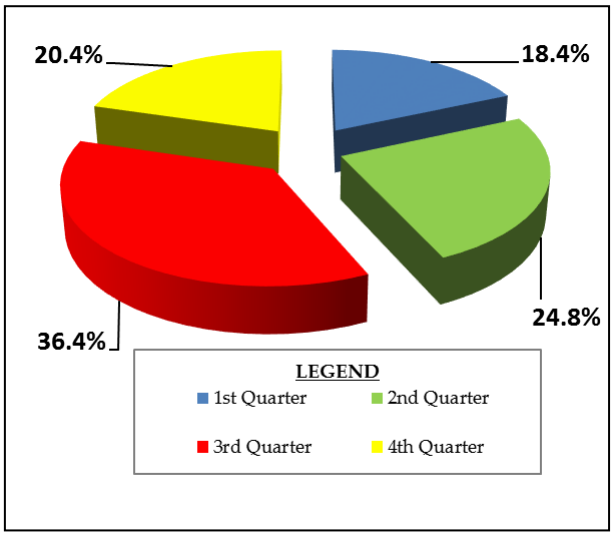

Fig. 13. Minor Injuries in Road Traffic Accident in the Cape Coast Metropolis. Source: Fieldwork, 2017.

In all the most alarming casualties recorded for the year 2017 through road traffic accident are minor injuries [5] which was 294 out of 383 cases representing 76.8% followed by serious injuries which is 70 out the total 383 representing 18.3% as recorded. The minimal cases on the casualty scale are fatal injuries which recorded only 19 representing 4.9%, showing that fatalities are minimal in the case road traffic accidents.

4.5. Time that Road Traffic Accident Happened in the Cape Coast Metropolis.

Time refers to the period in which an event occurs. Geographers have a strong ideology that everything exist and happens in space and time [13]. Time under this study is grouped into morning, afternoon and evening (see table 5).

Table 5. Time that road traffic accident happened in the Cape Coast Metropolis.
Source: Fieldwork, 2017.

Quarter	*Morning*	*(%)*	*Afternoon*	*(%)*	*Evening*	*(%)*
1st	26	24.1	18	18.6	33	22.2
2nd	25	23	24	24.7	45	30.4
3rd	29	26.9	30	31	31	21
4th	28	26	25	25.7	39	26.4
Total	**108**	**100**	**97**	**100**	**148**	**100**

For road traffic accidents that happened in the morning is the part of the day before noon. It ranges between the hours of 12: 00 am and 11:59 pm. From the table above it is noticed that first quarter recorded 26 cases of road accident which is convertible to 24.1%, 25 cases were recorded in the second quarter representing 23% while in the third and the fourth quarter 29 cases (26.9%) and 28 cases (26%) were observed. Thus based on time, only 108 of road traffic accidents happened in the morning which covers 30.5% out of 353 recorded in the time of occurence in the year 2017 (see table 5).

On the other hand, for road traffic accident that happened in the afternoon is part of the day that ranges between noon and evening precisely within the hours of 12:00 pm (noon) to 5:00 pm. As busily as it is, it was the only the only time range that recorded the lowest throughout the year 2017. In the first quarter, 18 cases were observed representing just 18.6%. This is followed by 24 road traffic accidents forming part of 24.7% which was observed in the second quarter; third quarter recorded the highest road traffic accidents with a value of 30 cases representing 31% as the fourth quarter observed 25 cases showing off 25.7%.

However, there is no doubt that most road traffic accidents happens in the evening within the Cape Coast Metropolis. Evening in this context refers to the latter part of the day, before nightfall. In the analyses of the study this period ranges from 5:01 pm to 11:59 pm.

Out of the 353 road traffic accidents recorded in time range, most of the event of road traffic accidents happened in the evening, with the first quarter recording 33 (22.2%) road accidents and the second quarter giving up 45 cases representing 30.4%. In the third quarter, 31 (21%) road traffic accident occurred and 39 (26.4%) of road traffic accident occurred in the fourth quarter (also see table 5).

4.6. Identification of the Major Causes and Factors of Road Traffic accident in the Cape Coast Metropolis.

Causes of road traffic accident are the supportive factors that bring about road traffic accident. These supportive factors reflect the specific causes of road traffic accidents (RTAs) [8]. Because of hte cumbersome nature of this data, it is analysed using tables, figures and explanations. With this GIS approach in analysing this is excluded. Although the causes of road traffic accident would be repeated in each quarter, its classifications should not be ignored. The cause is then categorized into three (3) individual factors including Human, Mechanical and Environmental Factors respectively. The table 6 below shows the causes and classifications of road traffic accident according to the three (3) individual factors.

Table 6. Causes and Factors of Road Traffic accident in the Cape Coast Metropolis.

Factor	*Cause*
Human	1,2,3,4,5,6,7,16,17,18,19
Mechanical	8,9
Environmental	12,13,14

Source: Fieldwork, 2017.

- **For the human factors;**

1 – Excessive speeding, **2** - Inattention and lack of judgement by drivers, **3** - Careless driving at junctions and corners, **4** – Improper overtaking, **5** – Inexperienced driving, **6** – Intoxication, **7** – Reckless and negligence by divers, **16** – Careless by children, **17** – Careless by Adults, **18** – Adults boarding or alighting vehicles whilst in motion and **19** – Other pedestrian faults.

- **For the Mechanical Factors;**

8 – Mechanical defects and **9** - Overloading.

- **For the Environmental Factors;**

12 – Skidding off roads and road defects, **13** – Other road defects, **14** – Obstructions.

The causes of road accident in the Cape Coast Metropolis were listed from 1 to 23, but only 16 of them were classified as the causes of road traffic accident in the metropolis in the year 2017. For the first quarter of 2017, the major classes of road traffic accident include excessive speeding (1), Inattention and lack of judgement by drivers (2), Careless driving at junctions or corners (3), Improper overtaking (4), Inexperienced driving (5), Reckless and negligence by drivers (7), Intoxication (6) and lastly Other road defects (13).

The second quarter also recorded Excessive speeding (1), Inattention and lack of judgement by drivers (2), Careless driving at junctions or corners (3), Improper overtaking (4), Inexperienced driving (5), Reckless and negligence by drivers (7), Intoxication (6), Mechanical Defects (8), Obstruction (14) and Adults boarding or alighting vehicles whilst in motion (18). Similarly for the third quarter, we have Excessive speeding (1), Inattention and lack of judgement by drivers (2), Careless driving at junctions or corners (3), Improper overtaking (4), Inexperienced driving (5), Reckless and negligence by drivers (7), Intoxication (6), and then Mechanical Defects (8) as causes classified in the quarter.

The occurrences in road traffic accident in the fourth quarter included; Excessive speeding (1), Inattention and lack of judgement by drivers (2), Careless driving at junctions or corners (3), Improper overtaking (4), Inexperienced driving (5), Reckless and negligence by drivers (7), Intoxication (6), Mechanical Defects (8), Obstruction (14), Adults boarding or alighting vehicles whilst in motion (18), Skidding off roads and road defects (12), Careless by children (16), Careless by Adults (17), Adults boarding or alighting vehicles whilst in motion (18), Other pedestrian faults (19) and Reckless or negligence drivers of horse driven vehicles (23) being the least. This conforms the findings of [1], [4] that the factors mentioned above are the majorcauses road traffic accidents in the Cape Coast Metropolis.

In summary of this, for the year 2017, reckless and negligence by drivers (7) that recorded 63 occurrences was classified as the number one (highest) cause of road traffic accident in the sub- region. This is followed by excessive speeding (1) with 45 occurrences, inattention and lack of judgement by drivers (2) and Careless driving at junctions and corners (3) placed third recording 38 occurrences each while Inexperienced driving (5) caused 13 RTAs. Others are, Mechanical defects (8), Intoxication (6), Obstructions (14), Overloading (9) and Adults boarding or alighting vehicles whilst in motion (18) caused 8, 6, 3, 2 ,2 road traffic accident each.

The rest are those that recorded 1 Road Traffic Accidents (RTA) occurrence each; skidding off roads and road defects (12), other road defects (13), Careless by children (16), Careless by Adults (17), other pedestrian faults (19) and Reckless or negligence drivers of horse driven vehicles (23) conforming to the findings of [27], [28]. Figure 14 shows the causes and classifications of road traffic accident in the Cape Coast Metropolis.

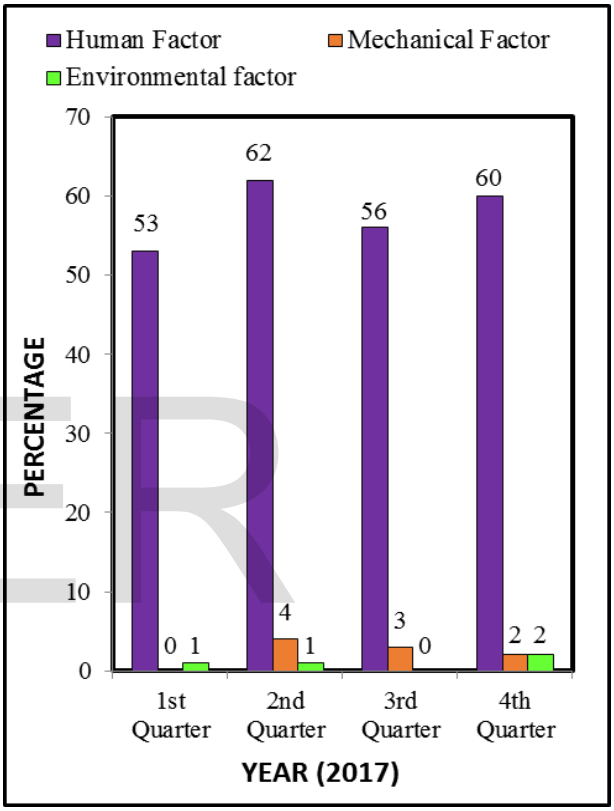

Fig. 14. Causes and classifications of road traffic accident in the Cape Coast Metropolis. Source: Fieldwork, 2017.

Figure 14 shows the causes and classifications of road traffic accident in the Cape Coast Metropolis in the year 2017. It can be noticed that human factors have being recognised to be most of the major cause of road traffic accident in the Metropolis. It is represented by the violet bars while the orange bars depicts the mechanical factors that contributes to road traffic accident and the lemon green bars depicts also the environmental factors causing road traffic accidents in the Cape Coast Metropolis in the year 2017. By default the mechanical factor in the first quarter and the environmental factor in the third quarter had zero cases abd hence were not shown. However, overall data is shown in table 7 and 8 in appendix A and B respectively.

4.7. COMPARATIVE ANALYSIS.

4.7.1. Comparing the cases of road accident between the year 2012 and 2017.

Table 7. 2017 Road Traffic Accident Data
Source: Fieldwork, 2017.

Quarter	Total no. Of cases	Comm. vehicles	Private vehicles	Fatal	Serious	Minor	Morning	Afternoon	Evening
1st	73	45	48	4	14	54	26	18	33
2nd	91	57	48	4	14	73	25	24	45
3rd	84	60	61	7	12	107	29	30	31
4th	94	65	75	4	30	60	28	25	39
2017	**342**	**227**	**232**	**19**	**70**	**294**	**108**	**97**	**148**

Table 8. 2012 Road Traffic Accident Data

Quarter	Total no. Of cases	Comm. vehicles	Private vehicles	Fatal	Serious	Minor	Morning	Afternoon	Evening
1st	49	18	20	2	6	40	25	30	59
2nd	45	17	44	6	22	69	19	12	15
3rd	38	7	41	5	7	60	12	5	18
4th	925	9	20	3	9	19	9	6	9
2012	**157**	**51**	**135**	**16**	**44**	**188**	**65**	**53**	**101**

Between the year 2012 and 2017, a five year gap, it is interesting to note that, no much work has not been done to reduce the menace of road traffic accident.

Most of the hotspots identified in the year 2017 still maintain their position as they record very high rate of road traffic accident in the metropolis. Comparatively, some of the hotspots identified in the year 2017 which include Pedu Junction, UCC West Gate, Aggrey Junction, Yamoransa and Morree Junction, Holy Child/Ekon/Green hill still holds their position as the frequently accident prone areas in the Metropolis. But the only difference was that in the year 2012 hotspot areas were 6 while in the year 2017 it totaled to 9 hotspot locations with Pedu Junction recording the highest accident/frequencies while Third Ridge/Nkanfoa Junction recorded the highest accident hotspot for 2012.

Also, the year 2012 recognised 11 causes and classifications of road traffic accident while 2017 recognised 17.

For the year 2012, a total of 157 cases of road traffic accidents were recorded against 342 in the year 2017, this represents a 54% increase in the total number of road traffic accident cases and fatality rate also increasing from 16 cases in the year 2012 to 19 in the year 2017 representing an increase of 15.8% within a 5 year gap (2012 – 2017). In all the total number of cases recorded for each road traffic accident variable has increased within a 5 year gap, that is from 2012 to 2017 (references can be made to table 7 and 8 respectively).

5.0. CONCLUSION

The research indicates that the highest cause of road traffic accident in the Cape Coast Metropolis is reckless and negligence driving which is classified as 7. This is the part of the drivers' negligence which brings about an accident in the Metropolis. Hence out of the 23 causes labelled from 1 to 23 together with its classifications, it is only 9 of them that were classified as the causes of road traffic accident in the year 2017. The highest cause classified as 7 which is "reckless and negligence" on the part of drivers recorded 63 occurrences. This is followed by "excessive speeding" also classified as1 then accounted for 45 occurrences and thirdly careless driving at junctions and corners and inattention and lack of judgment by drivers recorded 38 occurrences each.

It was found out that most of the vehicles involved in road traffic accidents were private vehicles which numbered up to 232 cars making a share of (50.5%) out of the total of 459 vehicles. The rest were commercial vehicles that ply the roads for commercial basis. This also accounted for 45% of the total share numbering up to 227 cars in all.

In all almost 30 locations were identified as potential hotspots areas in the Cape Coast Metropolis, out of which only 9 locations were mapped as actual hotspot areas.

After the analysis the study revealed that, 9 hotspots locations were identified which were comparatively competitive to each order. On a scale, the highest of all the hotspot intensity is Pedu Junction which recorded 33 cases followed by University of Cape Coast which is responsible for about 30 counts. Morree Junction together with Nkanfoa/Third Ridge Junction recorded the same counts which are 22 each while Yamoransa Junction, Kotokuraba and Siwdu accounted for 21, 20 and 18 respectively. Kingsway and Abura recorded 15 occurrences each on a range.

Taking the time of occurrences into consideration, the study made it available that, most of these accidents at these hotspot areas happened in the evening throughout the year having 148 (42 %) out of the 353 occurrences recorded. This is subsequently followed by morning and afternoon recording 108 (30.6%) and 97 (27.4%) occurrences each.

Again, with regards to the casualties recorded, it was revealed that for the year 2017, out of the 383 cases recorded in this portion of the road traffic accidents, minor injuries was the highest among them making a count of 294 representing almost 76.7% followed by serious injuries recording 70 (18.3%) and logically fatality as 19 (5%) and these rates are evenly distributed among all the four (4) quarters of the year.

In order to implement the strategic safety plan, it is vital to identify traffic crash locations with their spatial relationship. Therefore, a geographic information system (GIS) was used to identify the hotspot locations. Using GIS has provided a good experience and the platform to identify and visualize the extent of road traffic accidents in Ghana with Cape Coast Metropolis as a case study area. It is henceforth underscored that hospot areas could be identified to capture the differential elements of road traffic accidents which is a prerequisite for formulation and implementation of policies to reduce the menace and carnage on our roads hence promoting sustainable development.

The aim of this study is to identify road traffic accident hotspot locations using GIS tools. Specifically this involves plotting individual accident hotspots graphs and maps, identifying accident-fatality locations using GIS spatial analysis tools.

The above objective was achieved by using GIS ArcMap v.10.3 for the following;

1. **Digitizing the road map of Cape Coast Metropolis;**
2. **Creating of database and attribute table/structure for analysis and;**
3. **Creating road traffic accident analysis maps (hotspot and fatality locations) for Cape Coast Metropolis.**

Hence, hotspots and fatality analysis will be used to identify and supply required information to help decision makers in making suitable decisions to prevent and reduce traffic accidents. In general, traffic accidents' statistics has been considered as assessment index to evaluate possible future traffic accidents on our roads.

5.1. Recommendation

- The MTTU should develop an appropriate road accidentmaps with help of other stakeholders to capture locations under its jurisdiction hence capturing locations which are not captured in the Cape Coast map.
- Again road accident data should be precise and accurate to cover relevant details, such as street names, relevant areas where accident occurred.
- The Cape Coast Road Network must be reviewed at least a period of five (5) years to reflects changes in size, length and width of roads and new areas created under the law of Act of parliament. Also the GIS buffer generation or buffer zones could be used to look into accidents caused by road width (MTTU, 2004).
- The National Road Safety Commission (NRSC) must develop and promote road safety campaign and coordinate policies relating to it.
- The commission may also performs the following functions to help promote road safety and reduce RTA's;
- Undertake road safety education at least once every week. This study suggests and recommends that the public be sensitized, to curb road carnage. This includes public education, enforcement of observance of traffic rules, avoiding over-speeding, overloading and careless overtaking; stopping drunk driving; wearing seatbelts, recognizing the rights and needs of pedestrians, constructing good roads, provision of safe and efficient public transport, training and retraining of public service vehicle drivers.
- Encourage the development of road safety education as part of the curriculum and training of teachers in road safety
- Carry out special project for the improvement of road safety
- Coordinate, monitor and evaluate road safety activities, programmes and strategies among others.

Appendix A.

REQUIRED DATA. Table 9.
Overall Data of Road Traffic Accident for the year 2017

Location	No. of Cas-es	Vehicle Type		Casualties			Time of Accident			Causes
		Com m Veh	Priv. Vehi cle	Fa-tal	Seri-ous	Mi-nor	Morn ing	After-noon	Even-ing	
Abakam	5	8	10	0	3	8	10			1,7,8
Abura	15	16	7	1	5	8	2	9	7	2,4,7
Acquiarium	6	16	7	1	5	8	2	9	6	4,7
Adisadel	13	5	10	0	5	9	4	2	9	7,8
Aggrey	13	10	8	0	2	19	7	2	4	1,2
Ankaful	7	7	2	1	6	2	1	3	3	3
Aseibu	2	2	0	0	0	1	0	1	1	8
Bakano	13	7	10	0	2	21	3	3	8	1,2,5,7
Cape Coast Poly	7	3	4	0	2	5	0	1	6	2,7
Duakor	7	3	5	1	1	18	2	2	3	7
Ekon/Greenhill/Holychild	13	7	3	1	1	17	5	5	5	1,3,5
Essuakyir	5	5	3	0	0	4	3	1	1	0
Fourth Ridge	5	1	6	0	0	1	1	2	1	2
Ghana National	6	5	6	0	0	21	1	1	4	4
Goil/Flowers Gay/Ameen	5	3	2	0	1	0	1	1	3	3,4,7
Kakumdo	5	4	3	0	3	4	1	2	3	1,7
Kingsway/Ntsin/Anafo	15	8	10	0	3	8	10	4	3	2
Kotokuraba	20	18	9	0	2	18	5	9	7	1,6,7
Moree Junction	22	17	13	2	8	31	8	9	5	1,7
Nkanfoa/Third Ridge Junc	22	12	20	3	6	17	9	6	7	1,3,7,8,14,18
Ola/Augustines	12	7	7	1	0	5	5	4	3	0
Pedu Junction	33	25	24	4	2	21	10	5	14	2,3,7
Pedu Residential	9	5	8	0	2	3	2	4	6	4
Regional Hospital (Interberten)	2	3	3	0	0	4	1	1	2	1,4,5,7
Second Ridge/Childcare	0	0	0	1	0	0	0	0	0	0
Siwdu	18	19	11	0	2	10	7	5	6	3,5,7
Tantri/Petrol	8	4	3	0	0	9	2	2	6	2,7
UCC Campus	30	21	27	1	7	22	9	4	18	1,2,3,4,5,7
Yamoransa Junction	21	13	12	6	7	8	6	5	9	1,2,3,6,7
TOTAL	**342**	**227**	**232**	**19**	**70**	**294**	**108**	**97**	**148**	--------

Source: Police MTTU, Cape Coast, Ghana, 2017

Appendix B. Table 10.

Causes, Classification and Number of Occurences of Road Traffic Accidents (2017).

CAUSE OF ROAD TRAFFIC ACCIDENTS	CLASSIFICATION	NUMBER OF OCCURRENCES
Excessive Speeding	1	45
Inattention and lack of judgement by drivers	2	38
Careless driving at junctions or corner	3	38
Improper overtaking	4	18
Inexperienced driving	5	13
Intoxication	6	6
Other reckless or negligence	7	63
Mechanical defects	8	8
Overloading	9	2
Defective lights	10	5
Dazzling lights	11	1
Skidding off roads and road defects	12	3
Other road defects	13	1
Obstructions	14	3
Level crossing	15	6
Carelessness by children	16	1
Carelessness of adults	17	1
Adults boarding or alighting from vehicle whilst in motion	18	5
Other pedestrian faults	19	1
Passengers faults	20	2
Animals not under control	21	1
Reckless or negligence by pedal cyclists	22	1
Reckless or negligence by drivers of horse drawn vehicles	23	0

Source: Police MTTU, Cape Coast, Ghana, 2017

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