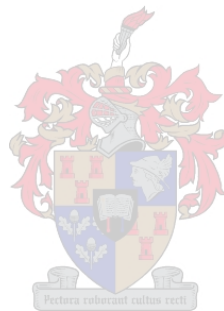


ANALYSIS OF TRAFFIC ACCIDENTS IN GABORONE, BOTSWANA

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Thesis presented in partial fulfilment of the requirements for the degree of Master of Arts at the University of Stellenbosch.



Supervisor: Dr SLA Ferreira

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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature:

Date:

ABSTRACT

Botswana, a developing country in southern Africa, has not been spared the proliferating scourge of traffic accidents that is sweeping across the world. After HIV/AIDS, traffic accidents are the second largest cause of unnatural deaths in Botswana. The country is losing two per cent of its GDP every year to traffic accident costs. Furthermore, road safety is one of the major challenges the country will have to overcome in order to achieve its Vision 2016. This study investigates traffic accidents in Gaborone, the capital city of Botswana, for the years 2000 and 2005.

The study analyses the characteristics of traffic accidents, examines their causes, maps the spatial distribution of traffic accidents for 2000 and 2005, and outlines the countermeasures government is instituting to curb accidents. The main data on traffic accidents used was extracted from the microcomputer accidents analysis package V5.0 (MAAP 5) obtained from the Traffic Police Division. Semi-structured interviews with transport and safety officers, traffic police and other stakeholders were conducted. The interviews were mainly about what government is doing to reduce the carnage caused by traffic accidents. Existing reports were also used as data sources. Microsoft Excel and ArcGIS 9.1 packages were used to do the analyses.

The road casualties of drivers/riders are concentrated in the economically active age category of 15-64 years (95% for all casualties). In particular, the casualties are very high in the 20-39 age cohort with one third and three quarters of all casualties for 2000 and 2005 respectively. In addition, driver casualties by gender for the 20-39 age cohort show a high representation of males, namely 57% and 64% for 2000 and 2005 respectively.

Passenger casualties for the two years show that males and females are nearly equally represented with 52% males and 48% for females in 2000, and 50% for both in 2005. However, fatalities by gender show that males are highly represented with around 60% and females 40% for both years. The majority of passenger casualties are young people in the 20-29 cohort with 46% in 2000, and 48 % in 2005. Pedestrian accidents analysis shows a high representation of child (under 15 years) casualties, which represents about 30% for all the cases. Children in Gaborone often become victims of traffic accidents when crossing the heavily congested roads on their way to and from school. Accidents involving children mainly occur when schools open after vacations. The 15-34 age groups are also strongly represented in pedestrian casualties with 50% and 47% for 2000 and 2005 respectively.

Temporal analysis by hour of the day shows a concentration of accidents during the peak hours before and after work. The peak times for accidents are 16:00-17:59, which experienced 14% of all accidents in both years, 06:00-07:59 and 12:00-13:59. Accidents by day of the week peak on Fridays and Saturdays (31% and 33% for 2000 and 2005 respectively). Ninety-seven per cent of traffic accidents in Gaborone in 2005 are attributable to human error, while over the years the spatial concentration of accidents has migrated from eastern and central Gaborone to the western part of the city, especially along the Western bypass (Motsete Drive). The government initiatives to curb traffic accidents are bringing hope, and aggressive programme implementation should see the menace coming under control.

The high representation of economically active persons as drivers, passengers or pedestrians involved in traffic accidents, means that both the private and government sectors are losing large numbers of their productive workforce. Thus, there is an urgent need to address road safety in a work-based context, as well as to continue with educational road safety campaigns among the general public. The young drivers, passengers and pedestrians in developing countries must be the target for road safety educational programmes.

Keywords: black spots; driver casualties; fatalities; MAAP 5; passenger casualties; pedestrian casualties; road safety campaigns; spatial analysis; traffic accidents; traffic congestion.

OPSOMMING

Botswana, 'n ontwikkelende land in suidelike Afrika, is nie die abnormale groei van die plaag van padongelukke wat die wêreld teister, gespaar nie. Ná HIV/VIGS is padongelukke die tweede grootste oorsaak van onnatuurlike sterftes in Botswana. Die land verloor twee persent van sy BBP elke jaar aan die kostes van padongelukke. Verder is padongelukke een van die hoof uitdagings wat die land sal moet oorkom om sy Vision 2016 te bereik. Hierdie studie ondersoek padongelukke in Gaborone, Botswana se hoofstad, vir die jare 2000 en 2005.

Die studie ontleed die kenmerke van padongelukke, ondersoek hul oorsake, karteer die ruimtelike verspreiding van padongelukke in 2000 en 2005, en gee 'n uiteensetting van die teenmaatreëls wat die regering instel om padongelukke te verminder. Die hoof bron van die padongelukdata wat gebruik is, is die Afdeling Verkeerspolisie se ongeluksanalisepakket V5.0 (MAAP 5) vir mikrorekenaars. Halfgestruktureerde onderhoude is met vervoer- en veiligheidsbeamptes, vervoerpolisie en ander rolspelers gevoer. Die onderhoude het hoofsaaklik gehandel oor wat die regering doen om die hoë padongeluksyfer te verminder. Microsoft Excel- en ArcGIS 9.1-pakkette is vir die ontledings ingespan.

Bestuurder/passasier padongelukgevalle is in die ekonomies aktiewe ouderdomsgroep van 16-64 jaar gekonsentreer (95% van alle slagoffers) en die ongevallen is veral baie hoog in die 20-39 ouderdomsgroep met een derde van die gevalle in 2000 en driekwart in 2005. Bestuurderslagoffers volgens geslag toon 'n hoë verteenwoordiging van veral mans in die 20-39 kohort, naamlik 57% en 64% in 2000 en 2005 onderskeidelik.

Ongevalle onder passasiers is amper gelykop verdeel tussen mans en vroue in 2000 (52% mans en 48% vroue) en presies gelyk in 2005. Daarteenoor is sterftes ongelyk verdeel, naamlik 60% mans en 40% vroue in beide jare. Die meerderheid slagoffers onder passasiers is jong mans in die 20-29 ouderdomsgroep (46% in 2000 en 48% in 2005). 'n Ontleding van voetgangerongelukke toon dat ongeveer 30% van die slagoffers kinders jonger as 15 jaar is. Kinders in Gaborone word padongelukgevalle wanneer hulle paaie oorstek op pad skool toe of huis toe. Ongelukke waarin kinders betrokke is, vind veral plaas kort nadat skole na vakansies heropen. Die 15-34 ouderdomsgroep is sterk verteenwoordig in voetgangerongelukke, d.i. 50% in 2000 en 47% in 2005.

Tydsanalise volgens tyd van die dag wys op 'n konsentrasie van ongelukke tydens spitstye wanneer mense soggens werk toe en smiddags huis toe beweeg. Die piek ongelukstye is 16:00-17:59, waartydens 14% van alle gevalle plaasgevind het in beide jare, 06:00-07:59 en 12:00-13:59. Ongelukke vind hoofsaaklik op Vrydae en Saterdag plaas (31% en 32% in 2000 en 2005). Sewe-en-negentig persent van die padongelukke in Gaborone in 2005 kan aan menslike foute toegeskryf word en oor die jare het die ruimtelike konsentrasie van ongelukke vanaf oostelike en sentrale Gaborone na die westelike deel, veral langs die Westelike verbypad (Motseterylaan), verskuif. Die regering se inisiatiewe om padongelukke te beteuel, bied hoop en aggressiewe program implementering behoort die ongeluksyfers onder beheer te bring.

Die hoë verteenwoordiging van ekonomies aktiewe bestuurders, passasiers en voetgangers wat padongelukslagoffers is, beteken dat beide die private en openbare sektore groot verliese aan hulle produktiewe arbeidsmag ly. Daar is dus 'n dringende behoefte om padveiligheid in die werkskonteks aan te spreek en om met opvoedkundige padveiligheidsveldtogte onder die gewone publiek voort te gaan. Veral jong bestuurders, passasiers en voetgangers in ontwikkelende lande moet die teiken van opvoedkundige padveiligheidsprogramme wees.

Trefwoorde: Swartkolle, bestuurderslagoffers, sterfgevallen, MAAP 5, passasierslagoffers, voetgangerslagoffers, padveiligheidsveldtogte, ruimtelike analise, padongelukke, verkeersdruk.

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CHAPTER 1 : TRAFFIC ACCIDENTS IN DEVELOPING COUNTRIES

1.1 INTRODUCTION

Motor vehicle traffic accidents are a major problem in both developed and developing countries (Hoyle & Knowles 1998; Vasconcellos 2001). Developed countries with their economic power have, however, better managed to control the rising numbers of road accidents. Opportunities for implementation of solutions to traffic accidents in developing countries are fewer (Hoyle & Knowles 1998). According to Pucher, Korattyswaropam, Mittal & Ittyerah (2005) and Vasconcellos (1996) the increase in the number of vehicles, especially private cars, is directly related to increases in traffic accidents. Vasconcellos (1996; 2005) gives a short history of the way the industrialized countries have perceived traffic accidents. Initially they considered them as acts of God, and as such, unavoidable. As accidents became more common on the roads of the industrialized countries, there was a realization that they were facing a problem in need of immediate attention (Vasconcellos 1996; 2005). The industrialized countries understood that traffic accidents are a human-made problem and hence preventable (Vasconcellos 1996). Another change in perception was to look at traffic accidents as a public health problem deserving special attention by the state (Vasconcellos 1996). A reason why traffic accidents are increasing in developing countries is that there are conflicts in acknowledging the problem by society (Vasconcellos 1996). Population growth, increasing levels of ownership of motor vehicles and the growth of towns and cities in developing countries have resulted in traffic congestions, pollution and traffic accidents (Pucher, Korattyswaropam, Mittal & Ittyerah 2005).

The World Bank (2004) acknowledges that traffic accidents constitute a world health problem, and it has estimated that 1.2 million people are killed every year on the world's roads, while 50 million are injured. The bank states that 85 % of the above figures are accounted for by low- and middle-income countries. World Bank (2004) warns that should no actions be taken to curb the rising numbers of traffic accidents, it is feared that by 2020 traffic accidents will be the third leading contributor to the global burden of diseases and injuries after heart diseases and major depression (see Table 1.1).

Traffic accidents have social and economic implications for developing countries and for the families of the casualties. Implications include loss of life, permanent disability, property damage, time and monetary costs (Mupimpila 2008). According to World Bank (2004), traffic accidents cost developing countries one to one and half per cent of their gross domestic product (GDP), while for developed countries it is two per cent. The global costs are estimated to be US\$518 billion per year, while the low-income countries account is US\$65 billion, which is more than they receive in development assistance (World Bank 2004). This is a debilitating situation that has besieged poor countries as the money could be used to fight other social ailments like poverty, HIV/AIDS and lack of development. “Many low-income and middle-income countries cannot provide all the health care services that people sustaining road traffic injuries would get in high-income countries” (World Bank 2004: 14). World Bank (2004) gives an example of a study in Kenya that found that only 10% of all health facilities could accommodate just more than 10 road-injured people.

Table 1.1 Changes in the rank order of disability-adjusted life years for the ten leading causes of the global burden of diseases

1990		2020	
Rank	Diseases or injury	Rank	Diseases or injury
1	Lower respiratory infections	1	Ischaemic heart disease
2	Diarrhoeal diseases	2	Unipolar major depressions
3	Prenatal conditions	3	Road traffic injuries
4	Unipolar major depressions	4	Cerebrovascular disease
5	Ischaemic heart disease	5	Chronic obstructive pulmonary disease
6	Cerebrovascular disease	6	Lower respiratory infections
7	Tuberculosis	7	Tuberculosis
8	Measles	8	War
9	Road traffic injuries	9	Diarrhoeal diseases
10	Congenital abnormalities	10	HIV/AIDS

Source: World Bank (2004: 2)

The Transport Research Laboratory (TRL) UK (Jacobs & Thomas 2000) reviewed road safety worldwide in 1999 and their findings on the global distribution of road deaths in relation to number of vehicles and population are summarized in Table 1.2.

What is patently clear in Table 1.2, is that Africa south of the Sahara has only small proportions of the world’s motor vehicles and people compared to the developed world, yet the former’s share of

road deaths is only four percentage points lower than that of the developed world. This is disturbing because according to the transport safety literature, the road fatalities in developing countries are increasing along with the rising number of motor vehicles in use (Pucher et al 2005; Vasconcellos 2005).

Table 1.2 Regional distribution of estimated proportion of road deaths, motor vehicles and population

Region	Fatalities (%)	Motor vehicles (%)	Population (%)
Sub-Saharan Africa	10	4	10
Developed world	14	60	15
Asia/Pacific	44	16	54
Central & Eastern Europe	12	6	7
Latin America & Caribbean	13	14	8
Middle East & North Africa	7	2	5

Source: Jacobs & Thomas (2000: 7)

Apart from the increase in motor vehicle numbers, Pucher et al (2005: 185) attribute the causes of traffic accidents to several other factors, namely

- inadequate road supply and quality, often unpaved and in a bad state of repair;
- unsafe driving behaviour, which results from virtually non-existent driver training, extremely lax licensing procedures, and lack of traffic law enforcement;
- unsafe vehicles;
- inadequate or non-existent traffic signals and signage and lack of traffic management;
- almost complete lack of infrastructure for pedestrians and cyclists;
- forced sharing of narrow, crowded rights of way for motorized and non-motorized vehicles, pedestrians, animals and street vendors; and
- overcrowding of buses, auto-rickshaws, and even motorcycles.

Vasconcellos (2005) points out that most accidents occur in built environments and blames the increase in traffic accidents on the structure of towns and cities: “The way the city is constructed, and the way the circulation structure is formed, have a direct effect on the nature of traffic conflicts and hence the probability of traffic accidents” (Vasconcellos 2005: 6). He observes that cyclists and pedestrians are the most vulnerable because they are involved in more severe accidents

(Vasconcellos 2005). In their discussion on the vulnerability of road users, Jacobs & Thomas (2000) report higher levels of pedestrian casualties in urban areas in all African countries except Botswana, where passenger casualties were higher. Vasconcellos (2005) maintains that streets are usually made to pass through high-density pedestrian areas, so that, the coexistence of high-speed motor traffic and low-speed pedestrian traffic makes accidents unavoidable. The poor people - who are mostly the pedestrians and cyclists - are unrepresented in the beneficiaries of urban roads investments but instead they are overrepresented among the victims of the adverse impacts that urban roads cause (Hook s.a.). According to Lacroix & Silcock (2004), the majority of road casualties in developing countries are not motor vehicle occupants but the pedestrians, cyclists and other non-motorized vehicle users and consequently they become the majority in road accidents. Roads are designed to increase both speed and safety of motorized vehicles and when used by non-motorized vehicles they become unsafe (Hook s.a.). When discussing traffic accidents and political environments Vasconcellos (2005) notes that decisions about road construction are usually based on economic rationale and are motor vehicle orientated, so that cyclists' and pedestrians' needs are not taken into account, hence few or no facilities are provided for non-motorized road users. Roads in built-up zones are three times more likely to attract traffic accidents than roads elsewhere in the city. Pedestrians and cyclists are the ones vulnerable in this case (Hoyle & Knowles 1998). While the poor suffer the most in terms of road casualties, the policies of governments tend to focus more on serving the needs of the elites (Lacroix & Silcock (2004).

Gender and age play important roles in traffic accident exposure. Males are more likely to be involved in accidents than females (Visser et al 2007). Adolescents and young males are at most risk of traffic accidents (Salvarani, Colli & Carlotti 2008; Falk & Montgomery 2007). Young male drivers think that they are more skilled at driving than average drivers or older drivers and they are less likely to be involved in traffic accidents (Falk & Montgomery 2007; Katila et al 2004). Behavioural factors such as thrill-seeking and overconfidence have led to an underestimation of the potential hazard caused by young male drivers (Falk & Montgomery 2007). On the other hand, senior or aged drivers (65 years and over) are increasingly involved in traffic accidents and their safety is becoming a social problem (Alvarez & Fierro 2008; Bayam, Liebowitz & Agresti 2005).

Traffic accidents are complex phenomena and their analysis is, in most cases, not well done because of inappropriate methods of data collection, storage and interpretation. Usually it is police officers that are charged with the responsibility of collecting data after the occurrence of an accident. The police are not well trained in proper traffic data collection (Al-Ghamdi 2003; Jacobs & Thomas 2000; Vasconcellos 2001; 2005), while others sometimes do not understand the importance of

keeping correct and accurate data. Under-reporting of traffic accidents also contributes to the complexity of traffic accidents analysis (Al-Ghamdi 2003; Jacobs & Thomas 2000; Odero, Garner & Zwi 1997). Various countries have different procedures and policies, standards and thresholds and commitment of resources to data collection in traffic accidents analysis (Kim & Levine 1997).

1.2 RESEARCH PROBLEM AND OBJECTIVES

Botswana, as a developing country in sub-Saharan Africa, has not been spared the proliferating scourge of traffic accidents, which is sweeping across the world. After HIV/AIDS, traffic accidents are the second largest cause of unnatural deaths in Botswana (Botswana 2002; Nyerenda 2005). Traffic accidents lead to human suffering in the form of loss of lives, disfigurement and damage to property (Botswana 2002; Mupimpila 2008). “An analysis of 498 cases in Gaborone for the year 2000 indicates that road traffic accidents accounted for about 80% of all work related fatalities and majority of the victims of fatal accidents were government employees” (Ooteghem 2006: 42). Traffic accidents cost the Botswana government two per cent of GDP per annum (Botswana Society 2003), which is too high given that the country is grappling with an HIV/AIDS epidemic and other socio-economic issues. In the long-term vision for Botswana, a commitment has been made by the nation that by 2016 Botswana will be a ‘safe and secure nation’ (Botswana 1997). Road safety is given as one of the challenges that the country will have to overcome before 2016 (Botswana 1997). Traffic accidents are viewed as a threat to the safety and security of the country. In her address to the National Road Accident Symposium in 2003 (Botswana Society 2003), the former minister of Works, Transport and Communications, Honourable Seretse, attributed traffic accidents to, among other things, high speed, alcohol abuse, ignorance of road rules, recklessness, livestock and human failure. Over the five-year period of 1998 to 2002, Botswana had more than 500 road fatalities every year (Botswana Society 2003). It is in view of the above problem facing the country the research on traffic accidents in Botswana is long overdue. Gaborone, the capital city of Botswana, is the obvious place to conduct such research. Gaborone is situated in the south of the country. It was built by the Mafikeng-based colonial administration almost 40 years ago (Botswana 2005a). It is the centre for government administration, commerce and industry and is experiencing rapid development of infrastructure such as buildings and roads (Botswana 2005a). See Figure 1.1 for the extent of the chosen study area. The population of the city according to the 2001 national census was 186 000 inhabitants (Botswana 2005a).

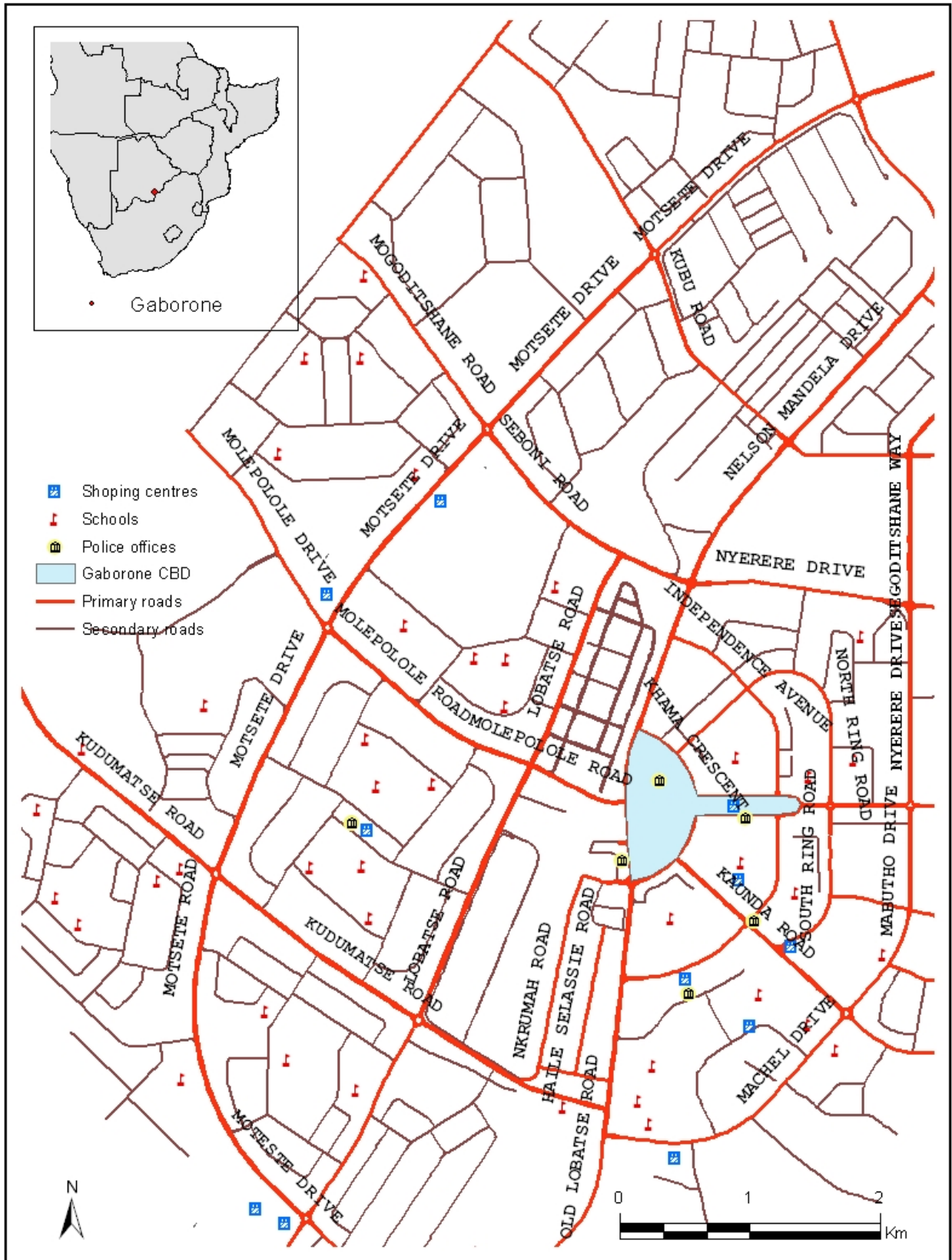


Figure 1.1 The study area, Gaborone, Botswana

The purpose of this study is to investigate traffic accident occurrences spatially and temporally in Gaborone, and to assess ways to control them. The study intends to answer the questions usually asked by geographers, namely:

- What types or categories of road accidents occur in Gaborone? (Severity, mode of transport, age and sex of drivers and pedestrians);
- When do the accidents occur? (Temporal analysis: yearly, monthly, weekly, daily and hourly);
- How and why do the accidents occur? The answers to the how and why questions will bring into focus the social habits of road users and their contributions to the causes of traffic accidents in Gaborone;
- Where do the accidents occur in Gaborone? (Spatial distribution);
- What are the countermeasures the government is putting in place to curb road accidents?

In pursuing the purpose and finding answers to these questions, five objectives will be worked towards:

- Analyse the characteristics of traffic accidents in Gaborone.
- Examine the causes of traffic accidents in Gaborone.
- Compare the traffic accidents that occurred in 2000 and 2005 in Gaborone.
- Use a geographical information system (GIS) to map the spatial distributions of traffic accidents in Gaborone for 2000 and 2005 in order to uncover possible patterns.
- Outline the countermeasures that the state is implementing to curb road accidents in Botswana.

In order to answer the above questions and achieve the set objectives, both primary and secondary data are needed. The methods of data collection and analysis are described and systematically followed to make the research replicable.

1.3 METHOD

The methods and techniques used to collect and analyze data, and interpret the findings, are summarized diagrammatically in Figure 1.2.

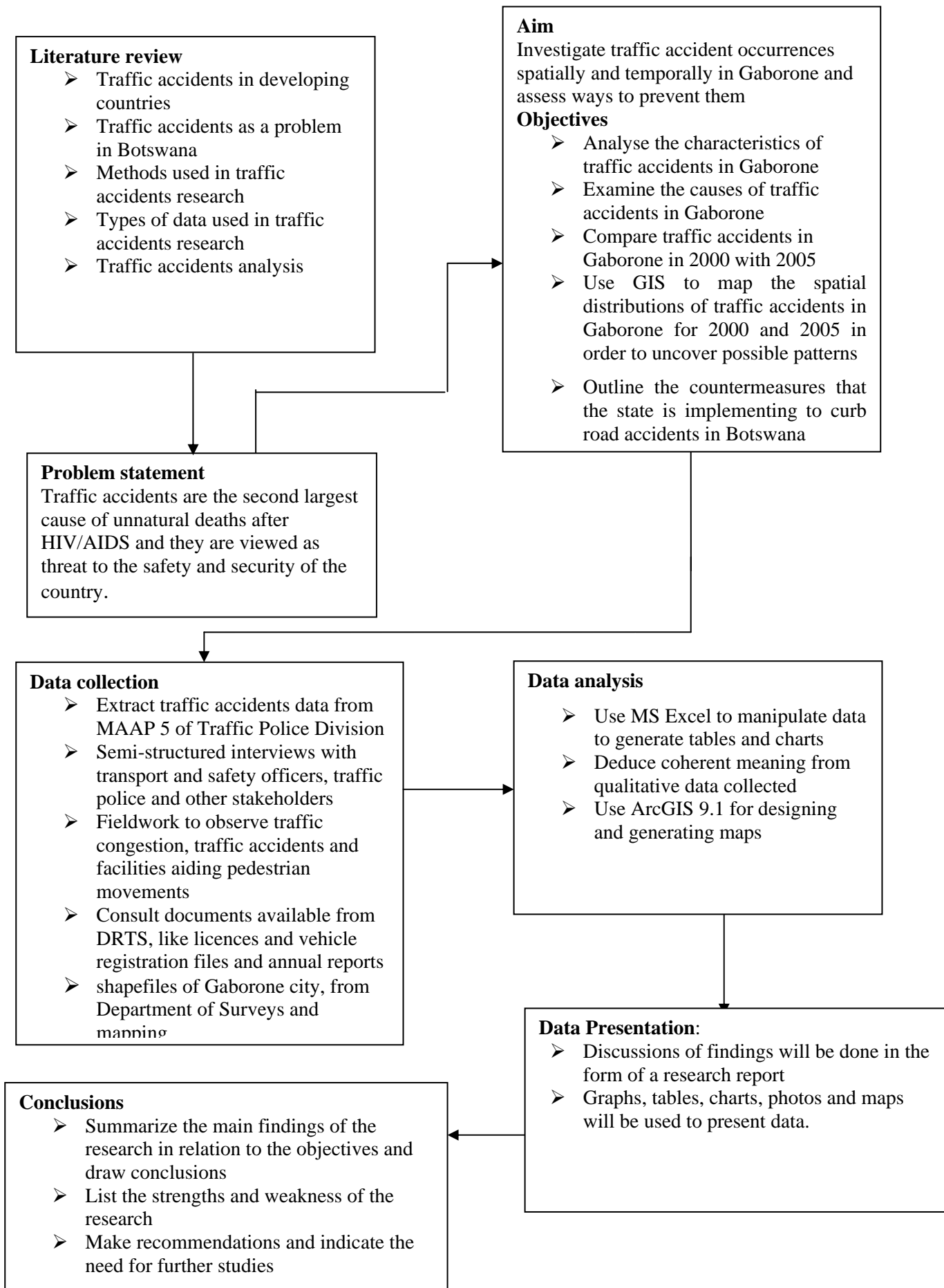


Figure 1.2. Research design for analysing traffic accidents in Gaborone

1.3.1 Data collection

The principal data for this research have been extracted from the microcomputer accidents analysis package V5.0 (MAAP 5) of the Traffic Police Division. The data have been meticulously collected by the police over time, but as yet have never been analysed rigorously. The locational data used for spatial analysis in this research is geo-referenced, however its main shortcoming is that it is only limited to intersections (junctions and traffic circles). The locational data of accidents that occur on the road between intersections (mid-block) are not available and this is a limitation of the study. The data from MAAP 5 are needed to achieve the first four objectives. The variables covered by the data were road casualties by age and gender (driver, passenger and pedestrian casualties), accidents by hour of the day and day of the week, accidents by mode of transport and the factors contributing to accidents.

The fifth objective aims at outlining and evaluating countermeasures the state is putting in place to reduce traffic accidents. For this objective semi-structured interviews were conducted with the stakeholders in road traffic accidents. Officials interviewed were transport and safety officers, traffic police, accident insurance claims officers, and economic researchers. Semi-structured interviews were used to allow the researcher to be flexible in his interviews, and to allow for the inclusion of questions not originally asked in the interview schedule. The interview schedule and a list of interviewees are in Appendixes A and B respectively. The interviews also elicited information about traffic congestion. The researcher also undertook fieldwork in the city to observe traffic conditions and pedestrian facilities like pedestrian-controlled traffic lights.

The Department of Road Transport and Safety' (DRTS) data on the number of licences issued and vehicle registrations were collected. In evaluating the countermeasures in place for curbing traffic accidents, the researcher reviewed available literature at DRTS namely, road accidents annual reports, strategic management plans and road traffic regulations. Lastly, shapefiles of Gaborone city were obtained from the Department of Surveys and Mapping to compile maps and to perform spatial analyses for 2000 and 2005.

1.3.2 Data analysis

According to Mouton (2001:108) data analysis “involves breaking up the data into manageable themes, patterns, trends and relationships”. In this study the researcher will try to establish

relationships among the variables, expose patterns and meaningful themes. Microsoft Excel is used to generate accident tables and charts, based on the variables such as age, gender, drivers, passengers, and pedestrians. ArcGIS 9.1 is used for designing and generating maps to show the spatial distribution of accidents in Gaborone city.

Secondary sources - road accidents annual reports, licences and vehicle registration files, strategic management plans and road traffic regulations - were consulted to supplement the primary data from MAAP 5 and to add depth to the of analysis and conclusions. Qualitative information from the interviews was assessed.

Chapter one deals with traffic accidents in developing countries. It summarizes traffic accidents from a global perspective but with a focus on developing countries. The research problem, objectives and methods of data collection are also set out. Chapter two focuses on the urban transport system of Gaborone by examining the modes of transport used by the public and by private individuals. It also pays attention to the issues of geometry of roads and how they create traffic congestion that can ultimately lead to traffic accidents. Chapter three comprises the analysis of the traffic accidents data. It defines important concepts used in the analysis of traffic accidents. Driver, passenger and pedestrian statistics of road casualties are analysed. Temporal occurrences of accidents and the modes of transport involved in traffic accidents are analysed. There is also an in-depth analysis of the causes of accidents and their (accidents) spatial distribution in the city. An overview of Botswana's efforts to reduce traffic accidents is given in Chapter four. These efforts are evaluated with the aim of raising salient features that need critical attention in controlling traffic accidents. In Chapter four conclusions are drawn from the observed patterns of traffic accidents. Recommendations are given and suggestions for further research are made.

Traffic accidents in a city can be influenced by the transport system of that city. In order to analyse and understand traffic accidents in Gaborone, it is necessary to focus on the city's transport system, which involves the modes of transport used for intra-urban travel, traffic congestion and the road geometry which influences traffic accidents. The next chapter deals with the urban transport system of Gaborone.

CHAPTER 2 : THE URBAN TRANSPORT SYSTEM IN GABORONE

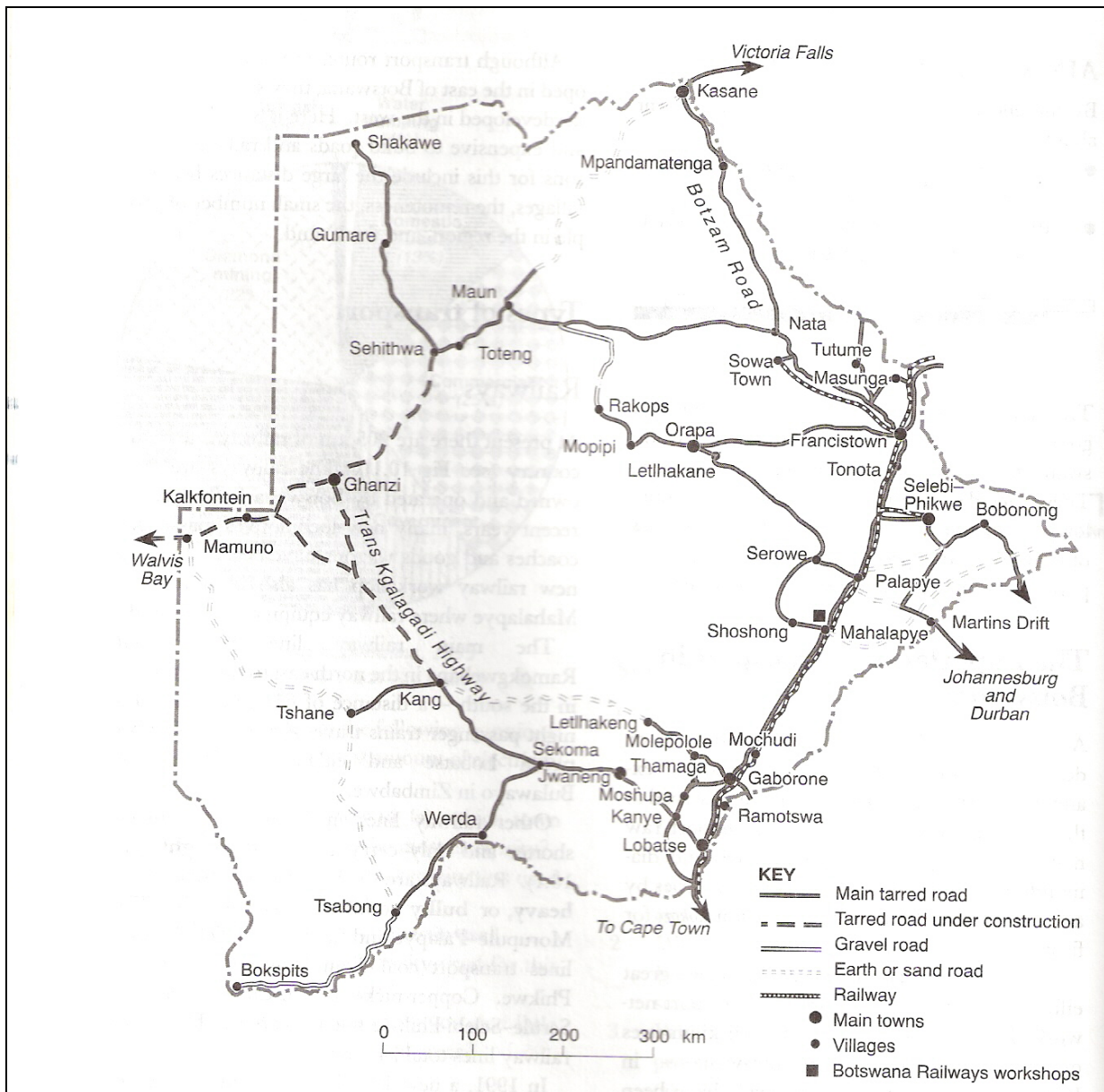
Villages and small towns, at distances of 5-8 kilometres, from Gaborone surround the city. The city is linked to these settlements by a network of major roads (primary roads) (see Figure 2.1). All the roads leading into or out of Gaborone city are called primary roads and are maintained by the central government, while the intra-urban roads are secondary roads maintained by the local government which in this case is Gaborone City Council (see Figure 1.1). Gaborone influences the villages and towns in different ways: people come to Gaborone for shopping, banking, working, buying and selling. A major component of the transport system of Gaborone is the daily commuters to and from the city. Vincent Butale (2006, pers com), Investigating Manager at the Motor Vehicle Accident Fund, estimates that 30% of the cars in Gaborone during business hours actually come from the neighbouring villages and towns. The city is also linked to the outside world, both nationally and internationally by the north-south railway line and by air via the Sir Seretse Kgama International Airport.

The purpose of this chapter is to introduce the reader to the transport system of Gaborone. It deals with the public transport system and its modes of transport. Private transport is discussed in relation to the number of new vehicles registered in Gaborone city. The socio-economic factors that contribute to city residents buying vehicles at a higher rate than others are pointed out. Traffic conditions on Gaborone's roads are examined and the physical status of the roads and other factors that lead to traffic congestion and accidents are discussed. Pedestrian traffic is discussed in relation to pedestrian facilities available in the city. These components of the transport system of Gaborone city are discussed as background to the traffic accident scenario of the city.

2.1 THE PUBLIC TRANSPORT SYSTEM

The two major modes of public transport used by passengers to and from Gaborone are buses and the train that connects Gaborone to northern city of Francistown. Minibuses and buses connect Gaborone with cities of neighbouring countries such as Johannesburg, Harare, Lusaka, Bulawayo, Windhoek and Mafikeng.

The principal public transport mode for intra-urban travel in Gaborone is taxis in the form of combi taxis and motor cars. The intra-city public transport structure comprises taxi routes (mainly combis), which reach to almost every part of the city which is accessible by combi taxi at a standard



Source: May (1998: 82)

Figure 2.1 Botswana's roads and railway networks

price (2007) of P2.50 (R3.00) irrespective of the distance traveled. There are, however, some parts of the city, where combi taxi services are economically unviable. Smaller taxis (cars) charging P3.00 (R3.50) per person access these areas. Passengers in a hurry can reach their destination quickly by paying a premium price of P15.00. There is serious monitoring of public transport fares and routes by the DRTS. The DRTS decides when and by how much to raise fares, but this is usually a lengthy process and is always met with disapproval by the taxi and bus association. There

is only one taxi and bus association in Botswana, which is made up of business persons who own taxis and buses (public transport) in the country. The committee, whose main roles are to see that the businesses are run professionally and to be the voice of public transport owners to government, leads the taxi and bus association.

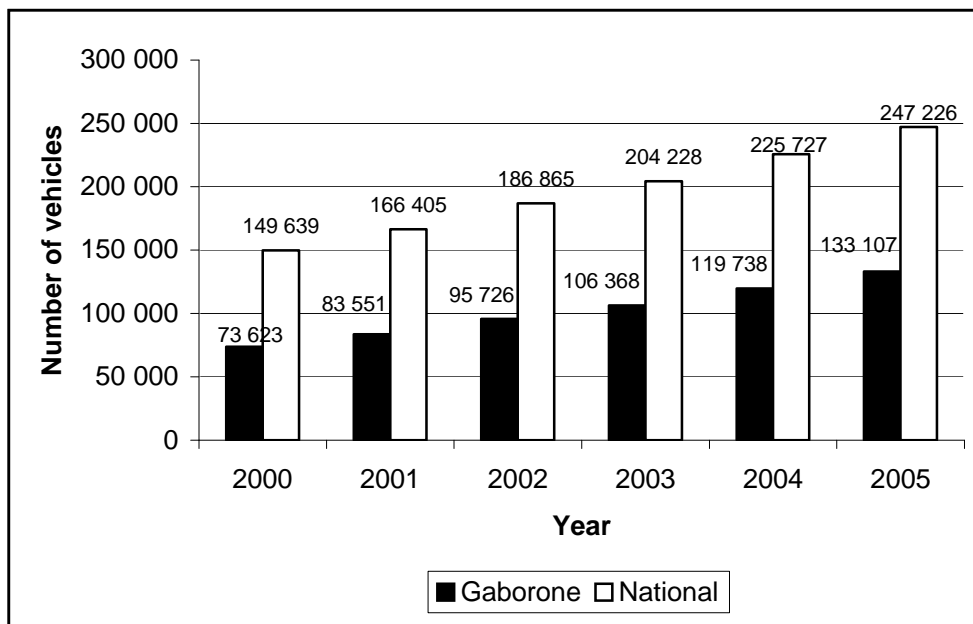
The workers of Gaborone city use taxis mainly to travel to and from work, but they also use them to travel to their social gatherings like church services, sports events, parties and weddings. The public transport system appears to be efficient because there is little evidence of people having to wait at bus stops for public transport to arrive.

Another mode in the public transport system is “cabs”. These are taxis that provide a 24-hour service to transport passengers from one destination to another in the city. They are usually summoned by telephone, and they pick passengers up at the place of their choice. They are commonly used at night when other modes of transport are not available. It must be noted that buses and trains are not used for intra-urban travel as they are only used for long-distance travel into and out of the city.

2.2 THE USE OF PRIVATE TRANSPORT

Apart from the public transport system in Gaborone, there is the use of private vehicles such as motor cars, 4x4s, pickups and combi taxis. In most cases a vehicle is used by the driver alone and sometimes with one or two passengers who are dropped or collected at school or a workplace. Judging by the flood of cars on the roads in the mornings, one might think that more people use private vehicles than public transport. On closer inspection it is evident that most of these cars have only one or two passengers in addition to the driver. For the period 2000-2005, national vehicle registration shows that about 20 000 new vehicles were registered per year in Botswana of which Gaborone contributed an average of 61% per year of these newly registered vehicles (see Figure 2.2). In 2005 there were more than 133 000 vehicles in Gaborone, which is 54% of all the registered vehicles in the country. The number of vehicles for Gaborone was calculated by adding all the registered vehicles at Gaborone registration stations, while for the national total is all the vehicles registered at the 25 registration stations countrywide (including Gaborone stations) added together. These numbers exclude visiting foreign-registered vehicles commonly seen in Gaborone. In most cases a vehicle is registered in the town where it is bought because the local motor dealers register the vehicles on behalf of their clients. Of course, a person living in Gaborone can buy and register a

vehicle in another town where it is cheaper and then use it in Gaborone. The same applies if vehicles are cheaper in Gaborone and people from other towns buy and register them in Gaborone. The 61% share of Gaborone gives an idea of the volume of vehicles added to the city's streets every year. The numbers are not disaggregated by type of vehicle but it is likely that most are motor cars. The numbers shown in Figure 2.2 represent an increase of 81% in vehicles between 2000 and 2005 in Gaborone alone, while that of the whole country was 65%.



Source: DRTS (2006)

Figure 2.2 Number of motor vehicles registered in Botswana and Gaborone, 2000-2005

Over the past three decades Botswana has been fortunate enough to be the only African country that could sustain fast economic growth over a long period (World Bank 2000). The economic growth is measured in goods and services, and this includes good infrastructure, even distribution of resources, good government programmes and bank loan services. These may translate into conditions conducive to local residents buying new vehicles. The economic growth of Botswana has resulted in a sustained increase in real per capita income. The GDP per capita increased from P8318 in 1996 to P10 508 in 2003, with an average annual growth of 3.3% (Botswana 2003b) (Figure 2.3). The increase in private car ownership is a direct result of rapid economic growth (Mupimpila 2008).

Two other factors contributing to higher private car ownership in Botswana are the public service motor car-purchasing scheme and currency differentials. The power of Botswana currency (Botswana pula) has made it more affordable for locals to buy vehicles at cheaper prices in neighbouring countries. The use of the Internet has made it possible for Botswana to buy cheaper



Source: CSO and MFDP Model (Botswana 2003b)

Figure 2.3 Real per capita GDP growth according to National Development Plan 8

used cars from Asian countries such as Japan and Singapore. It is now common to see families owning two vehicles, the second one being a used Japanese import. A Bank of Botswana report (Botswana 2005b) shows that the country is doing well in controlling inflation, which has resulted in people affording to take long-term loans from banks to buy vehicles. Botswana also has microeconomic stability, which is conducive to portfolio investments, especially insurance (Mokgethisi 2006, pers com). This is a requirement that provides collateral for obtaining long-term loans (Mokgethisi 2006, pers com).

2.3 TRAFFIC CONGESTION

Traffic congestion is a situation where travel time along roads (vehicles) or pavements (pedestrians) is considered too high (Vasconcellos 2001). Traffic congestion is a common phenomenon in both developing and developed countries (Pucher et al 2005). Congestion is a major problem in Gaborone (Koorutwe 2006). According to Noland & Quddus (2005), delay on the road is reducing the economic productivity and quality of life of those stuck in traffic. The highway infrastructure in Gaborone is not coping with the number of vehicles and its roads. The city's Principal Road Engineer has lamented that after designing and constructing a road with the intention of solving traffic congestion, it takes a short time before traffic flow exceeds the capacity of the road (Mokgethi 2006, pers com). The main causes of traffic congestion in Gaborone are roundabouts (traffic circles) and unsignalized intersections (junctions without traffic lights). The Director of the

Roads Department has attributed congestion to roundabouts: “Despite having distinct advantages of designated U-turns, many roundabouts in Gaborone result in traffic congestion and are not suitable for the present traffic scenario” (*Botswana Daily News* 2005: 10). He added that the roundabouts are serving their purpose of promoting safety, but some drivers become impatient in the queues and their inconsiderate behaviour causes accidents (*Botswana Daily News* 2005).

Roundabouts have been phased out in Gaborone’s city centre because of their contribution to traffic congestion and they have been replaced by traffic-light-controlled intersections. According to the Principal Road Engineer, some road users in the city prefer roundabouts as they are safe, while others feel that they (roundabouts) slow down the traffic and should be replaced by traffic lights (Mokgethi 2006, pers com). The roundabouts are now used on the roads bypassing the city (Motsete Drive) and the roads leading out of the city (Lobatse and Molepolole Roads) (see Figure 2.4).

Peak traffic flows are in the morning between 06:30 and 08:30, during lunchtime from 12:30 to 14:30, and in the evening from 16:30 to 20:00. Congestion in the city centre is cleared by 18:00 but persists on the outskirts of the city, especially on the Western bypass (Motsete Drive) at roundabout intersections (see Figure 2.5). The Western bypass is a barrier between the old Gaborone city and the new residential areas (Blocks 5, 6, 7, 8 and 9). The traffic roundabouts along the Western bypass, namely the Game City, Block 5, Bonington, Btv, Hundai and Airport roundabouts, are links between Gaborone city and the new residential areas, as well as being gateways to the surrounding villages and towns. Shopping complexes along the Western bypass Game City, Molapo Crossing and Westgate – close late. Westgate, next to Btv traffic circle, attracts many vehicles at night owing to the presence of popular OK food store which only closes at 22:00. The fact that the roundabouts are links between the residential areas and the city – added to the adjacency to the shopping malls that close late - explains why the traffic congestion only clears late along the Western bypass. Traffic counts showing the spatial pattern of traffic congestion in the city are not available from the Traffic Census Unit in the Department of Roads.

According to Koorutwe (2006) traffic congestion in Gaborone city during peak hours is caused by the convergence of vehicles at major intersections. Congestion traffic is the breeding ground for traffic accidents and this has resulted in the major intersections being the location of most of the traffic accidents in Gaborone city.



Photo by author

Figure 2.4 Roundabout along Motsete Drive (Western bypass)

Photo by author

Figure 2.5 Traffic congestion along Motsete Drive at 1700hrs

2.4 PEDESTRIAN TRAFFIC

Most pedestrians in Gaborone are people walking from one mode of transport to another, or those crossing roads to shops, schools or workplaces. Police routinely give information to road users through the media (radio, television and newspapers) about the state of pedestrian concentrations along the roads in the mornings during weekdays to enable drivers to look out for pedestrians. The pedestrians in Gaborone mainly constitute schoolchildren and workers.

Facilities aiding pedestrian movement in the city are traffic lights, zebra crossings, footbridges, pedestrian walks and painted islands at intersections. There are eleven pedestrian control traffic lights (push-button) spread across the Gaborone city as of March 2007. While traffic lights are installed at the intersections to help in controlling traffic, the pedestrian control traffic lights are located at places where pedestrians cross in large numbers. There are paved pedestrian sidewalks along Motsete Drive (Western bypass), Nelson Mandela Drive, Nyerere Drive and Molepolole Drive.

This chapter has presented relevant background information about the transport system of Gaborone. Of paramount importance is the public transport system and the use of taxis as a mode of transport. The issue of new vehicles registered in Gaborone city in comparison to those registered elsewhere in the country helps to assess how many vehicles are added to Gaborone's roads annually. The chapter also highlighted traffic congestion in the city as a crucial factor to accidents.

In discussing the traffic accidents of a place, it is important that one carefully examines the traffic accident characteristics which involve road casualties, time and place of occurrence, as well as the factors that lead to these traffic accidents. The next chapter reports on a traffic accidents analysis of Gaborone.

CHAPTER 3 : ANALYSIS OF TRAFFIC ACCIDENTS

3.1 INTRODUCTION

This road traffic accidents research involves the analysis of casualties among road users, which involve drivers, passengers and pedestrians. The analysis also includes the time of accident occurrences (hour of the day and day of the week). Since the study is about traffic accidents, it is important to critically look into the modes of transport involved in accidents as well as to investigate the causes of the accidents. The spatial distribution of accidents in Gaborone is also discussed.

Traffic accident analysis has specialized terminologies that will be used in this study, namely

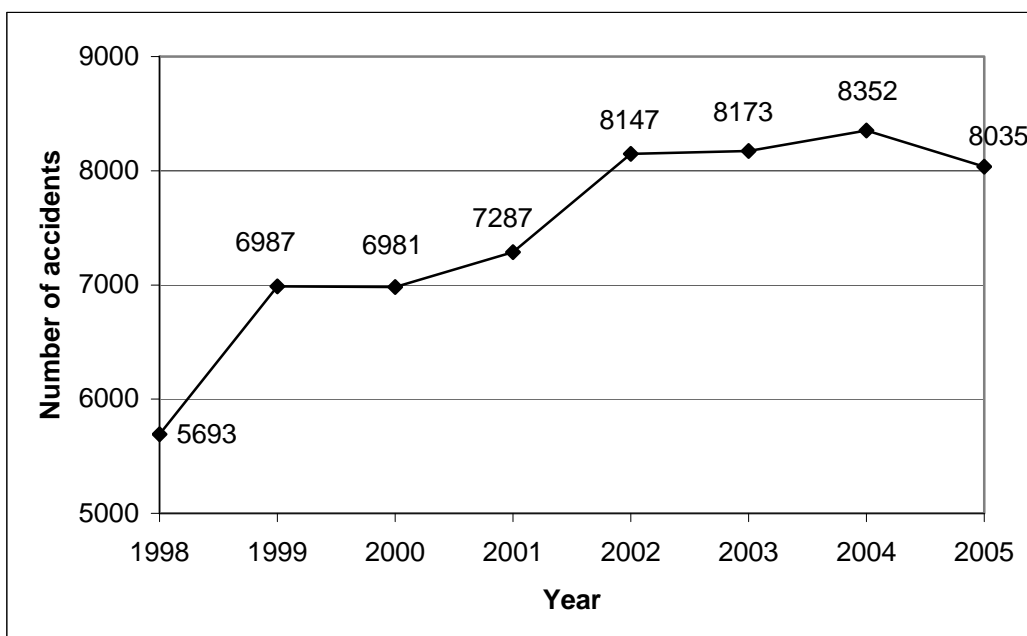
- *An accident* is a sudden and unintentional event resulting in death, injury or property damage (Botswana 2003a; Elvik & Vaa 2004).
- *A fatal accident* is one in which at least one person is killed in the accident or as a result of which death occurs within 30 days (Botswana 2003a; Elvik & Vaa 2004). Persons killed are *fatalities*.
- *A black spot* is a location on the road where there is an abnormally high number of accidents (Elvik & Vaa 2004). It is a high-risk location on the road (Geurts & Wets 2003). Black spots can be targeted on the road network and fixed or attended through alteration of road geometry and environmental conditions precipitating traffic accidents (Geurts & Wets 2003). In urban areas black spots are mostly found in road intersections (Geurts & Wets 2003, Kim & Levine 1997).
- *A serious accident (severe accident)* is one which causes no deaths but results in severe or serious injuries to a person who must be detained in hospital for bone fractures, concussion, severe cuts, crushing, etc that require medical treatment (Botswana 2003a).
- *Casualties* embrace the number of people killed, seriously injured or slightly injured in a road accident (Botswana 2003a).
- *A minor injury* is an injury of minor character like a bruise or cut not judged to be severe (Botswana 2003a).
- *Damage* is the term used for an accident that results in property or material loss only, without any casualty (Botswana 2003a).

The above terms are meant to help the reader understand the traffic accidents analysis reported below. Road users often experience conflicts in their use of roads and these may result in road or

traffic accidents. The road users include the drivers of motor vehicles, the riders of bicycles and donkey carts, passengers and pedestrians. The first theme in traffic accidents analysis is road casualties.

3.2 ROAD CASUALTIES

Figure 3.1 shows the number of road accidents in Gaborone for an eight-year period. Traffic accidents increased by 41% between 1998 and 2005, while there is a slight decrease (3.8%) from 2004 to 2005. This study focuses on accidents that occurred in 2000 and 2005. The 2005 final year was chosen because it represents the most recent available data, while 2000 was chosen to gain a picture of the change that has taken place in the period of at least six years. The total number of traffic accidents in 2000 was 6981 and in 2005 it was 8035, an overall increase of 15%. Although the traffic accidents graph (see Figure 3.1) for 1998-2005 shows an upward curve, it is clear from Figure 3.2 that casualties (fatalities, severities and minor injuries) in 2005 are fewer than in 2000. Property damage incidents in 2005, however, exceed those in 2000. Clearly, property damage contributes immensely to the traffic accident statistics with its 22% increase between 2000 and 2005. The subsections that follow analyse road casualties according to drivers, passengers and pedestrians.

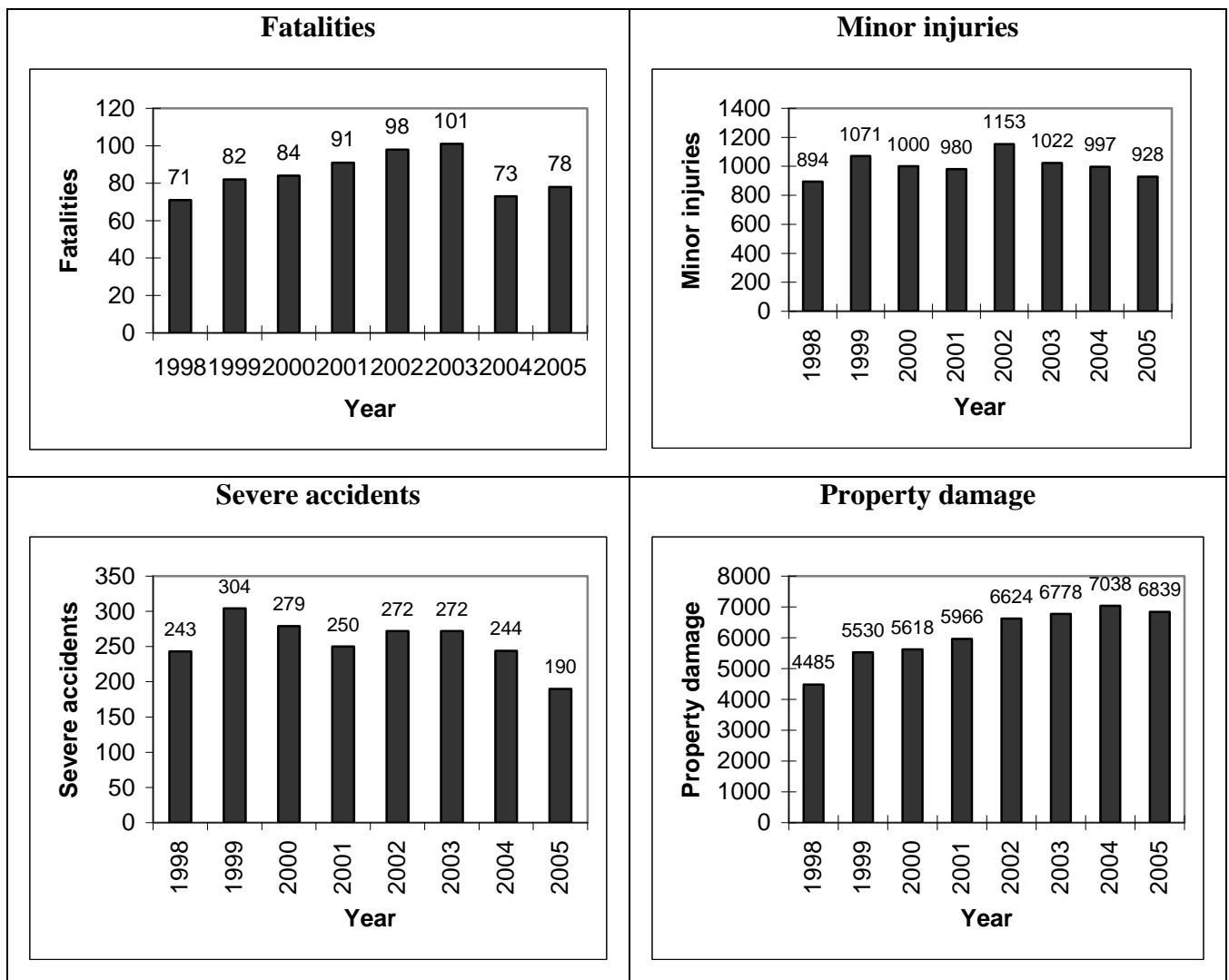


Source: Traffic Police Division (2000; 2005)

Figure 3.1 Total number of accidents in Gaborone, 1998-2005

3.2.1 Driver casualties by age and gender

This subsection deals with driver/rider casualties, disaggregated by age and gender. The term ‘rider’ means “those who were riding motorcycles, bicycles and donkey carts” (Botswana 2002: 14). The definition of ‘rider’ excludes the passengers on motorcycles, bicycles and donkey carts and simply means the ‘drivers’ for motorcycles, bicycles and donkey carts. Donkey carts are a serious problem on the rural roads and the roads in the outskirts of towns and cities in Botswana. They mainly pose a danger at night because they do not have lights, nor do the owners see the importance of putting reflectors on their carts.



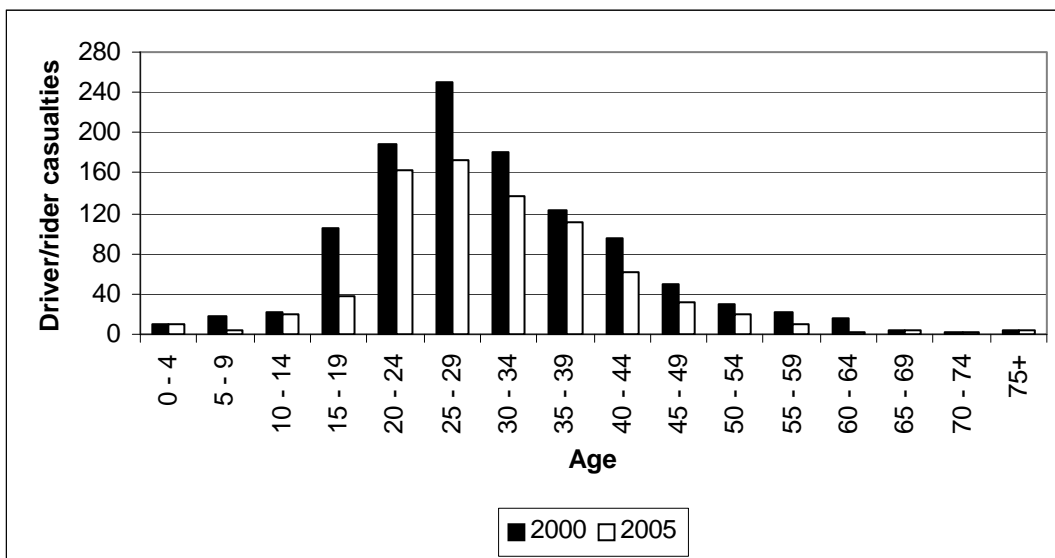
Source: Traffic Police Division (2000; 2005)

Figure 3.2 Number of accidents per category in Gaborone, 1998-2005

The casualties are categorized into three age groups for discussion purposes, namely 0-14, 15-64, and 65 and older. Figure 3.3 shows few driver/rider casualties (4.0% of total) among persons younger than 15 years for both years studied. Casualties are concentrated in the 15-64 (economically active) category with 95% of all casualties for both study years. The casualty among

persons younger than 15 are mainly cyclists, as their age does not allow them to drive licensed vehicles. The less economically active category (65 and older) represents less than one per cent of the accidents in both study years. It must be noted that there has been a reduction of 30% in total driver/rider casualties between the two years, from 1115 in 2000 and 785 in 2005.

Table 3.1 provides information and Figures 3.4 and 3.5 illustrate driver/rider casualties according to gender and age for 2000 and 2005 respectively. Male casualties outnumber female casualties by 5.8:1 in 2000 and 6.2:1 in 2005. In the 15-64 age category, the 20-39 age cohort for female and male casualties show high incidences in both years: in 2000 it constituted two thirds of total casualties while in 2005 it was three quarters. In the 20-39 age cohort for 2000, males constitute 57% while for 2005 it was 64%. The significance of the 20-39 cohort is that it is the most economically active group in terms of driving. The ratio of male to female driver's licence holders as at 2006 was 3 to 1 (DRTS 2006).



Source: Traffic Police Division (2000; 2005)

Figure 3.3 Driver/rider casualties in Gaborone by age, 2000 and 2005

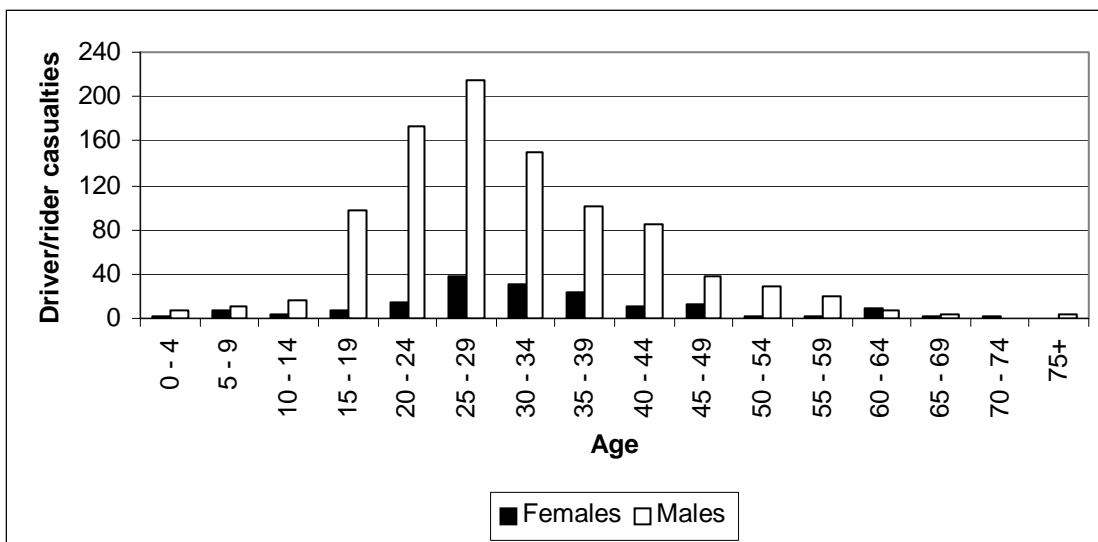
The economically active group (20-39), travel most and they are the drivers who characteristically take risks behind the wheel (Botswana 2003a). This is the age group composed mainly of young and inexperienced drivers. Studies have shown that young drivers are more at risk of being

Table 3.1 Driver/rider casualties in Gaborone by gender, 2000 and 2005

Gender	2000		2005	
	Number	Percentage	Number	Percentage
Male	952	85.4	676	86.1
Female	163	14.6	109	13.9
Total	1115	100	785	100

Source: Traffic Police Division (2000; 2005)

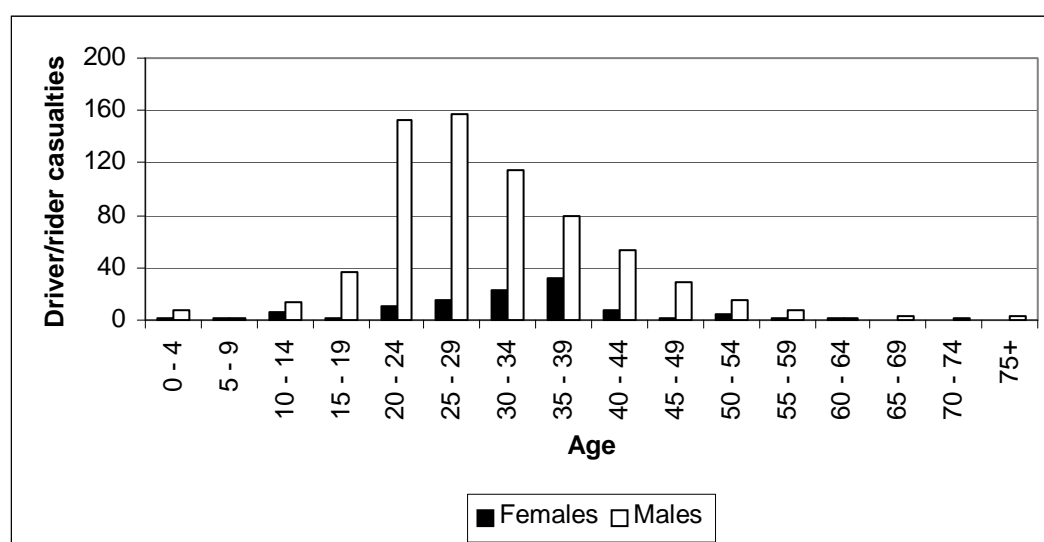
involved in traffic collisions than other groups (Williams 2003). Inexperience in driving and youthfulness are independent factors that encourage risk behaviour (Espino, Hasselberg & Laflamme 2006). The youth often travel around the city in open vans as passengers to attend social activities such as parties, sports events and weddings. They tend to be involved in alcohol and drugs abuse that impairs their concentration, hence making themselves prone to tragic crashes, which are often fatal (Botswana 2003a; Smink, Ruiters, Lusthof, Gier, Uges & Egberts 2005; Vaez & Laflamme 2005). According to Banda (2004) and Mupimpila (2008), most traffic accidents in Botswana are caused by young and inexperienced drivers (below the age of 40). On the other hand, Tronsmoen (2008) points out that the reason why young drivers are highly represented in traffic accidents is that they overestimate their own driving skills and underestimate the hazard involved in their driving.



Source: Traffic Police Division (2000)

Figure 3.4 Driver/rider casualties in Gaborone by age and gender in 2000

This economically active group (20-39) is involved in commuting to and from work with many working as drivers and consequently therefore spending much of their time driving; hence their greater exposure to traffic accidents (Mitchell, Driscoll & Healey 2004). Those working as drivers experience what Mitchell, Driscoll & Healey (2004) refer to as work-related casualties which need to be addressed in a work-based context (road safety awareness at work place), as well as through ongoing educational campaigns addressing road safety in the communities. A study done in Tehran found that about half of the victims were in the economically active cohort of 21-50 years (Zadeh, Vahabi, Nazparvar & Amoei 2002). The same study (Zadeh et al 2002) refers to two studies done in China that confirm the findings of this study. An epidemiological study carried out in 1994 in the Sichuan Province of China shows that most of the victims of road fatalities were males aged 21-40 years (Zadeh et al 2002). Another study in China done over a 10-year period (1984 to 1994), confirms that more than 60% of road fatalities were men between the ages of 20 and 50 years (Zadeh et al 2002).



Source: Traffic Police Division (2005)

Figure 3.5 Driver/rider casualties in Gaborone by age and gender in 2005

Traffic accidents disaggregated by driver casualties in Gaborone show the youth (20-39) as the main victims of road tragedies, with male drivers bearing the brunt. There are various reasons why males are the main victims, one being that driving licences issued to males outnumber those for females to a ratio of 3:1 in Gaborone (DRTS 2006). Some other reasons for the male/female differential in accident involvement in developing countries are discussed next.

Gender analysis by Zadeh et al (2002) found that the ratio (4:1) of men to female traffic victims in Iran could be attributed to the cultural, social and economic condition of Iranians. “Men have more

responsibilities, which results in higher risk of accidents for them” (Zadeh et al 2002: 76).

Drivers at the youthful stage, especially males, tend to exhibit certain driving behaviours, which can result in traffic casualties. Sukhai’s (2003) study in Durban found reasons why some drivers engage in aggressive and hazardous driving behaviour. Aggressive driving, according to Sukhai (2003), includes verbal or gestural expressions of anger on the road directed to other road users with the intention to harm the latter, while hazardous behaviour involves driving above the speed limit or driving under the influence of alcohol. Sukhai (2003: 15) identified five characteristics of aggressive drivers, namely

- They place top priority in getting to their destination in the fastest possible time;
- Aggressive drivers believe in competing with other fast cars;
- Aggressive drivers respond to other aggressive drivers who wish to pass or cut in front of them by becoming unyielding and refusing to give the other vehicle the right of way;
- Aggressive drivers feel contempt for anyone who doesn’t look, act or drive the way they want to look, act or drive; and
- Aggressive drivers believe it is their right to punish or hit back at drivers whose driving behaviour threatens them or others.

Males constituted 87% of the participants in the sample of 1006 (Sukhai 2003). About 53% of the motorists studied acknowledged driving above the speed limit, 48% claimed to speed up to a yellow traffic light, and sometimes intentionally drive through the red light (Sukhai 2003). One tenth of the sampled motorists acknowledged driving under the influence of alcohol (Sukhai 2003). The drivers also reported that their hazardous driving began when another motorist cut in front of them without signalling or cutting in and then driving slowly (16%). Taxi drivers were the main culprits of this behaviour of cutting in and then driving slowly while looking for potential passengers (Sukhai 2003). Driving behind other motorists with poor driving skills also annoyed drivers. Aggression was found to be prevalent during peak traffic hours (Sukhai 2003). The study conducted by Sukhai may have been done in a city (Durban) in a different country (South Africa) but the fact is that it is in a developing country and therefore comparable to Botswana.

Zhang, Huang, Roetting, Wang & Wei (2005) compared drivers’ attitudes in China (developing country) with those of their counterparts in the USA (developed country). Focus groups were used as the unit of analysis in both countries. When asked about the characteristics of safe driving, participants of the two countries mentioned obeying the rules, good temper and mood, and defensive driving (Zhang et al 2005). Both countries’ groups agreed that young and aged drivers are not safe drivers because of their physical and psychological characteristics (Zhang et al 2005).

“Drivers of both countries, especially the older drivers, mentioned that as driving experience increased, you are more and more cautious” (Zhang et al 2005: 24). One Chinese taxi driver said, “I prefer to yield to and be far from those aggressive drivers because chasing them would hurt me, my passenger, and my business” (Zhang et al 2005: 24-25). The results of the Zhang et al (2005) study showed that participants in China related safe driving to a person’s driving skill, experience, capability and physical conditions, while participants in the USA focused on how to deal with signal systems, their vehicle, the environment and other vehicles (Zhang et al 2005). According to Zhang et al (2005), most female drivers prefer to drive defensively. When men in Tanzania were asked to rate their vulnerability to traffic accidents, they rated their vulnerability as being similar to that of women; yet they were more at risk than women (Astrom, Moshiro, Hemed, Heuch & Kvale 2006). Just like in Tanzania, men in Botswana are more vulnerable to traffic accidents than women.

3.2.2 Passenger casualties

Given that the modes of passenger transport in and around Gaborone city are almost restricted to taxis, combis and private vehicles, the locals do not have options like trains or buses so that they must use what is available. Passengers who travel in pickups and lorries are more vulnerable when their vehicle is involved in an accident.

In 2000 (see Table 3.2), the 772 passenger casualties included 22 fatalities, 157 passengers seriously injured and 593 with minor injuries. Of these 772 casualties, males constituted 52% and females 48%. There were fewer passenger casualties in 2005 (496)—equally divided between males and females—and they included 20 fatalities, 76 seriously injured passengers and 400 with minor injuries. Fatalities constituted 59% males and 41% females in 2000, while in 2005 the proportions were 60% and 40% respectively. The 36% decrease in the total number of passenger casualties between 2000 and 2005 is noteworthy. The decrease could be because of the educational programmes that the government is putting in place to encourage the passengers to use public transport which is the safest mode of transport in Botswana (Mupimpila 2008).

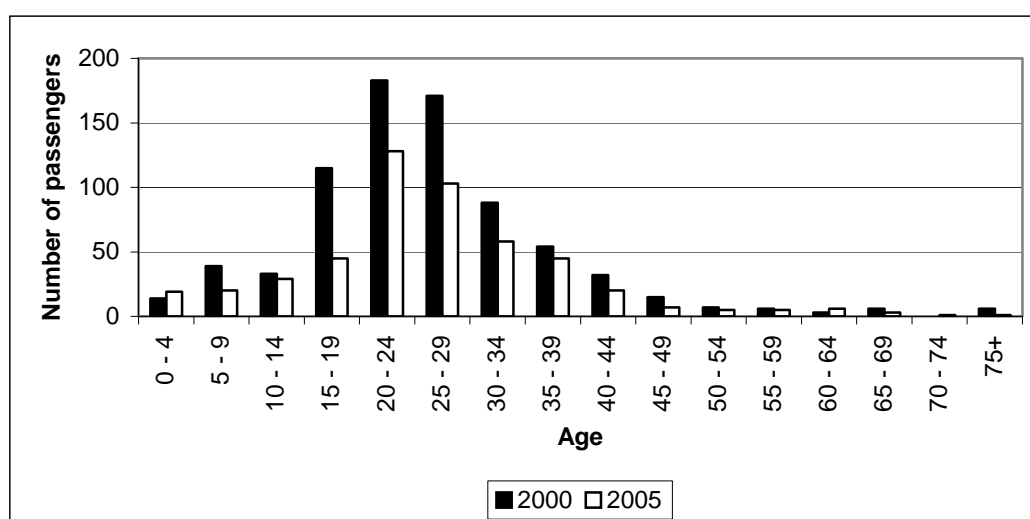
Figure 3.6 shows high incidences of casualties in the age groups between 15 and 34 years, particularly in the age cohorts of 20 to 29 which contributed 46% in 2000 and 48% in 2005. The age group 15 to 34 is the youth and they constituted 72% and 67% of passenger casualties in 2000 and 2005 respectively. In this age category (15-34) males are represented slightly more in both years, that is 54% (2000) and 57% (2005) (see Figures 3.7 and 3.8). Generally passenger casualties according to gender show similar proportions for the two years.

Table 3.2 Severity of passenger casualties in Gaborone by gender in 2000 and 2005

Type of casualty	2000						2005					
	Male		Female		Total		Male		Female		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Fatality	13	3.2	9	2.4	22	2.8	12	4.8	8	3.4	20	4.0
Serious injury	91	22.6	66	17.9	157	20.3	36	14.5	40	11.9	76	15.3
Minor injury	299	74.2	294	79.7	593	76.8	201	80.7	199	84.7	400	80.6
Total	403	100	369	100	772	99.9	249	100	247	100	496	99.9

Source: Traffic Police Division (2000; 2005).

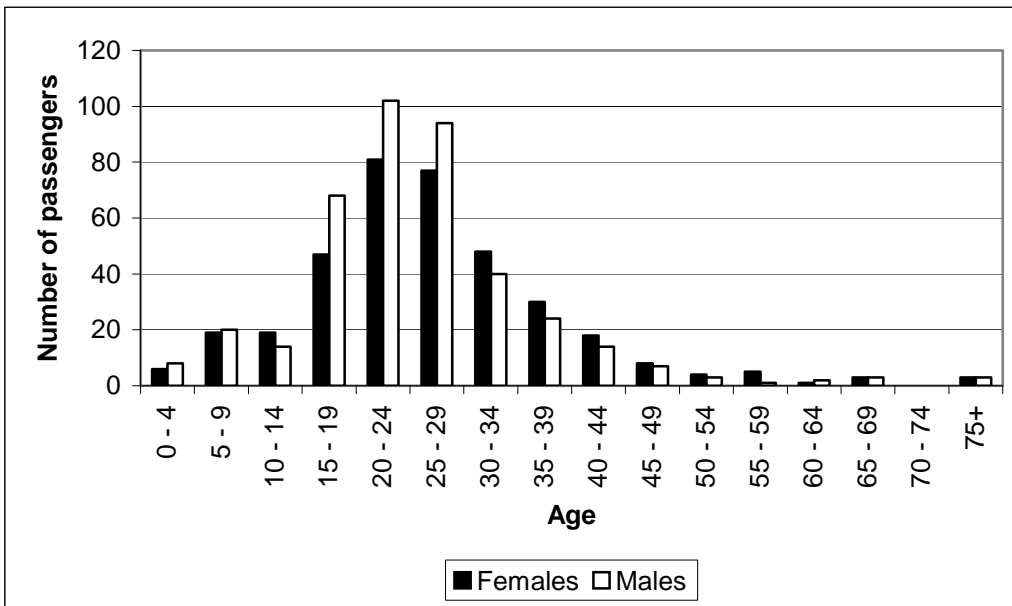
Note: Percentages do not add to 100 due to rounding.



Source: Traffic Police Division (2000; 2005)

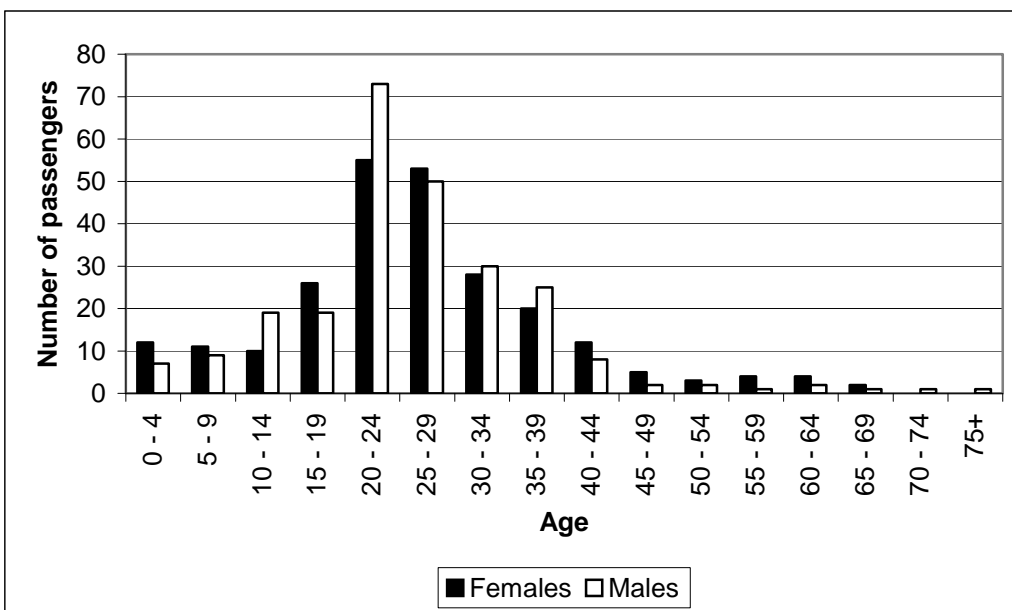
Figure 3.6 Passenger casualties in Gaborone by age group, 2000 and 2005

Accidents involving passengers usually result in minor injuries, but unfortunately there are also significant occurrences of fatalities and serious injuries. Traffic flows in cities are usually slow due to congestion and as such the accidents that occur are normally less severe (Noland & Quddus 2005). On the other hand, increased traffic levels and congestion will, according to Noland & Quddus (2005), increase the chance of traffic interaction, hence more accidents but proportionally



Source: Traffic Police Division (2000)

Figure 3.7 Passenger casualties in Gaborone by gender and age, 2000



Source: Traffic Police Division (2005)

Figure 3.8 Passenger casualties in Gaborone by gender and age, 2005

fewer severe casualties and increased property damage. This explains why the total number of accidents in 2005 is greater (8035) than in 2000 (6981) but the number of human casualties recorded is lower. The increase in total accident numbers in 2005 involving property damage (damage of cars, pavements, traffic lights, traffic circles and lamp posts), namely 5618 in 2000 to 6839 in 2005.

The high incidence of traffic accidents among the working group as drivers and passengers means that the private and government sectors are losing significant numbers of their productive workforce through death or injury (Botswana 2002). This underlines the need to address road safety in a work-based context as well as to continue with educational road safety campaigns aimed at the general public (Botswana 2002; Mitchell, Driscoll & Healey 2004). The youthful drivers, passengers and pedestrians are the target population for road safety educational programmes in developing countries.

3.2.3 Pedestrian casualties

According to Motshegwe (2008a) pedestrians are killed or injured in large numbers when crossing high-density roads which have inadequate pedestrian crossing facilities. He was actually referring to Gaborone's Western bypass (Motsete Drive) which has developments (shopping and residential) on both sides, hence generating many and frequent pedestrian crossings (Motshegwe 2008a). Teenage pedestrians are the ones who are prominently represented in pedestrian casualties since they usually walk in small groups of friends along or across the roads making them vulnerable to accidents (Motshegwe 2008b).

Pedestrian casualties by gender (see Table 3.3) show that males predominate (365) compared to females (253) in 2000. The same applies for 2005 where males (325) still outnumber females (249). Male pedestrian fatalities represent 83.8% of all pedestrian fatalities in 2000, but this reduced to 70.3% in 2005. Interestingly, the total number of fatalities in both years was the same. The total number of pedestrian casualties fell by 7.1% from 2000 to 2005, which could be attributed to traffic congestion in the city causing vehicles to move more slowly giving pedestrians more time to make correct decisions on where to cross.

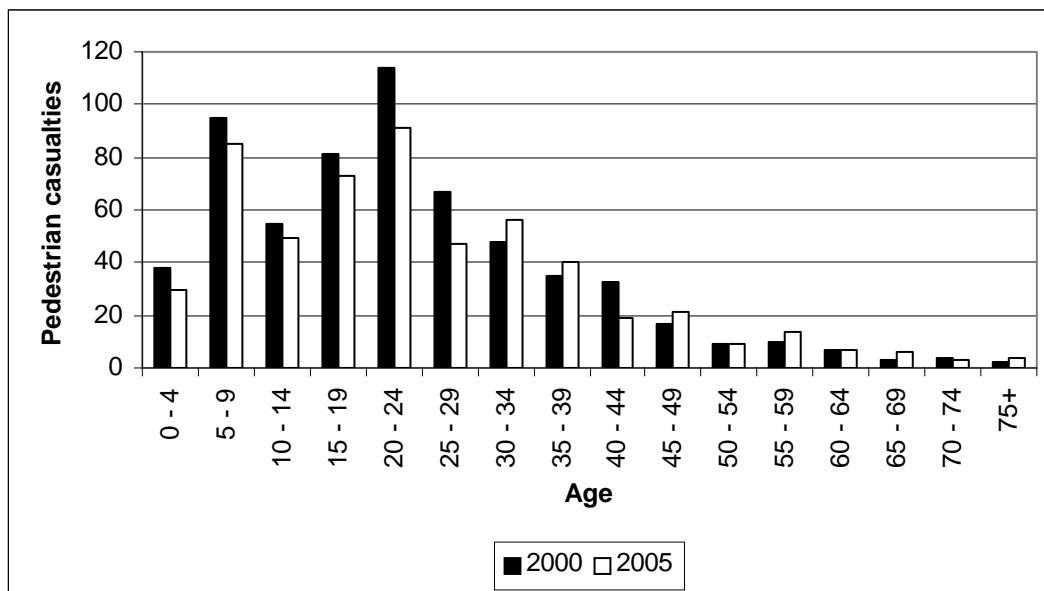
Figure 3.9 and Table 3.4 tell an alarming story about casualties among children. Youngsters aged four or younger represented 6% and 5% of all casualties in 2000 and 2005 respectively; those in the age category of 5-9 years accounted for 15% for each year; and casualty numbers of all children under 15 years represent 30% and 29% of the total casualties of 2000 and 2005 respectively. The 5-9 cohort is at risk when crossing roads, especially to and from schools and shops. Their judgement of oncoming vehicles is not developed enough to make a decision of when to cross a road safely. The 10-14 age group is evidently more mature and able to make better decisions of when to cross a road although their casualty rate remains unacceptably high. Equally distressing is the picture of the 15-34 age group that accounts for 50% and 47% of all casualties in 2000 and 2005 respectively and the peak among the 20-24 age cohort (18% and 16% for 2000 and 2005 respectively). The 15-34

age group is at risk due to the abuse of intoxicating substances that affect their perception of when it is safe to cross roads (Botswana 2003a; Smink, Ruiter, Lusthof, Gier, Uges & Egberts 2005; Vaez & Laflamme 2005).

Table 3.3 Severity of pedestrian casualties in Gaborone by gender in 2000 and 2005

Type of casualty	2000						2005					
	Male		Female		Total		Male		Female		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Fatality	31	8.5	6	2.4	37	6.0	26	8.0	11	4.4	37	6.4
Serious injury	92	25.2	61	24.1	153	24.8	72	22.2	37	14.9	109	19.0
Minor injury	242	66.3	186	73.5	428	69.2	227	69.8	201	80.7	428	74.6
Total	365	100	253	100	618	100	325	100	249	100	574	100

Source: Traffic Police Division (2000; 2005)



Source: Traffic Police Division (2000; 2005)

Figure 3.9 Pedestrian casualties in Gaborone by age, 2000 and 2005

The analysis of pedestrian accidents in Gaborone shows a high proportion of child (under 15 years) casualties—around 30% for both years. According to Odero (2004), children (under 15 years) frequently get injured as pedestrians in developing countries. Boys naturally have a lot of energy for playing, especially football and in most cases there is lack of safe open space for playing and as a result they may find themselves crossing roads in chase of their ball. Girls are less vulnerable as they usually play nearer home. The studies show that child pedestrian casualties most often occur when crossing roads (Petch & Henson 2000; Tandukar et al 2006).

In an interview with the Children Traffic Education Officer (Mrs Motsamai) at DRTS, she admitted that most traffic accidents involving children take place during the first days after schools reopen (Motsamai 2006, pers com). It seems that during school terms children develop a good sense for crossing roads, but during school vacations they lose their ability to make decisions about traffic flow. The internal structure of towns in Botswana has been planned in such a way that roads are used as barriers, separating blocks of residential areas. For example, a primary road (Molepolole) is used to separate Phase I residential area from Gaborone West Phase II residential areas and the same applies in other residential areas (see Figure 3.13). A problem arises when children in one residential area are admitted to schools in other residential areas, for example a child staying in Block 5 is admitted in a primary school in Block 9 and vice versa (see Figure 3.13). Children are then forced to cross a traffic-congested primary road when walking to and from school, and this exposes them to the possibility of traffic accidents. The schools are also located deep in the residential areas so that it becomes difficult for school management to monitor the road crossings or use the scholar patrollers to assist children to cross roads. The situation of Gaborone is different to other African cities where children get involved in traffic accidents when engaged in economic activities like buying and selling along the roads (Adesunkanmi, Oginni, Oyelami & Badru 2000). According to Adesunkanmi et al (2000) children engaged in stationary selling and buying in markets are less likely to be exposed to traffic accidents than those who move around.

This research could not establish the relationship between the child pedestrian casualties in Gaborone with their economic status. Traffic safety literature has observed that child pedestrian casualties are mostly from low-income families (Jacobs & Thomas 2000; World Bank 2004). The Children Traffic Education Officer confirmed that no research had been done on this topic and that no data is collected on the economic status of child pedestrian casualties (Motsamai 2006, pers com).

Table 3.4 Pedestrian casualties in Gaborone by age, 2000 and 2005

Age	2000		2005	
	n	%	n	%
0 - 4	38	6.1	30	5.4
5 - 9	95	15.4	85	15.3
10 - 14	55	8.9	49	8.9
15 - 19	81	13.1	73	13.2
20 - 24	114	18.4	91	16.4
25 - 29	67	10.8	47	8.5
30 - 34	48	7.8	56	10.1
35 - 39	35	5.7	40	7.2
40 - 44	33	5.3	19	3.4
45 - 49	17	2.8	21	3.8
50 - 54	9	1.5	9	1.6
55 - 59	10	1.6	14	2.5
60 - 64	7	1.1	7	1.3
65 - 69	3	0.5	6	1.1
70 - 74	4	0.6	3	0.5
75+	2	0.3	4	0.7
Total	618	99.9	574	99.9

Source: Traffic Police Division (2000; 2005)

Note: Percentages do not add to 100 due to rounding.

As mentioned, some pedestrians use intoxicating substances such as drugs and alcohol, the effects of which may lead to pedestrian crashes. “Making the decision about when it is safe to cross roads in relation to available traffic gaps is a complex task requiring efficient perceptual, cognitive and physical skills, for example detecting vehicles in motion, integrating multiple sources of information, and initiating actions as quickly as possible. Accurate perception of the motion of the approaching vehicle is paramount when making judgements and these decisions may place high demands on intoxicated pedestrians, particularly for those with high blood alcohol concentration (BAC) levels, in busy or complex traffic or when a decision needs to be made quickly” (Oxley, Lenne & Corben 2006: 259). They also argue that a pedestrian who is drunk is likely to be slow when crossing a road, or move into the path of oncoming vehicles or fall asleep on or near the roadway. These factors expose pedestrians to high risk of traffic accidents. Alcohol intake can affect the ability of pedestrians to select gaps in flowing traffic (Oxley, Lenne & Corben 2006).

Safe gap selection is a likely problem for older people due to age-related deterioration in perceiving objects in motion (Oxley, Ihsen, Fildes, Charlton & Day 2005). Elderly people may have problems with integrating diverse information necessary for making judgements about oncoming vehicles. They invariably move slowly and they may suffer from poor vision. According to Odero (2004), the small proportion of casualties aged 65 or older in Africa is partly because of their small numbers in the continent's general populations. There is evidence that pedestrians of all ages make decisions about crossing roads based on the distance of an oncoming vehicle rather than on its time of arrival (Oxley et al 2005). Time gap is the integration of distance and speed (Oxley et al 2005) but pedestrians tend to reason that the further the approaching vehicle is away, the safer it is to cross (Oxley et al 2005). Such deductions are dangerous because a vehicle may be far away but travelling at a high speed, which might inevitably lead to a pedestrian collision.

Dissecting traffic accidents into road casualties like drivers/riders, passengers and pedestrians is only one face of traffic accidents research. It is imperative to bring other issues of accident occurrences into the picture. Time of accidents occurrence is examined next.

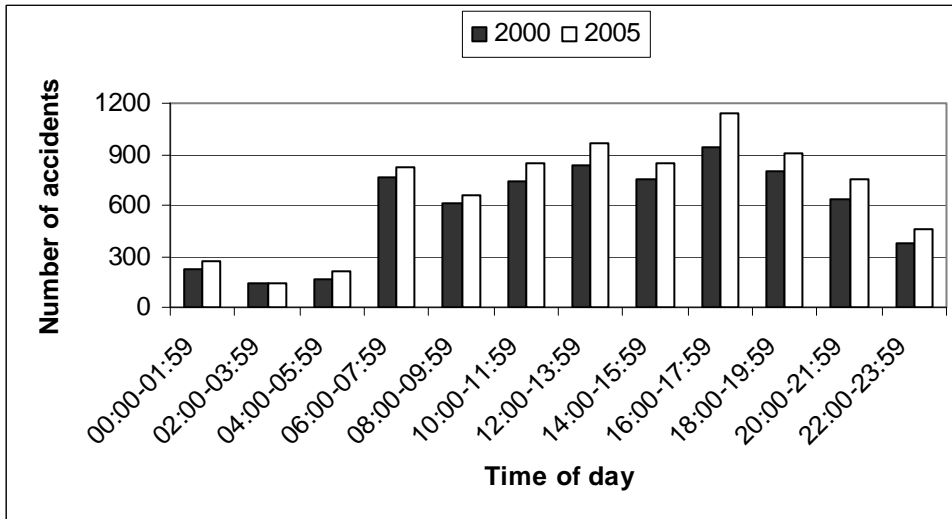
3.3 TEMPORAL ANALYSIS

The purpose of temporal analysis is to find out the relationship between the incidence of accidents and time of occurrence. It is important that the traffic authorities know the times and days of concentrations of traffic accidents as this will help them to target their programmes on times and days of the week which are prone to accidents. The analysis in this study is done in terms of accidents by hour of the day and by day of the week.

3.3.1 Traffic accidents by hour of the day

Figure 3.10 shows that most traffic accidents occur between 06:00 and 21:59 (87%), with two thirds of the accidents occurring during daytime (06:00-17:59), which corresponds with the time when traffic is heaviest. The peak accident period is between 16:00 and 17:59 (13.5%), which is the rush hour after people stop work. Traffic flow during this time is heavy given that people are stopping work, some are rushing to shops which mostly close at 18:00, and others are collecting their children from schools. Some people are engaged in social activities that normally take place after working hours such as sports, business meetings, extramural courses at educational institutions and so forth.

There is also a significant number of accidents during the morning (06:00-07:59) and lunchtime (12:00-13:59) rush hours. This can also be attributed to work-related activities. The accident figures for 2000 and 2005 have similar pattern, except that there is an increase in each category in 2005. These increases can be attributed to the 81% increase of traffic on Gaborone's roads between 2000 and 2005 (recall Figure 2.2).



Source: Traffic Police Division (2000; 2005)

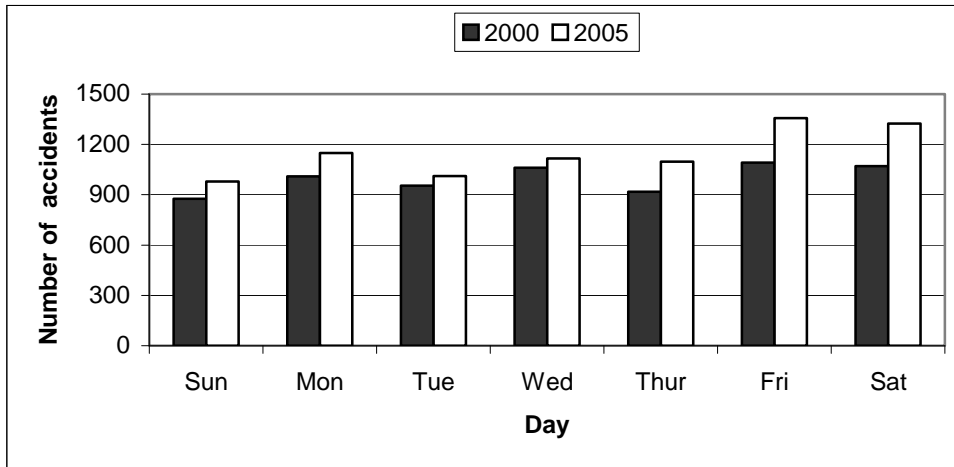
Figure 3.10 Traffic accidents in Gaborone by hour of the day, 2000 and 2005

3.3.2 Traffic accidents by day of the week

Fridays and Saturdays are the days on which the occurrence of traffic accidents peaks. Sundays experience the lowest frequency, while Mondays have the third highest. Together the accidents on Fridays and Saturdays constitute 31% and 33% of weekly accidents in 2000 and 2005 respectively (Figure 3.11). One can make a conclusion that 30% of traffic accidents take place over weekends in Botswana (Mupimpila 2008).

The temporal analysis shows that most traffic accidents in Gaborone occur on Fridays and Saturdays. Gaborone city is not an exception since, according to Odero, Garner & Zwi (1997), traffic injuries in developing countries are highest during weekends. According to Botswana (2003a), a reason for the high number of accidents on Fridays and Saturdays is the large volumes of traffic at night while the level of law enforcement is low. Another reason is that Gaborone residents engage in weekend social activities that expose them to road accidents, namely parties, drinking sprees, wedding celebrations and joyriding. Odero, Garner & Zwi (1997) attribute the weekend accidents specifically to alcohol-related activities. They point out that “increased night-time and weekend crashes place high demands on emergency staff at times when staffing in hospitals is often

at its lowest level, and has implications for the efficient organization and provision of emergency medical services” (Odero, Garner & Zwi 1997: 453-454).



Source: Traffic Police Division (2000; 2005)

Figure 3.11 Road accidents in Gaborone by day of the week, 2000 and 2005

Temporal analysis of traffic accidents can inform traffic managers on the “when” question. If traffic officials know when traffic accidents are most likely to occur, preventive measures can be taken. It is also important to know which types of vehicles are mostly involved in accidents so that public awareness programmes may be directed to their drivers and occupants. The modes of transport involved in accidents are analysed and discussed next.

3.4 ACCIDENTS BY MODE OF TRANSPORT

The mode of transport refers to the type of transport involved in an accident. Taxis have, in this study, been separated from motor cars, because the former are public transporters and need to be distinguished from private vehicles. The same distinction was not made between minibuses and buses since there are some minibuses and buses that are not used for public transport purposes; hence buses and minibuses are treated as public transport. “Animal” mode means animal-drawn carts such as donkey or mole carts.

Motor cars top the list in 2000 and 2005 at 46% and 52% as the mode of transport most involved in traffic accidents (see Table 3.5). There was a 31% increase in the number of accidents involving motor cars over the six-year period. The mode of transport with the second highest rate of involvement in both years is pickups, accounting for one third in 2000 and less than one third in

2005. Vehicles in the public transport system (taxis, minibuses and buses) accounted for 8% in 2000 and 7% in 2005, with minibuses contributing the lion's share.

Table 3.5 Mode of transport involved in accidents in Gaborone, 2000 and 2005

Transport mode	2000		2005		Percentage change 2000 to 2005
	n	%	n	%	
Motor car	5130	45.8	6709	51.5	30.8
Pickup	3782	33.7	3736	28.7	-1.2
Minibus	727	6.5	819	6.3	12.7
4x4	584	5.2	854	6.6	46.2
Lorry	331	3	293	2.2	-11.5
LDV	169	1.5	191	1.5	13
Lorry and trailer	124	1.1	109	0.8	-12.1
Taxi/Combi taxi	93	0.8	54	0.4	-41.9
Bus	71	0.6	93	0.7	31
Cycle	68	0.6	42	0.3	-38.2
Motorcycle	57	0.5	88	0.7	54.4
Other	53	0.5	26	0.2	-50.9
Tractor	15	0.1	10	0.08	-33.3
Animal	6	0.05	12	0.09	100
Total	11 210	99.95	13 036	100.7	-16.3

Source: Traffic Police Division (2000; 2005)

Note: Percentages do not add to 100 due to rounding.

It would be insightful to relate these vehicle accidents rates in Gaborone to the actual number of registered vehicles per mode of transport. Unfortunately, the vehicle records management unit could not disaggregate vehicles registrations by body type into stations (Gaborone is one of the stations). The breakdown of the number of vehicles registered by body type for the whole country up to June 2005 showed that motor cars (including taxis) made up 37% and pickups 38%. The remainder includes 4x4s, excavators, caravans, dumpers, motorcycles, minibuses, tractors, trailers and horses. Since Gaborone accounts for 53% of the vehicles registered in the country, it is safe to say that the accident rates of motor cars and pickups in the city are more or less a reflection of vehicle registrations per mode of transport.

Motor cars were the leading mode of transport (52%) involved in traffic accidents in Gaborone, followed by pickups (28%) in 2005. Interestingly, national figures show that in 2002 and 2003 pickups were the primary mode of transport in traffic accidents at 37% and 36% respectively (Botswana 2003a). In both years motor cars took second place at 31% (Botswana 2003a). The predominance of pickups in national road accident statistics is quite likely because Botswana is a large semi-arid country and consequently the distances travelled and the type of roads traversed, mandate the use of pickups for long-distance journeys for most passengers. Pickups have proved to be such a danger on Botswana's roads for drivers and passengers that the government has become opposed to the use of pickups as a mode of travel since the vehicles lack safety devices such as canopies (Botswana 2002). Jacobs & Thomas (2000) have singled out casualty-causing collisions by lorries and pickups in Botswana and Kenya, while in Tanzania involvement of motor cars and buses is high, especially public buses which contribute more than 98% of collisions and 59% of fatalities (Rwebangira, Pearce & Maunder 1999). About 58% of public transport modes (buses, minibuses and taxis) have been the leading modes involved in traffic accidents in urban Kumasi, Ghana (Mock, Forjuoh & Rivara 1999).

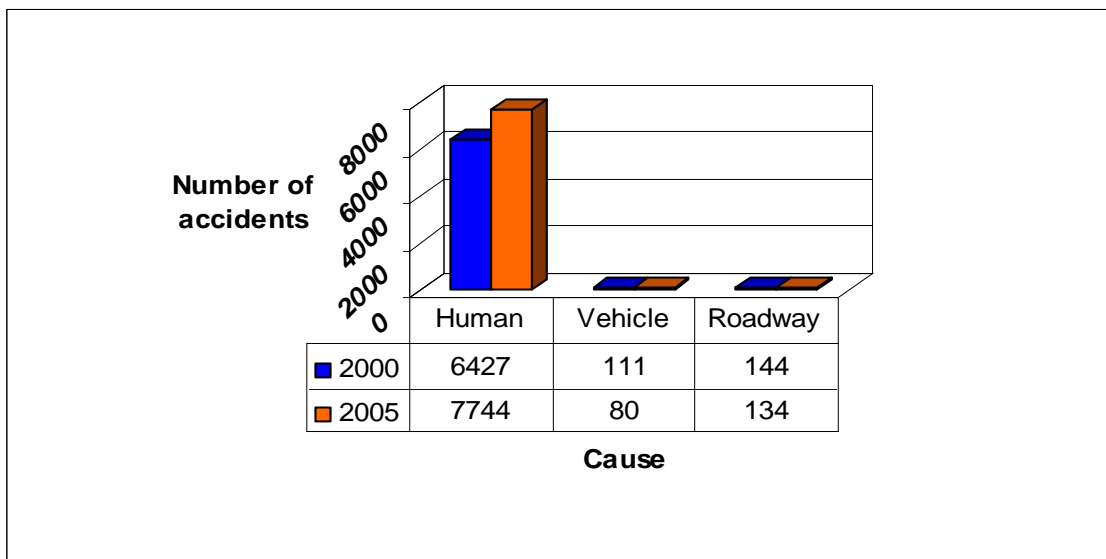
It is important to note that public transport (buses, minibuses and taxis) accounted for only 7.4% of traffic accidents in Gaborone in 2005. However, this is not a true reflection of what is really happening. The researcher observed that taxi drivers are more often indirectly involved in accidents because of their aggressive driving and practice of cutting in front of other road users thereby causing, private vehicle drivers to stop abruptly or try to avoid them, hence collisions. The taxi and minibus drivers display bad attitudes on the road which the private vehicle drivers do not like. During the traffic congested peak hours, the taxi drivers frequently drive outside the road lanes to overtake other vehicles and when they see other taxi drivers who are already on the road, those on the road will block the traffic so that other taxis can get into the traffic flow. In an informal discussion with a taxi driver, he admitted that drivers of private vehicles and taxis "hate" each other because of the deplorable behaviour usually displayed by the taxi drivers. He attributed this bad behaviour to the pressure put on drivers by passengers who want to reach their destinations as quickly as possible, and to taxi owners who require drivers to make a certain number of trips in a day. Nonetheless, the low incidence of public transport involvement in traffic accidents, makes public transport the safest mode of transport in Botswana (Mupimpila 2008).

Having discussed the mode of transport in relation to traffic accidents in Gaborone, there is also a need to investigate other factors that underlie the occurrence of accidents, hence the causes of traffic accidents in Gaborone are looked into next.

3.5 CAUSES OF ACCIDENTS

Causes of traffic accidents are usually referred to as factors contributing to accidents. These factors are categorized into three groups: human, roadway environment and vehicle factors (Botswana 2003a; Jovic, Kern & Biloglav 2006). “Human factors involve the driver’s actions (failure to give way, speeding and violating traffic laws) or condition (effects of alcohol and drugs, inattention, decision errors and not alert to potential hazards etc.), while roadway environment factors include the design of the roadway, roadside hazards, road furniture and road conditions and vehicle factors involve poor brakes, defective brakes, dirty windscreens, and generally unroadworthy vehicles” (Botswana 2003a: 32).

Gaborone city accident data for 2000 and 2005 shows that human factors are without question the leading causes of traffic accidents, constituting 96% and 97% for the two years (see Figure 3.12). The other two factors (roadway environment and vehicles) share the small remaining proportions. Table 3.6 summarizes the causes of road accidents in Gaborone city in 2005.



Source: Traffic Police Division (2000; 2005)

Figure 3.12 Factors contributing to accidents in Gaborone in 2000 and 2005

In 2005 accidents in Gaborone were overwhelmingly caused by drivers/riders who accounted for 88% of all accidents resulting in the death of 54 people. It is noteworthy that animals (cattle, donkeys and dogs) roaming the streets of Gaborone are a menace to the public as they contributed to 6% of the accidents and 2.6% of fatalities in the city. Livestock are attracted to the green grass on traffic circles and their unattended presence poses a threat to the lives of road users and contributes

to property damage. Accidents caused by pedestrians constituted only 3% of the accidents in 2005 but they resulted in one quarter of the fatalities. Pedestrians' main error is crossing the road without looking and this alone resulted in 20 fatalities. Accidental pedestrian contact with a vehicle most often results in severe injury or death.

Table 3.7 summarizes driver/rider errors and violations. Riders in this case are cyclists. Driver errors include drivers' negligence, following too closely behind other vehicles, failure to comply with traffic signs or signals, losing control of the vehicle, unlicensed driving, driving under influence of alcohol and drugs, excessive speed, fatigue and sickness. At national level in 2003 human factors accounted for 95.6%, roadway environment for 1.2%, and vehicle factors for 3.2% of accidents (Botswana 2003a). This shows that the Gaborone scenario is not unique and this uniform pattern points authorities to the factors to target in finding solutions to the traffic accident problem.

Table 3.6 Causes of traffic accidents in Gaborone in 2005

Causes	Frequency	Percentage	Fatality	Percentage
Driver/rider	6973	87.6	54	69.2
Animal	487	6.1	2	2.6
Pedestrian	264	3.3	20	25.6
Road	120	1.5	0	0
Vehicle	81	1.0	2	2.6
Passenger	17	0.2	0	0
Weather	12	0.2	0	0
Obstruction	2	0.03	0	0
Mobile phone	2	0.03	0	0
Total	7 958	99.9	78	100

Source: Traffic Police Division (2005)

Note: Percentage does not add to 100 due to rounding.

According to Odero (2004) human factors account for 70% of all causes of traffic accidents in Kenya. Other research has shown that in several countries human factors account for more than 90% of traffic accidents and only a small proportion of accidents can be attributed to roadway environment and vehicle factors (World Bank 1997). In-depth analysis has, however, shown that accidents are not caused by a single factor but by a combination of factors (Jacobs & Thomas 2000; Odero 2004; World Bank 1997).

Table 3.7 Driver and rider errors and traffic violations in Gaborone in 2005

Errors & violations	Frequency	Percentage	Fatality	Percentage
Other drivers' negligence	4 730	67.8	27	50
Reversing negligently	656	9.4	0	0
Following too close to other vehicles	646	9.3	0	0
Failure to comply with traffic sign or signal	244	3.5	6	11.1
Loosing control	186	2.7	13	24
Unlicensed driver	165	2.4	3	5.6
Under influence of alcohol drink or drugs	113	1.6	2	3.7
Turning without care	80	1.1	0	0
Excessive speed	71	1.0	2	3.7
U-turning	46	0.7	1	1.9
Cyclist error	29	0.4	0	0
Fatigue or sleep	4	0.06	0	0
Sickness	3	0.04	0	0
Total	6 973	100	54	100

Source: Traffic Police Division (2005)

It is a pity that the police usually want to single out one contributing factor that has caused an accident, and this is encouraged by the fact that their data-capturing forms only make provision for a single causal factor to be recorded. Single causes reported by the police over-simplify the reality of the causes of accidents (Jacobs & Thomas 2000; Odero 2004). The World Bank (1997) gives an example of a drunk driver who drives his car off the road at a sharp curve and hits a tree and is killed, somebody may say intoxication (human factor) caused the accident, but if the road did not have a sharp curve (roadway environment) he might not have driven off the road, and if the tree (roadway environment) was not there he might not have been killed.

Negligence by drivers was the primary cause of accidents in Gaborone in 2005 when it was responsible for 77% (adding the percentages of the two negligence, that is 67.8% + 9.4%) of all accidents (Table 3.7). Varying driver negligence rates have been reported elsewhere: 70% in

Tanzania, 44% in Ethiopia and 24% in Zimbabwe in 1998 (Jacobs & Thomas 2000). In 14 studies on traffic accidents in developing countries, Odero, Garner & Zwi (1997) observed that driver negligence, which includes reckless driving, improper overtaking and disregarding of traffic lights, was judged by the police as the main causal factor of traffic accidents. Police officers, however, have little investigation training and they “are often inclined to cite the motorized road user as being at fault as he will most likely be in a better position to pay compensation than would a pedestrian or cyclist” (Jacobs & Thomas 2000: 20). Again, it is difficult for the police to know whether the cause of an accident is something to do with road or vehicle factors because these are technical fields for which technical expertise is required to interpret them (Van Schoor, Van Niekerk & Grobbelaar 2001).

According to Odero (2004: 7), reports from Kenya, Uganda, Ethiopia, Tanzania, Ghana, South Africa and Zimbabwe show the following to be the causes of traffic accidents:

- speeding and perilous overtaking;
- alcohol and drug abuse;
- driver negligence;
- poor driving standards;
- vehicle overload;
- poor maintenance of vehicles;
- bad roads and hilly terrain;
- negligence of pedestrians; and
- distractions of drivers (speaking on cellphones).

Van Schoor, Van Niekerk & Grobbelaar (2001: 720) have observed that in a “large number of accidents investigated....mechanical failures were as a result of defective tyres and brakes”. Mechanical failures were prevalent in minibuses (taxis) and, in addition to the defective tyres and breaks, the vehicles were overloaded (Van Schoor, Van Niekerk & Grobbelaar 2001).

Following too close to other vehicles is the third most common cause of accidents in Gaborone (9.3% of all accidents in 2005). This problem is prevalent in cities with heavy traffic congestion where vehicles travel too close to one another so that when a crash occurs it often causes a chain collision. Fortunately, fatalities are rare in these conditions because the vehicles are moving at low speeds (Noland & Quddus 2005). The inevitable result of an accident caused by following too closely is damage to vehicles. In Gaborone in 2005, 619 out of 646 accidents caused by being too close to other vehicles resulted in property damage.

One factor that seemed uncommon in Gaborone as a cause of traffic accidents but common in other developing countries, is excessive speed. As indicated in Table 3.7, it accounts for only 1% (ninth out of 13 factors), but in other countries it is ranked among the top two, for example in Riyadh it is ranked highest as the cause of severe accidents (Al-Ghamdi 2003) and in the United Arab Emirates it is ranked second, accounting for 16% of casualties and 27% of fatalities (Bener & Crundall 2005). Speed does not only affect the severity of a collision but it also exposes the road user to risks of being involved in accidents (Aarts & Van Schagen 2006; Afukaar 2003). High speed may also be an underlying factor of other causes of traffic accidents such as losing control of a vehicle. Speed becomes more dangerous in an urban setting, especially at signalised intersections when drivers race to beat the green light changing to red.

At this point it is appropriate to take another perspective on traffic accident causes and prevention provided by other researchers—a viewpoint different from that presented so far. According to Peltzer & Renner (2003: 619) “in the context of Western accident prevention, all events are controllable and all accidents preventable. On the other hand it is vital to consider the view of accidents as random events due to bad luck”. Dixey (1999) points out that preventive actions against accidents always take into consideration rational approaches and rarely do they consider non-rational explanations of causes of accidents, such as accidents being caused by bad luck, God, gods or witchcraft. Cultural perceptions on the causes of traffic accidents may have a strong influence on the methods that governments can employ to prevent accidents. Peltzer & Renner (2003: 619) argue that “many drivers share deep-rooted mystical and superstitious attitudes that may lead to systematic errors in the appraisal of risks and possible causes of road traffic accidents”. In an attempt to understand the role played by cultural superstition, Peltzer & Renner (2003) did research on South African black professional taxi drivers. Their study produced evidence that a significant number of drivers believed in destiny, witchcraft or evil spirits as possible causes of traffic accidents (Peltzer & Renner 2003). These drivers believe that the way to avoid accidents is by using protective medicines, consulting traditional healers or prophets and by cleansing ceremonies (Peltzer & Renner 2003). A similar study by Dixey (1999) in Nigeria amongst the Yoruba community, revealed their belief in predestination, both in terms of traditional religion and also in modern religion such as Christianity and Islam. The community would approach a *babalawo* (priest) for advice about the future when they wanted to travel or, after having an accident, they would consult a *babalawo* who would tell them that they had done something evil (Dixey 1999).

As noted earlier, the majority of accidents in Gaborone are attributable to human factors. The human factors are mainly the errors made by the drivers such as negligence. However, in attending

to these human errors, some researchers suggest the consideration of cultural perceptions too. This study sees the location of the occurrence of traffic accidents as another factor that is important to traffic accident research; hence the next theme is the spatial distribution of accidents.

3.6 SPATIAL DISTRIBUTION OF ACCIDENTS

According to Anderson (2003: 3), “road safety involves three major components: the road system, the human factor and the vehicle factor that are inter-linked through geo-referenced traffic events and provide the basis for road safety analyses and attempts to reduce the number of road incidents and improve road safety”. Knowing where road accidents occur provides the authorities with important information for policing or instituting the necessary measures to reduce future accident occurrences (Anderson 2003). Accidents are events that take place on the road or on the adjacent surface area. Table 3.8 provides information about, and Figures 3.13 and 3.14 show, accidents that occurred on major (primary) road intersections or junctions in Gaborone. Intersections are places of conflict between vehicles moving in different directions so that they tend to attract traffic collisions.

The Gaborone central business district (CBD), which contains the bulk of the city’s government offices and shops, shows a number of clustering of accidents in 2000–24% of all accidents occurred in and around the CBD, especially on Kgama Crescent. Nelson Mandela Drive, which cuts across the town and the CBD, was the venue of 30% of the accidents and Segoditshane Drive the scene of 20%. The CBD, Nelson Mandela Drive and the eastern areas, including the northern side make up eastern Gaborone. This eastern part is the original town that has since grown (and still is) westward. The residential areas (Blocks 5, 6, 7, 8) beyond Motsete Drive make up the new extensions of Gaborone that include Phases II, Phase IV and Block 3. The accidents along Motsete Drive accounted for 13% of all the accidents in 2000. By 2005, because of development in the western part of Gaborone, the black spots (concentration of accidents on the road) had migrated from eastern to western Gaborone. In 2005 the CBD saw only 12% of all the recorded accidents—a reduction of almost 50%—Segoditshane Drive 17% and Nelson Mandela Drive 22%. Motsete Drive now (2005) features the major black spots which together constitute 32% of the total number of accidents mapped. Accident locations have migrated from the eastern and central parts of the city to the western part in the six-year period.

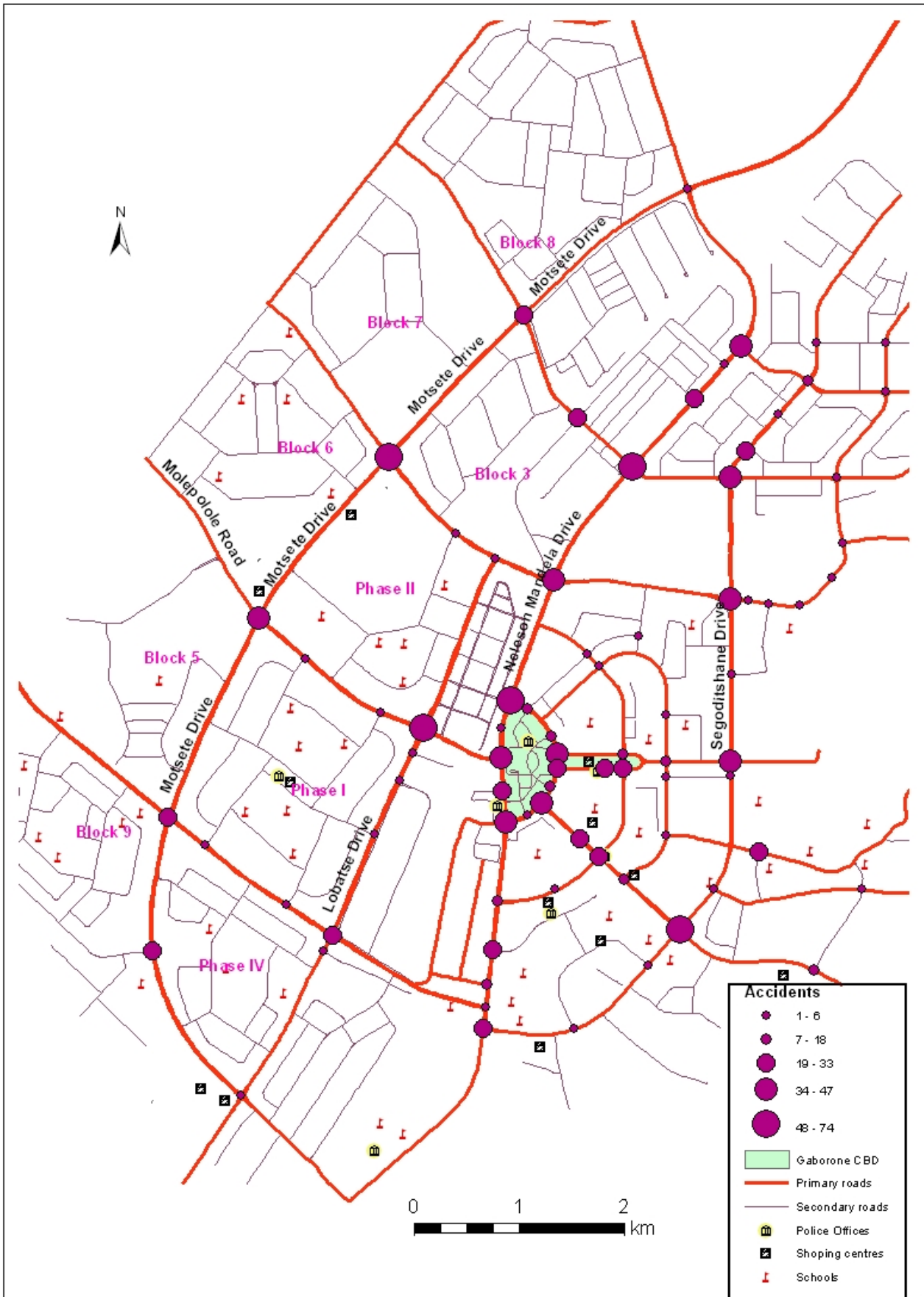


Figure 3.13 Intersectional distribution of traffic accidents in Gaborone, 2000

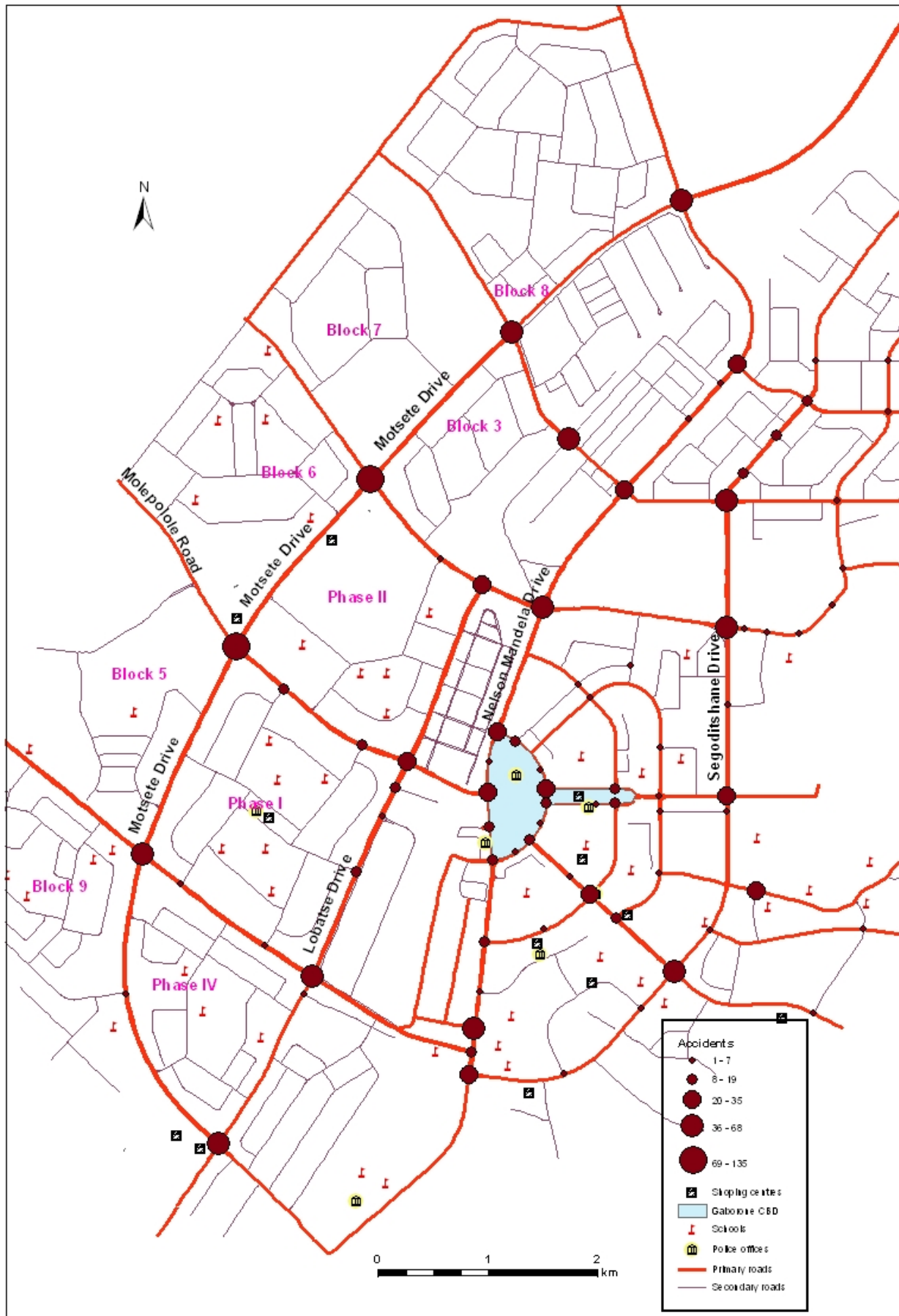


Figure 3.14 Intersectional distribution of traffic accidents in Gaborone, 2005

Table 3.8 Traffic accident concentrations at intersections in Gaborone, 2000 and 2005

Location	2000		2005	
	Count	Percentage	Count	Percentage
Motsete Drive (Western bypass)	182	13.3%	440	32.0%
Gaborone CBD	328	24.0%	165	12.0%
Mabutho/Nyerere/ Drive/Segoditshane Drive	276	20.0%	234	17.0%
Old Lobatse/Nelson Mandela	410	30.0%	303	22.0%
Other places	170	12.5%	233	17.0%
Total	1366	100%	1375	100%

Source: Traffic Police Division (2000; 2005)

Chapter three has attempted to analyse the traffic accidents in Gaborone. It has achieved the first four objectives of the study by investigating and analysing the different characteristics of the traffic accidents; discussing the road casualties according to driver, passenger and pedestrian casualties; and examining traffic accidents casualties in terms of gender and age.

Another characteristic of traffic accidents discussed is the temporal occurrences. Temporal analysis addressed the question about when traffic accidents take place. The temporal analysis found that accidents peak between 16:00 and 17:59, 12:00 and 13:59 and 06:00 and 07:59. The finding is the same for both years and these peak periods for accidents correspond with the peak periods of traffic congestion, namely the time of going to work in the morning, lunch hour and stopping work in the afternoon. Accidents peak on Fridays, Saturdays and Mondays. This chapter also raised the issue of the type of transport involved in the accidents. Motor cars and pickups were the leading modes of transport in traffic accidents in Gaborone in 2000 and 2005.

The chapter also reported on the causes of traffic accidents in Gaborone where, in the two years studied, most cases were attributable to human factors. Driver and rider negligence is the main cause of traffic accidents as it accounted for three quarters of all accidents in 2005. Animals roaming the streets and pedestrians also play significant roles in the causes of traffic accidents. The research mapped the spatial distributions of traffic accidents for 2000 and 2005 in Gaborone. The maps show a concentration of traffic accidents in the central and eastern parts of the city in 2000 but as the city expanded westward, the accident concentration moved to the western parts by 2005.

The government of Botswana has been making efforts to curb the incidence and increase in traffic accidents in the country. The next chapter outlines the countermeasures the state is initiating.

CHAPTER 4 : BOTSWANA'S EFFORTS TO REDUCE TRAFFIC ACCIDENTS

The Botswana government, through the Department of Road Transport and Safety (DRTS) in collaboration with Botswana Police Traffic Division and Department of Roads, has done some work aimed at reducing road traffic casualties. Other government departments, parastatals and private organizations have given DRTS support in its endeavours. The purpose of this chapter is to outline government's efforts in attempting to counteract the scourge of traffic accidents in the country. The research aims not just to profile but also to evaluate the efforts of the government in reducing road traffic accidents. In this evaluation one needs to assess the internal organizational structure and activities of DRTS, and this includes appraising the efforts of sister departments and facilities already involved in transport safety. It is beyond the scope of this research, however, to review the whole structure of the DRTS and its sister departments so that this research is restricted to the activities of the DRTS and the works of the National Road Safety Committee (NRSC). The activities of the DRTS and the NRSC have been summarized in a speech by the former Minister of Works and Transport when addressing a symposium on traffic accidents in 2003 (Botswana Society 2003). These activities are:

- applying remedial measures on black spots in the road network;
- improving traffic legislation;
- advocating and disseminating road safety education;
- advancing the safety of schoolchildren;
- raising driving standards
- ensuring safety of public service vehicles (passenger and freight).

The government, through the Ministry of Works and Transport, has embraced education, enforcement and engineering (three Es) to foster the aim of combating road traffic casualties. The government's programmes are evaluated in this chapter by discussing each of the three Es which can be seen as government's strategy to prevent traffic accidents (Safe Kids Canada 2004). The efforts of different government ministries, private organizations and other stakeholders are discussed under the National Road Safety Committee whose activities are appraised.

4.1 EDUCATION

Flaherty (1997: 309) defines road safety education as a “diverse range of activities, from early childhood road training to initial driver training (where a person is taught the basic repertoire of perceptual, motor and informational skills necessary to operate a vehicle safely) to attitude-changing programmes (which are intended to inform adult road users of the need to change existing dangerous practices, e.g. drinking and driving, speeding, not wearing seat belts, etc.)”. Such education in Botswana is the core responsibility of the Road Safety Division in the DRTS.

4.1.1 Children’s education

As a way of exposing young children to traffic safety education, the Road Safety Division has, through its Children’s Traffic Education Unit established a children’s traffic school. The traffic school was built in 1998 by courtesy of Shell Oil Botswana and UNICEF under the National Programme of Action for children (DRTS s.a.). The school caters for children from age one to fourteen. Children who are at the levels of pre-primary and primary school, including children with various disabilities in government and non-government schools, come to this school as day visitors. The school has one classroom and a small open-air town of roadways with traffic lights and signs. Children are taught the theory of road safety in the classroom and taken outside for practical lessons on the roadways. From 1998 to date 69 246 children have attended the lessons in the traffic school (Ministry of Works and Transport 2008).

Concerning the problems the Children’s Traffic Education Unit is experiencing, the Children’s Traffic Education Officer stated that parents do not educate their children on road safety, a view that shared by the Traffic School Teacher (Mange 2006, pers com; Motsamai 2006, pers com). The Children’s Traffic Education Officer explained that even if children are imbued with traffic safety knowledge, drivers do not obey road signs and hence they continue to put the lives of small children in danger (Motsamai 2006, pers com). Another problem mentioned by the officer is that at traffic school children are shown pedestrian facilities like pavements they can walk on, no such pedestrian facilities exist along the actual roadways they walk along (Motsamai 2006, pers com).

Traffic schools are being planned in Palapye, Francistown, Lobatse and Maun towns and, in addition, the department intends to provide mobile children’s road safety schools that will help take road safety programmes to the rural areas (DRTS s.a.). There are also plans to integrate road safety education into the formal school curriculum in order to cater for students aged 15 and older who are

at secondary school level (Motsamai 2006, pers com). To advance this plan there is someone in the National Road Safety Committee who represents the Ministry of Education Curriculum and Evaluation Department. The ultimate goal is to either infuse or integrate road safety across all levels of the curriculum. The schools are also being encouraged to form road safety clubs that will help to educate other children and promote educational campaigns in villages (DRTS s.a.).

4.1.2 Public education campaign

The DRTS employs public education campaigns to achieve the goal of changing the public's attitudes on the country's roads. The campaigns are directed at drivers, passengers and pedestrians. In Botswana a road safety day is usually commemorated on 7 December every year. This is the major day of the road safety campaign and is held on a rotational basis from one village or town to another. It is meant to give support to District Road Safety programmes and to take road safety to the people. This is the level at which the community and schoolchildren have the opportunity to participate in road safety campaigns. Some of the objectives of the National Road Safety Day campaigns, as stated in the DRTS website (www.transport.gov.bw), are:

- mobilize the whole nation to reflect on the tragic losses of human lives, hard-earned property, especially vehicles;
- sensitize road users on the hazards awaiting them on the roads during their journeys over the festive season;
- remember our loved ones, friends, relatives, colleagues, and countrymen who have met their untimely deaths on the roads; and
- mobilize, forge and renew our partnership with road users with a view of rededicating and recommitting ourselves to the cause of road safety and the pledge to reduce road casualties (DRTS s.a.).

The DRTS has also embarked on peak-period safety educational roadblocks after piloting them on national road A1 in 2003 (DRTS s.a.). Educational roadblocks are conducted during public holidays across the country on the national roads. Since their inception the roadblocks have gained popularity through media exposure as well as support from government departments and officials, parastatals and the private sector. The support is mostly in the form of human resources, finances, equipment and facilities that are needed to educate the road users on their way. The departments and companies send their people out to the roadblocks to assist with educating road users by targeting drivers especially (Figures 4.1 to 4.4). Information officers distribute road safety flyers, give talks, encourage the drivers to rest, and distribute water to the road users. Organizations and companies that have participated include the Motor Vehicle Accident Fund, Botswana Medical Aid

Society, Botswana Power Corporation, Shell Oil Botswana, MedRescue International, Net care 991, BP Oil Botswana and Barloworld (Botswana 2004).

Road safety educational campaigns in general and the roadblocks in particular have been successful in reducing road accident fatalities, as shown in Table 4.1. The Christmas/New Year festive season has always been characterized by high numbers of accidents and casualties, but the countrywide introduction of the educational and roadblock campaigns in 2004/2005 has dramatically reduced the absolute number of accidents, but not in relative terms (Botswana 2004). One trusts that the roadblocks were the reason for the reduction in fatalities.

Table 4.1 Results of Christmas/New Year traffic safety campaigns, 2001 to 2005.

Year	Number of accidents	Fatalities	Fatalities per accident
2001/2002	472	26	0.06
2002/2003	615	28	0.05
2003/2004	653	35	0.05
2004/2005	268	16	0.06
2001-2005	2008	105	0.05

Source: Botswana (2004)

Road education campaigns in Botswana, and other places in the world, are given themes which are meant to inspire road users to change their attitudes on the road. People participating in these campaigns usually wear T-shirts, caps and other paraphernalia, which send messages to the road users. The chosen themes are published in newspapers and displayed on billboards. The educational roadblock campaign themes as given to specific holidays in different years are listed in Table 4.2.

Table 4.2 Themes of public holidays roadblock campaigns in Botswana

Year	Holiday	Sub-theme
2003	Good Friday/Easter	Tiredness can kill, take a break
2004	Independence Day	Loose your speed, not your patience
2005	President's Day	Drive now talk later
2006	Good Friday/Easter	Be smart, think tyre safety

Source: Botswana (2004)

The DRTS is also working on improvements to driver training and testing as one of its priorities. The department has already designed a curriculum and some instructional materials for driving-school instructors to train learner drivers. The Driver Training Unit is working on capacity building for instructors. According to the Traffic Safety Officer of the Driver Training Unit, driver training is a pillar of road safety education and it must claim its rightful place and be well recognized as a potential solution to all traffic safety-related problems (Phalane 2006, pers com). He (Phalane 2006, pers com) reiterated that 80% of driving-school instructors in the country are not qualified. This confirms what Botswana (1996) notes that driving school instructors do not have to pass a proficiency test. Almost all the privately-owned driving-schools in Gaborone, and the country at large, operate outdoors under trees for their theory lessons and practicals. According to a Traffic Safety Officer, by concentrating on teaching children, pedestrians and passengers, the victims receive instructions while the “killers” (the drivers) are virtually ignored (Phalane 2006, pers com). He is advocating that drivers must be given driver training so that when they go onto the roads their attitudes will have been changed (Phalane 2006, pers com). His argument is that Botswana’s road safety education programmes are skewed away from driver training, yet it is the very backbone of road safety (Phalane 2006, pers com).



Source: DRTS (2006)

Figure 4.1 Former director of DRTS (right) and DRTS publicity and information campaign officer at a safety educational roadblock

4.2 ENFORCEMENT

Education alone cannot change the behaviour of road users: enforcement must be brought in to complement education. “Thus education programmes aimed at attitude-changing often have a secondary objective that of persuading the target audiences to accept the enforcement of related (possibly unpopular) legislation” (Flaherty 1997: 314). Enforcement is “actions taken to ensure compliance with the legislation” (Elvik & Vaa 2004: 1035). Enforcement must be able to deter the road users from ignoring certain road signs or violating regulations.

Enforcement in Botswana is intended to discourage road users from drinking and driving, driving unroadworthy vehicles, and unlicensed driving while encouraging the use of seat belts and complying with traffic signs and road regulations. The Botswana Traffic Police Division is faced with the enormous task of mounting roadblocks for inspecting vehicles, attending accidents, patrolling the roads and performing administrative tasks. In addition, the division is responsible for collecting data in the field and entering it into the central database system. All the junior police who were interviewed raised their concerns about lack of manpower and resources to do their work efficiently. When comparing their numbers with the workload in the field, it appears that the demands of traffic accidents are overextending them. They apply breathalysers tests and do blood testing in alcohol checks on drivers in the field. They also man speed traps and vehicle-mounted cameras along the major roads outside the city to encourage obedience of speed limits. Another complaint made by the officers in the field was about the accident report forms which take a long time to fill in and, moreover, they felt that some items in the form were repetition.

Since 2004 Botswana Police have established permanent roadblocks on the major roads leading in and out of Gaborone, specifically to reduce crime and for road safety purposes. They check vehicle licenses and roadworthiness. During the fieldwork the researcher observed that the officers at these permanent roadblocks are very busy on Friday and Saturday nights, while during the week the situation is more relaxed.

Police continuously inform road users during weekdays about the conditions of traffic on the roads in Gaborone and Francistown through the local radio and television stations. They inform drivers about traffic flows, accident locations and obstructions on the roads that might cause accidents. DRTS and Botswana Traffic Police are jointly managing the government’s National Traffic Management Information System through MAAP 5 which has been developed by the Transport Research Laboratory of the United Kingdom (Botswana Society 2003). MAAP 5 has made it

possible for the traffic police division to produce weekly statistics (national) on the number of accidents and casualties that occurred throughout the week. The Accident Analysis and Research Unit of the DRTS complements these by producing annual reports on traffic accidents for the country.



Source: DRTS (2006)

Figure 4.2 Road safety educationists in the field

During the interview with the police at the traffic accidents statistics office, the researcher realized that the police were using two different forms for collecting data. The one form was the original one that had been used for many years, while the other one was new, but had never been approved for use by the authorities. Most of the stations in the country were using the unauthorized form. The explanation given was that a consultancy company was given a tender to review the original form and on completing their review they printed the forms before submitting them for approval. The authorities later rejected the new forms. Since a lot of money had been used to print the forms, the police officers were forced to use them in order to use up the stock. The new form is more detailed, designed differently and does not bear the “Botswana Police” name and the “Traffic Accident Report Form” title.

The discrepancy between the two forms was mainly related to terms of references decided upon by the authorities and consultants. The original form has seven pages and the new form nine. Both forms have to be completed in triplicate. The new form has the advantage of being carbonated. The number of pages is inconsistent with forms used elsewhere, for example in India the forms range from two to four pages (Khan, Kathairi & Garib s.d.) but cover the same variables in the Botswana police forms. The Botswana accident record form (original) covers the following information:

- General information such as year, reference number, district, city/town/village, station, number of vehicles involved, number of drivers killed/injured, number of passengers killed/injured, number of pedestrians killed/injured, month of accident, date, hour and week of accident and severity;
- Location, which includes a sketch map of the accident, name of road, and site of significant buildings and landmarks;
- Particulars of vehicle: make and model, year of manufacture, registration number, vehicle manoeuvre and vehicle type;
- Road user (driver) which includes sex, age, driver injury (severity), seat belt worn, driver licence, drugs/alcohol suspected;
- Road user (passenger) which includes name and address, position in the vehicle i.e. front seat, or sitting/standing, passenger sex, age, seat belt worn, injury (severity) and nature of injury;
- Road user (pedestrian) which includes name and address, sex, age, injury (severity), alcohol suspected, nature of injury, pedestrian manoeuvre i.e. walking on road, crossing, school pupil; and
- Roadway environment, which includes traffic density, light, day/night, road curvature, slope, junction type, junction control, road construction, road surface type, surface quality, surface condition, slippery, collision type, and accident type i.e. urban or rural.

The use of two different forms may cause discrepancies in data collection. The data collected using unstandardized forms gives inaccurate information and the use of an unauthorized form may have negative impacts on enforcement should at-fault road users realize they are being charged on the grounds of an unlawful document.

In addition to education and law enforcement—which contribute to road safety awareness in general—it is necessary to focus on how engineering can be used to improve road safety in both the road geometry and the mechanics of the vehicle. The next section considers the last of the three Es, engineering.

4.3 ENGINEERING

According to Flaherty (1997: 316) engineering can be “generally used to refer to technological changes to the vehicle or to the roadway and its environs in order to improve road safety”. Engineering is a priority for the Department of Roads to improve road safety in Botswana.

It is important for engineers or road designers to respond in a reasonable time to fix traffic accident black spots on the road. Accident prevention and mitigation processes are referred as black spot improvement (Erdogan, Yilmaz, Baybura & Gullu 2008). The Department of Roads is working energetically to construct roads in the country’s rural and urban areas (Botswana Society 2003). There are quite a few roads in Gaborone which are currently under reconstruction as a way of fixing black spots on the roads. More lanes have been created, especially on exits from the City. Examples are Gaborone-Pilane highway and the Gaborone-Mogoditshane road. Traffic lights are being installed at strategic intersections and junctions in the city in order to regulate traffic better.



Source: DRTS (2006)

Figure 4.3 The Minister of Health (left) receiving road safety information



Source: DRTS (2006)

Figure 4.4 Roadside assistants waiting for a call from road users

The DRTS is also working on improving safety performance of public passenger and freight transport vehicles through four roadworthiness testing centres in Gaborone and other towns. Before a transport license can be issued, the vehicle must be tested roadworthiness. In addition, after an accident a vehicle (public or private) is taken to these testing centres where vehicle technicians determine whether the cause was mechanical or not. However, not every vehicle is sent to the centre for testing after an accident because sometimes those involved will agree to settle their disputes amicably and pay the fines. With public transport it depends on the severity of the accident whether the traffic police will send a vehicle for testing. More testing centres are planned to be built until 2009, which marks the end of National Development Plan 9 (DRTS s.a.).

Though government has put in place education, enforcement and engineering measures to fight the scourge of traffic accidents, there is also the National Road Safety Committee that sees to it that the three Es are used to promote road safety in the country.

4.4 NATIONAL ROAD SAFETY COMMITTEE (NRSC)

The NRSC consists of heads of departments representing departments in ministries in Gaborone. Its main aim is the promotion of traffic safety in Botswana with a mandate to do the following:

- closely consult traffic safety research in order to take appropriate action to promote traffic safety;
- undertake the collection of information in connection with traffic safety and make it available to authorities and persons concerned, and to the public in general;
- give guidance regarding traffic safety by means of organizing conferences, seminars, and lectures, and by means of the media and in any other manner deemed fit by the national committee; and
- consult with authorities and persons concerned in the road safety system in order to assist the minister in the coordination and activation of combating road accidents (DRTS s.a.).

The National Road Safety Committee is supported by District Road Safety Committees (DRSC) which operate in 28 main towns and villages (DRTS s.a.). The NRSC “is arguably one of the most successful in Africa and is very successful in terms of publicity and education initiatives” (Jacobs & Thomas 2000: 2). The main aim of DRSCs which are headed by District Commissioners, is the coordination of road safety within districts through the following initiatives:

- organize seminars, conferences and lectures from time to time;
- take every reasonable step to inform the public of road safety problems;
- maintain close liaison with schools in order to promote road safety awareness among schoolchildren; and
- carry out other functions as required by the National Road Safety Committees from time to time.

The DRSCs draw up their annual road safety plans and submit them to the national committee, which compiles an annual plan of action for the whole country. The national committee also approves funds to be used by the district committees. District committees usually compile annual reports of their activities and send them to the NRSC but the NRSC does not collate these reports into a national road safety committee report.

The researcher is convinced that Botswana’s road safety programmes are on the right track, except that implementation of the programmes needs to be stepped up. Government initiatives that deserve praise include:

- educational roadblocks which have brought hope to the country in fighting road casualties;
- children’s traffic school and the plans for building more of them in the country;

- the use of MAAP 5 for managing traffic accidents data;
- road construction in the country; and
- roadworthiness testing centres.

Road traffic casualties call for good preventative programmes with aggressive implementation. One of the objectives of the NRSC is to follow closely traffic safety research in order to take appropriate actions in promoting traffic safety. The researcher is concerned about the issue of road safety research in the country. The DRTS, NRSC and other stakeholders, including the University of Botswana, have roles to play to ensure that road safety research is carried out in the country. For the past ten years no road safety research has been done in the country. During the interview with DRTS, officials expressed concern that the Accident Analysis and Research Unit has not been doing any research (Motshegwe 2006, pers com; Phalane 2006, pers com), despite this deficiency having been pointed out in a consultancy report dated 1996 (Botswana 1996). Given the fact that the unit is managed by a single person who is also responsible for traffic accidents annual reports and other analyses that need to be done, it is clear that the work is too much for one officer. The programmes are not being implemented for lack of manpower. The DRTS and the Traffic Police Division are managing a traffic accidents database through MAAP 5 which is not fully operationalized due to a lack of qualified personnel. There is a need to supplement the database with road safety research. Research can provide authorities with information about what is happening on the ground and propose solutions to traffic accidents problems. However, the police database would be more helpful if it is managed through a geographic information system (GIS). GIS has the capability of holding a huge amount of data that can be stored, easily shared and managed (Erdogan, Yilmaz, Baybura & Gullu 2008). It is capable of providing graphic and non-graphic outputs from its data analyses (Erdogan, Yilmaz, Baybura & Gullu 2008). “GIS based accident information systems can identify relationships between spatial phenomena that are almost impossible to determine with non-spatial database” (Erdogan, Yilmaz, Baybura & Gullu 2008: 2).

Although road safety research was not a high priority obligation over the last ten years, government’s precautionary measures against traffic accidents show their commitment to reducing casualty numbers. But the courses of action taken are insufficient to achieve their objectives so that it is incumbent on government to review their programmes time and again to find new ways of improving and implementing them.

The chapter has outlined the counter measures that the government has put in place to prevent and mitigate traffic accident scourge. The government is using the three Es as a strategy which aims to reduce traffic casualties. The NRSC has been given a mandate to see to it that the three Es are

implemented in the country. The Chapter has also called upon the stakeholders to play their roles in road safety research. The next Chapter summarises the main finding of the research and to make recommendations.

CHAPTER 5 : CONCLUSION

5.1 SUMMARY OF FINDINGS

Urban planning in Gaborone has created conditions that have become cause of traffic accidents. Traffic circle intersections, though safe, cause severe traffic congestion at peak times, especially on Motsete Drive. This road was specifically designed by planners to reduce traffic pressure from the city centre (Nelson Mandela Drive and Segoditshane Drive) but, unfortunately, developments such as shopping centres were drawn to the road (Motsete Drive). This has resulted in increased traffic congestion on Motsete Drive, hence more accidents on the road. Lack of pedestrian facilities in the city has made it difficult for pedestrians to co-exist with the motor vehicles. Children going to and from school are forced to cross heavily congested roads so that child fatalities remain high.

The study focuses on traffic accidents in the years 2000 and 2005 and the statistics show a 15% increase of accidents between the two years. Interestingly, although accident numbers have increased, fatalities, severe and minor injuries have decreased. Property damage, however, has increased.

The road casualties among drivers are concentrated in the economically active age category and particularly in the 20-39 cohort. Driver casualties by gender for the 20-39 cohort show a high representation of males. This suggests that road safety programmes must be directed to the 20-39 category, especially to the males. The 20-39 age group is the young and inexperienced economically active group (Mupimpila 2008). Young and inexperience are variables characterized by risk behaviour (Espino, Hasselberg & Laflamme 2006) and in many cases these drivers are under the influence of alcohol and drugs (Botswana 2003a; Smink et al 2005; Vaez & Laflamme 2005).

Passenger casualties for the two years show that males and females are equally represented. However, fatalities among males are greater than for females. Young people (20-29) are the main victims of passenger casualties. Pedestrian casualty statistics for Gaborone shows that males are predominately involved in accidents. Their activities range from playing in the streets and walking to school for children to economic engagement like walking to work or buying and selling in town. Pedestrian accident analyses show a disturbingly high representation of children (under 15 years) as casualties. According to Odero (2004) children (under 15 years) often get injured as pedestrians, the main contributing factor in Gaborone being that children cross densely congested roads when going

to and from school. Their schools are located away from the main roads inside the residential areas, hence it is difficult for school managements to monitor road crossings through the use of scholar patrols. The 15-34 age group is highly represented in pedestrian casualties. Pedestrian casualties among the working group can be partly attributed to their exposure to alcohol and drugs (Botswana 2002, Oxley, Lenne & Corben 2006), and their engagement in economic activities that keep them on the streets like going to work, job seeking, buying and selling (Adesunkanmi, Oginni, Oyelami & Badru 2000).

Time analysis shows a concentration of accidents during the peak hours of reporting to and leaving from work as well as during lunchtime. The peak hours for accidents are 16:00-17:59, 06:00-07:59 and 12:00-13:59. City Managers have an opportunity to put measures in place to reduce accidents during these times. These peak accidents times are related to traffic congestion. Accidents also peak on certain days of the week (Fridays and Saturdays, followed by Mondays and Wednesdays). The weekend concentration of accidents demonstrates the social engagements of Gaboroneans in partying, drinking, weddings and joyriding. Interestingly, most of these weekend accidents take place at night when the level of law enforcement is low. The night-time and weekend accidents place high demands on emergency services when staffing levels in hospitals is low (Odero, Garner & Zwi 1997). The Gaborone temporal pattern of accidents occurrence should give planners an indication of when to provide more emergency services and measures to curb the increasing occurrences of accidents.

Privately-owned vehicles in Gaborone are the dominant mode of transport involved in traffic accidents. Motor cars are the leaders in accident involvement followed by pickups. Public transport vehicles account for less than 10% of the accidents. Human factors are the main causes of traffic accidents in Gaborone, driver/rider negligence being the leading culprit. The driver/rider negligence factor leads to more than two thirds of the fatalities. Drivers/riders mainly cause accidents in Gaborone through their negligent driving, following too close behind other vehicles, failure to comply with signs, and being under the influence of alcohol or drugs. The second leading cause of accidents after drivers/riders is unattended animals that roam the streets of the city. Pedestrians also cause accidents and, although their involvement is low, the accidents are often tragic or fatal. Clearly, educational programmes of road safety must be directed at the drivers/riders of private vehicles. It is also apparent that pedestrians must be subjected to road safety awareness programmes. This research has established that in 2005 at-fault pedestrians caused 264 accidents, which resulted in 20 fatalities. This means those pedestrians seem to fail to judge the traffic when crossing, do not always comply with traffic signs, and sometimes use the road while under

influence of drugs/alcohol. The children among them have poor judgement of the proximity of approaching vehicles.

Road accidents in Gaborone in 2000 showed a spatial concentration in the eastern and central parts, especially along Segoditshane Drive and Nelson Mandela Drive (Old Gaborone). Motsete Drive accounted for only 13% of the accidents in 2000 but by 2005 it had more than doubled to 32%. Graduated symbols show a concentration of accidents along the roads in eastern and central Gaborone in 2000 but by 2005 the symbols had grown in size in Motsete Drive in the west. Traffic accidents have migrated from eastern and central Gaborone to the western part of the city over a period of five years. This can be attributed to the creation of the Western bypass which was meant to reduce pressure on the city centre caused especially by long-distance vehicles, but the use of traffic roundabouts and infrastructural developments (shops and residential blocks) in the western part of the city have attracted more traffic and hence more accidents. The use of roundabouts on Motsete Drive has contributed immensely to slowing down traffic and hence more accidents. The roundabouts on the Motsete Drive cannot be replaced by traffic lights, since the road is the only one in the city with a high speed limit (80km/h) while for the rest it is 60km/h. This higher speed limit quite likely leads to more severe accidents. In this case interchanges might be suitable. According to Elvik & Vaa (2004: 309) an “interchange is an intersection whereby the primary traffic streams are segregated from each other by being placed on separate levels”. Interchanges might be more expensive but they are safe and they increase the speed of vehicles, while roundabouts are safe but reduce the speed of vehicles (Elvik & Vaa 2004), which is already a problem on the bypass road. There is a need for the government to treat the black spots, especially in the junctions and roundabouts of Motsete Drive, and also in the rest of the roads in the city.

This research concludes that the combination of human factors and roadway engineering factors is responsible for traffic accidents in Gaborone. However, the government’s road safety programmes are beginning to bear fruits as shown by the decrease in casualties. The total number of traffic accidents and the damage they cause show slight decreases but this could signify two possibilities, namely that the incidence of accidents is beginning to decrease in Gaborone or that it is just a temporary respite which may increase in the future.

5.2 LIMITATIONS OF THE STUDY

The traffic data used was retrieved from Botswana Police data, stored in MAAP 5. The data itself is limited to the capability of MAAP 5. MAAP 5 was only 50% operationalized as at 2007, so that it could not perform certain tasks deemed crucial for this study. The system could only link accident occurrences with location. It could not link location with the other accident attributes such as causes, driver, passenger, and pedestrian casualties. Therefore the spatial analysis is limited to location of accident occurrences. Had GIS technology been used as a system for data management by the police, the data would have been of better quality and it could have been used to create maps and show black spots based on other attributes such as accidents by age, gender or cause. For example, one would be able to tell the total number, age and gender of injured people at a certain location. In a GIS database management one can place a cursor on a certain accident location or black spot and all the accidents attributes (characteristics) of that area are shown.

Another limitation of MAAP 5 is that it only captures the accidents that occurred in the intersections because they (intersections) have coordinates; hence the data is geo-referenced. The location of accidents that occurred between the intersections (mid-blocks) could not be captured by the system, but were only captured, as accident attributes which are not linked to their place of occurrence. Hence this research only used the intersectional (accidents that occurred on junctions or traffic circles) data for the spatial analysis. The main reason why the location of accidents that took place on the road between the intersections is not been captured by MAAP 5 is that part of the road does not have coordinates and could not be geo-referenced. Having some parts of the road without coordinates (geocode) and the situation of missing accident data, mean that the data used in this research is limited as far as GIS analysis possibilities are concerned.

The data is also limited because in the temporal analysis time is divided into two-hour intervals instead of one hour as is normally used in traffic analysis. This problem is attributable to the source, namely MAAP 5.

5.3 RECOMMENDATIONS

In addition to what the government is already doing and plans to do about road safety, there is still much that can be done. Botswana is experiencing a major health problem that is HIV/AIDS. The government has developed good strategies to challenge this problem, some of which have been

borrowed from Botswana by the World Health Organization to be used in other countries. Moreover, the international community has praised the government HIV/AIDS's programmes. This research concludes that since road accidents are also a health problem, Botswana should use her experience to fight the accident carnage. Strategies suitable for road safety can be borrowed from HIV/AIDS programmes. This research recommends the following be done as ways to mitigate the traffic accident carnage:

1. There should be an independent coordinating agency just like National AIDS Coordinating Agency for HIV/AIDS with the responsibility of coordinating the implementation of road safety programmes and facilitating the activities of the role players.
2. There should be a national strategic framework for road safety that spells out the roles to be played by the stakeholders like different government departments, parastatals, the private sector, civic leaders and the communities. In this way everybody will be having a part that he or she is responsible for, and the coordination agency will be making sure that all these people are playing their part.
3. A recommendation made by the interviewees was that there should be some road safety non-governmental organization (NGO) to assist the government on road safety issues. There is currently no NGO specifically for this in the country. The NGO will also work with the community at the grass-roots level, hence encouraging ownership of road safety projects and activities. Botswana's neighbour, South Africa, has been actively involved with this for some years and some good case studies can be learnt from (Salida 1999; Vermaak 1999).
4. DRTS must seriously consider community initiatives and take them on board in planning road safety programmes. Community participation (bottom-up) should be a basic component of road safety programmes (Jacobs & Thomas 2000).
5. DRTS should find ways in which their research unit can be actively involved in road safety research in the country.
6. The traffic circles on the Western bypass in Gaborone should be replaced by interchanges to increase safety and reduce congestion.
7. A pedestrian bridge should be built across Motsete Drive at the Molapo Crossing shopping complex to allow free movement of pedestrians to and from the shops and to cater for the large number of people moving from blocks 5 and 6 to the popular Zion Christian Church across the road.
8. A road safety audit should be carried out in Gaborone and the whole country in order to establish the road safety conditions of the country.
9. The planning system must consider a situation whereby schoolchildren attend the schools in their localities instead of having to cross main roads to get to and from schools in other

areas. Schools should also use crossing guards and school safety patrols to assist children to cross the roads and to ensure monitoring of the traffic near schools (Safe Kids Canada 2004).

10. This research recommends that the Traffic Police Division and the DRTS get qualified staff who can fully use MAAP 5 technology. This will reduce some of the operational limitations that the technology currently has. They should also consider moving towards the use of GIS technology for their database management.

It is important that government takes up the issue of establishing a coordinating agency as a matter of urgency and empowers it to facilitate traffic accident programmes in a holistic approach. Town planners also should take traffic and safety stakeholders on board during their planning sessions because from this research it is clear that the roads geometry and the location of schools, shopping complexes and residential areas play crucial roles in the occurrence of traffic accidents. Structural planning of the city must be based on research if it is to address traffic accident problems.

5.4 FUTURE STUDIES

It is recommended that a similar study be carried out for the whole country. This research can be used as a baseline, given that very little has been done in the country concerning traffic accidents research.

It is imperative that developing countries should view traffic accidents as a man-made problem and as such it is preventable. Prevention and mitigation of traffic accidents should start at the planning stage of towns and cities. Planners in developing countries should not only consider motorized vehicles in their planning but should also cater for cyclists, pedestrians, passengers and children. More money should be directed to educational and infrastructural development which aid the road users rather than being used to help with recovery after accidents. As mentioned in the introductory Chapter, if no actions are taken to curb the rising number of traffic accidents it is feared that by 2020, traffic accidents will be the third leading contributor of diseases and injuries after heart diseases and major depressions. Social and economic implications of traffic accidents to developing countries cannot be over emphasized; it is incumbent on governments to come up with some initiatives with aggressive programmes to address traffic accidents.

[18 847 words]

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PERSONAL COMMUNICATIONS

Butale V 2006. Investigating Manager, Motor Vehicle Accident Fund. Interviewed on 16 June about traffic accidents in Gaborone.

Mange T 2006. Children's Traffic School Teacher. Interviewed on 4 July about children's traffic school.

Mokgethi B 2006. Principal Roads Engineer, Roads Department. Interviewed on 4 July about the status of roads and traffic volumes in Gaborone.

Mokgethisi Z 2006. District Officer (Economic Planning), Boteti Sub-district. Interviewed on 17 September about economic factors that encourage Batswana to buy vehicles in large numbers.

Motsamai L 2006. Children's Traffic Education Officer. Interviewed on 19 June about children's traffic school.

Motshegwe A 2006. Information, Publicity and Campaigns Officer. Interviewed on 5 July about traffic safety campaigns.

Phalane T 2006. Traffic Safety Officer, Driver Training Unit. Interviewed on 19 June about traffic accidents and driver training.

APPENDIX A: INTERVIEW SCHEDULE

What is the main cause of traffic accidents in Gaborone?

Is there any relationship between vehicle ownership and the number of accidents in Gaborone?

What is the impact of traffic accidents on the country's economy?

What is your view about Gaborone's road system in relation to traffic accidents?

What is the government doing to solve the problem of traffic accidents?

Is there any relationship between accidents and road design in Gaborone, especially the use of traffic circles as opposed to the use of traffic lights?

What is the severity of crashes involving drivers who were under the influence of alcohol?

What is the severity of accidents during off-peak and peak traffic times?

Are there any community initiatives to curb traffic accidents?

APPENDIX B: LIST OF INTERVIEWEES

1. Butale V: A Investigating Manager, Motor Vehicle Accident Fund
2. Dipate G: Road Traffic Statistics Officer and Traffic Officer (Botswana Traffic Police Division)
3. Koloi N: Transport Promotion (DRTS)
4. Mange T: Children's Traffic School Teacher
5. Mmutle M: Crash Analyst (DRTS)
6. Mokgethi B: Principal Roads Engineer, Roads Department.
7. Mokgethisi Z: District Officer (Economic Planning)
8. Monnane M: Economic Researcher (Botswana Institute for Development Policy Analysis)
9. Motsamai L: Children's Traffic Education Officer
10. Motshegwe A: Information, Publicity and Campaigns Officer (DRTS)
11. Phalane T: Traffic Safety Officer, Driver Training Unit
12. Sedodoma M: Road Traffic Statistics Officer and Traffic Officer (Botswana Traffic Police Division)