

UNIVERSITY OF GHANA

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

**A GEOGRAPHICAL APPRAISAL OF TRAFFIC CONGESTION AT THE
CENTRAL BUSINESS DISTRICT OF TAKORADI.**

BY

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN
PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
MPHIL GEOGRAPHY DEGREE.**

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DECLARATION

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DEDICATION

I dedicate this work to my precious wife and love Mrs. Mabel Abena Acheampong and also to my parents Mr and Mrs Acheampong and finally to my siblings. I'm very grateful for your assistance and encouragement.

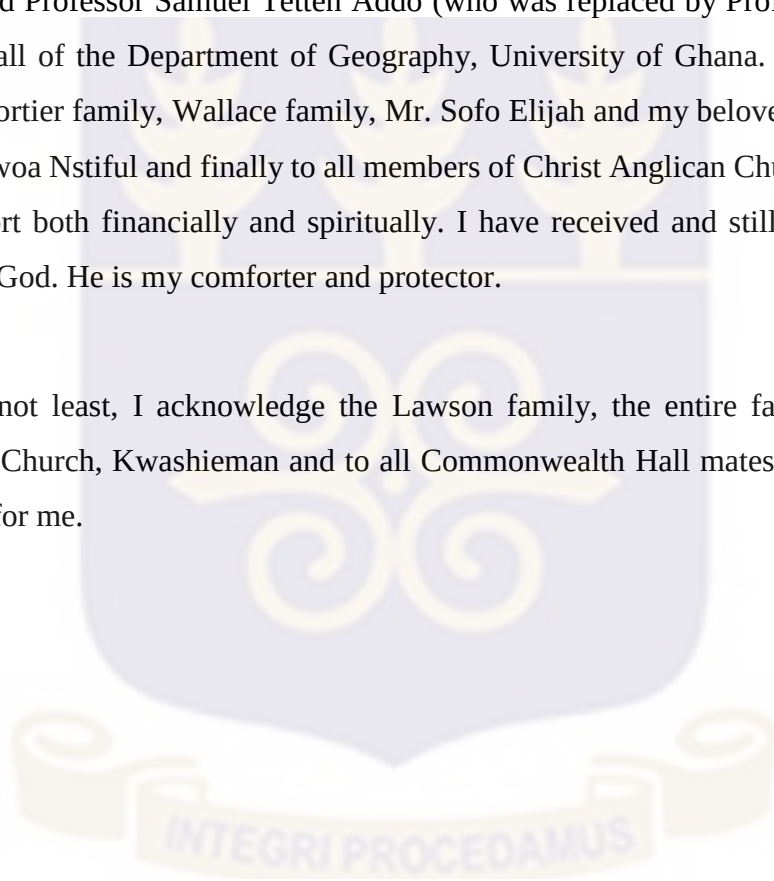


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ABSTRACT

Research has confirmed how transportation obviously helps to achieve economic growth, especially within cities all over the world (Hartegen & Fields, 2006). Due to improper planning and forecasting of cities' growth, however, traffic congestion has become the bane of socio-economic growth. This study sought to examine the socio-economic effects of traffic congestion in Takoradi, Ghana and among other things reviewed the geographical variations among five arterial roads in the city. Using questionnaire design, a semi-structured interview guide, as well as a camera to gather data and the Ullman Theory of Spatial Interaction to direct the theoretical basis of the study, the following key findings were made: The Kwame Nkrumah Circle-Market Circle corridor had the highest mean of 3.52 of perception of traffic severity out of the total of 13.8 recorded on all the five roads appraised in the study. The road with the least perception of congestion severity was however the Paa Grant Circle-Takoradi Polytechnic stretch with an average of 2.08. Furthermore, a significant relationship was found to exist among delays, increase in prices of goods and services, accidents, pollution and traffic congestion on corridors 5, 4, 1 and 2 respectively. To remedy the situation this study recommends measures such as the rehabilitation of the railway lines, the decongestion of the CBD, the regulation of infrastructure development, the expansion of the roads, as well as the regulation of the activities of 'trotro' and taxi drivers in the Metropolis. The recommended measures will not only help to mitigate the congestion but also ensure the smooth operation of socio-economic activities in the city of Takoradi.

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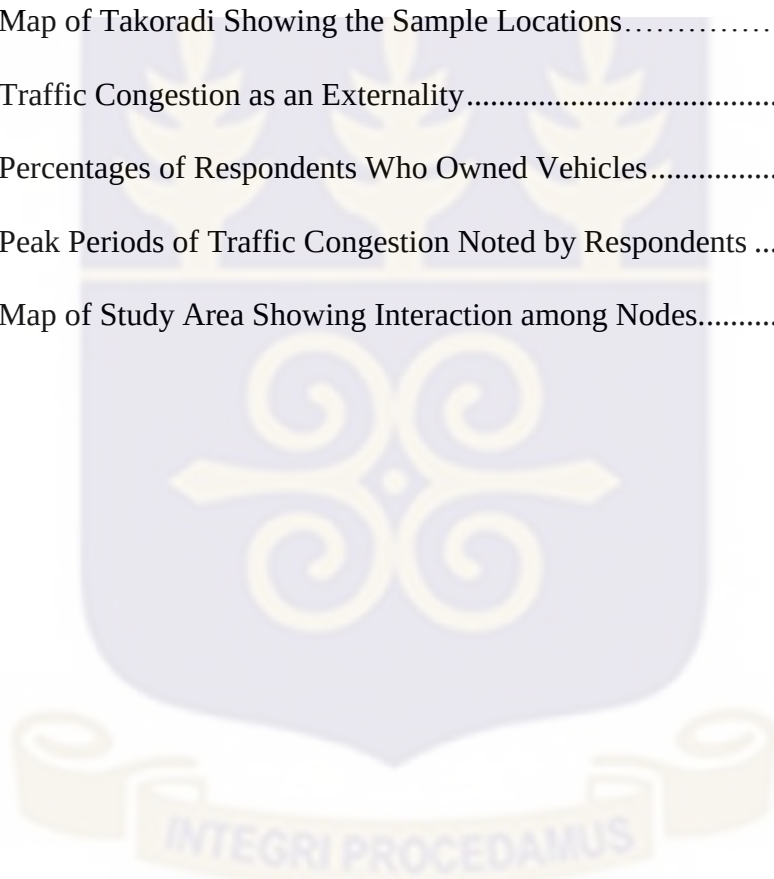
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CHAPTER ONE

INTRODUCTION

1.0 Introduction

This section of the study - that is Chapter One - is an overview of the whole thesis: it discusses the problem statement, research objectives, research questions, reasons for the study, limitations of the study apart from outlining the remaining chapters of the work.

1.1 Background of the Study

The dynamics of traffic congestion have been a delicate phenomenon, discussed in literature in recent times (Porter and Abane, 2008). This could be partly as a result of the hand-in-hand development of cities and traffic since the earliest large human settlements (European Conference of Ministers of Transport (ECMT), 2007). Today, most cities cannot do away with the continuous modeling of efficient ways to providing the urban centre the needed transport services since transport is the daily rhythm of life (Hoyle, 1988). Transport is therefore considered an essential feature of all modern economies. In general terms, as an economy grows and develops, it becomes more dependent upon its transport system, especially in the urban centres (Robinson and Bamford, 1978).

However, factors that attract inhabitants to the city centres sometimes lead to intolerable levels of traffic congestion on urban streets and thoroughfares, especially in developing countries. In particular, traffic engineers, transportation planners and public officials responsible for metropolitan transportation systems are frequently criticized for failing to make a dent in traffic congestion (Taylor, 2000; Victorian Competition and Efficiency Commission (VCEC), 2006). A question worth answering has been whether these

authorities are unable to identify the causes of such congestion in order to provide lasting solutions to them?

Adenle (1981) offers us a layman's answer to the causes of traffic congestion: to him traffic congestion in the urban centres is as a result of the fast growth and expansion of the population and area size of the urban centres respectively. The less privileged in society are compelled to migrate to the urban areas in search of greener pastures, that is, urban-based activities such as commerce, construction, manufacturing and general government presence become catalysts of urban centre growth, which in turn encourages and accelerate the tempo of rural-urban migration (Osoba, 2012).

The case of developing countries like Ghana becomes more pronounced as inhabitants of the urban centres refuse to abide by laws that restrict them from the use of the edges of roads as places of petty trading (Ministry of Road and Highways, 2010). This is a major characteristic of the Central Business Districts (CBD) in the country and Takoradi is no exception. The CBD of Takoradi is less congested with traffic compared to Accra and Kumasi (Sekondi Takoradi Metropolitan Assembly (STMA), 2012). The Kumasi Metropolis has a population of 2,035,064 and is rated the most highly populated urban centre in Ghana, followed by the Accra Metropolis with a population of 1,848,614 and the Sekondi-Takoradi Metropolis with 559,548 (Ghana Statistical Service (GSS), 2012). However, the population density of Accra (1,236) is far higher than that of Kumasi (196), signifying a higher probable congestion level with respect to traffic on the roads in Accra than in Kumasi (Grants and Yankson, 2003). Takoradi's population density is 99, hence that Metropolis comes third in the ratings by the GSS (2012) of the most congested urban centres in Ghana.

Nonetheless, due to the growth in natural population, increase in job opportunities particularly due to the oil find at Cape Three Points and other land use (especially in the Central Market and Harbour areas), people from all walks of life are attracted to the city of Takoradi. Thus the challenges confronting the larger cities are also manifest in the centre of Takoradi's business district (Ministry of Energy and Petroleum, 2014).

The argument has always been about whether or not traffic congestion is a necessary evil since it is an inevitable by-product of vibrant, successful cities, and hence the need to view the "congestion problem" in a different light. Conventional wisdom holds that traffic congestion exacts a terrible social and economic toll on society; therefore expanding transportation capacity may only make things worse; and redesigning cities and expanding alternative transportation modes may also offer the best long-term means for reducing traffic congestion (Taylor, 1999). In sum, as a result of the lack of a clear-cut consensus on the challenges of traffic congestion, this study sought to provide a geographical appraisal of the effects of traffic congestion on socio-economic activities aforementioned in the City of Takoradi.

1.2 Problem Statement

Takoradi is located within the Western Region of Ghana; its geographical coordinates are 4° 53' 0" North, 1° 45' 0" West. The city is separated from a second city called Sekondi by approximately eight kilometres and for this reason the two cities are mostly referred to as Sekondi-Takoradi (STMA, 2013; Amoyaw, 1999). With the oil find in the Western Region and booming economic activities such as banking, port and trading activities, the need for a vibrant transport services provision had become inevitable (Ghana News Agency, 2012; Asomaning, 2010). This assertion which also agrees with the argument made by Pacione,

(2005), is consistent with statement made by Sekondi-Takoradi Metropolitan Assembly in a report in 2011 that Takoradi's transport services is the fuel for growth, expansion and smooth operation of the economic activities within the Metropolis (STMA, 2013).

Presently, however, Takoradi is faced with undesired traffic congestion due to the lack of efficient spatial planning and forecasting of the City's growth and performance (Ghana News Agency (GNA), 2012). This is particularly true for most cities in Ghana, notably Accra and Kumasi due to the failure by governments to implement policies and programmes to mitigate urban traffic congestion (Addo, 2002, p.5). Furthermore, the Department of Urban Roads (2010: cited in a report by the STMA, 2013 p.44) stated that, Takoradi over the years has experienced tremendous increase in the volume of road traffic especially in the CBD. For instance in their study of '*Vehicular Traffic in Sekondi-Takoradi*' based on some selected arterial roads in Takoradi Mahama et al (2013) found that road traffic in Takoradi generally experienced a positive growth rate of **1.51%** between the years 2003 and 2008.

Moreover, increase in traffic is also partly due to the percentage increase in the population and number of driving persons in the Metropolis (STMA, 2010). The City experienced a 9.45% increase in population from the year 2000 to 2010 as compared to the 3.5% increase from 1970-1984 (STMA, 2013). Furthermore, according to the Ministry of Energy and Petroleum other factors that cause traffic congestion in the city include competition among different service industries that depend solely on the road transport services in the city.

Such service industries comprise catering, hospitality, logistics supplies, freight forwarding, fabrication and waste management services. Joint use of the roads by large

and smaller vehicular trucks and inadequate space at the terminals in the city make commercial vehicles park along the roads, thereby making it difficult for traffic to flow. Finally, expansion of the service industries without the provision of car parks, also leads to delays in traffic (Adams, 2014 cited in GNA, 2014). Owing to the increase in traffic congestion, socio-economic activities within the city are negatively affected, resulting in a decrease in total economic output of the city (Sekondi Takoradi Medium Development Plan (STMDP), 2011).

The study is also based on the fact that most studies on urban transport in the world are usually centered on topics such as urban transport and travel behaviour (Dissanayake & Morikawa, 2008); pollution (Atash, 2007); regulation and management (Sohail et al., 2004); motorization policies (Willoughby, 2001) and congestion (Daganzo & Cassidy, 2008) with little attention on the effects of congestion on cities' growth and performance, especially in developing countries. For instance, in Ghana, there had been studies on themes such as problems and solutions to urban transport (Addo, 2002; Oppong, 2000), bus rapid transit system (Agyemang, 2009), vehicular traffic congestion (Mahama et al, 2013), transport and land use (Yankson and Grant, 2002: Asiedu and Agyemang: cited in Okoye, 2010) and road safety (Agyemang, 2009) with most of them conducted in Accra the capital of the country.

Again other studies which even centered on Takoradi such as *Sustainable Urban Development in Africa, The Case of Urban Transit in Sekondi-Takoradi, Ghana* by Obeng-Odoom (2015) tackled the reason for the shift from rail usage as the preferred mode of transport to road transport, and found that the road transport sector provides employment for a large number of people, both directly and indirectly. That study, however, failed to

link transport development in Takoradi to the city's socio-economic activities. Accordingly, Tsey (2013) stated that even though railway development brought considerable relief to labour and head porters in particular in Takoradi, it was never intended to ensure harmonious development hence the challenges in Takoradi today. It is therefore prudent to investigate how growth in the use of road transport as the main mode of transport in Takoradi influences socio-economic activities in the city since the activities are directly linked to the provision and use of transport services.

The study therefore sought to examine the effects of the increase in traffic congestion on socio-economic activities namely: work, transportation, education, health, religious activities and recreation in the metropolis.

1.3 Objectives

The main objective of the study is to provide an appraisal of the effects of traffic congestion in Takoradi. The following specific objectives are examined:

1. To examine variations of the traffic situation on five (5) major corridors in Takoradi.
2. To examine the effects of the traffic congestion on socio-economic activities in Takoradi.
3. To examine measures taken to mitigate the challenges posed by traffic congestion in Takoradi.

1.4 Hypothesis

There is a high significant relationship between severity of traffic congestion and socio-economic activities, namely, work, transportation, education, health, religious activities and recreation in Takoradi.

1.5 Justification of the Study

Takoradi used to be preferred to its twin-city Sekondi because of the vibrancy of economic activities in the former, compared to the latter (Amoyaw, 1999). That is, according to Addo, (2006), in his study entitled, '*Geography, Transport and Development, A Spatial Trinity*' the city of Takoradi is one of the most significant urban centres in Ghana due to its strategic location as a transit point to the north, south, central and western parts of Ghana, which makes it prone to traffic congestion (Addo, 2006). Until 1928, Sekondi was the main centre of port and trade activity in the Western region of Ghana, making its economy a vibrant one and a basis for its growth.

However, after the 1st World War, Sekondi lost its port and other functions to Takoradi. For instance, expansion of activities at the Market Circle and other services notably, banking, transport services, commerce and the construction of the Takoradi Harbour by Governor Guggisberg in 1928 has ever since affected the growth of Sekondi. Many people have been attracted to Takoradi City for obvious reasons. For instance, the population of Sekondi was 26,417 and higher than Takoradi (17,327) before 1960 but the trend changed after 1960 and since then Sekondi's population growth has been slower while Takoradi's continues to increase at a faster rate. Takoradi's population for instance, increased from 58,161 in 1970 to 61,484 in 1984, while Sekondi's decreased from 33,713 in 1970 to 31,916 in 1984, (Addo, 1994). The current population of Sekondi is 76,388 while Takoradi is 94,096 (Ghana Statistical Service, 2012).

Apart from the natural growth of the population of the city, there is a significant increase in employment of both Ghanaians and expatriates, who have added to the traffic volumes

on the streets of the city (The Chronicle, 2016; Obeng-Odoom, 2015). Additionally, Takoradi plays a vital role in the development process of Ghana due to the presence of a relatively large CBD and the harbour. It must however be noted that the Sekondi township interacts so much with Takoradi to the extent that the two cities have being named the twin-city hence have become inseparable of each other (Obeng-Odoom, 2015). For instance, Sekondi performs most of the administrative functions while Takoradi is noted as the hub of economic activities in the region.

Furthermore, this study also followed from the call made by the Director General of the Ghana Ports and Harbours Authority, Mr. Richard Anamoo on the 28th of November 2012 when an Irish delegation from the Department of Foreign Affairs and Trade visited the Port of Tema. Mr Anamoo mentioned the need for expansion works on the port of Tema and Takoradi as well as the roads in the cities where the harbours are located. The end was to provide optimum transport services on the roads in the two cities (Tema and Takoradi) particularly in Takoradi, to deal with the increasing volumes of traffic in the city. The study also sought to build on and fill the gap left in the study conducted by Mahama et al (2013) on vehicular traffic count in Takoradi. That is, based on the evidence of traffic volumes in the city this paper goes further to identify its effects and measures to mitigate challenges faced by residents in the city.

The choice of socio-economic activities examined is also informed by the argument made by Harten and Fields (2009) in their study entitled, '*The Effects of Traffic Congestion on Regional Economic Performance*' in which they stated that traffic congestion affects cities' economic growth in all activities of endeavour, namely, religious, economic, political, and social activities. For this reason this study selected at least one indicator of each of the

activities they mentioned in their work. Also, due to constraints in time to finish the study, only six of the said indicators were examined. They include: work, transportation, education, health and environment, recreation and religious activities. Findings from the study are therefore meant to add to the body of knowledge and literature as well as serve as background research information for city authorities including the Department of Urban Roads, Sekondi Takoradi Metropolitan Assembly (STMA), local government and other institutions, which are committed to finding measures to mitigate the ever growing traffic congestion in the metropolis.

1.6 Limitation of the Study

One major limitation of the study is the fact that not all activities influenced by traffic congestion on the roads in Takoradi were studied. Some few ones which are categorized under socio-economic activities were examined. The choice of socio-economic activities investigated in the study, however, follows from the fact that not all identifiable socio-economic activities could be studied due to time constraints. Due to the limited period within which the study was conducted it was impossible to examine other associated issues with transport at Takoradi. A typical example is infrastructure development, fuel consumption and income of commuters. As a result of this limitation, the study proposes a further enquiry into the effects of traffic congestion, where other effects such as the portion of income lost to such congestion could be examined.

1.7 Organization of Chapters

The study is organized into five chapters. Chapter One provides a general background of the study. It discusses reasons for the research: statement of the problem, objective of the study, specific research questions, justification of the study and the limitation of the study.

This chapter also outlines the organization of the remaining chapters of the study as follows:

Chapter Two reviews relevant literature on the dynamics of traffic congestion. Specific discussion centers on themes such as the definition of traffic congestion, trends in traffic congestion in the world, Africa, Ghana and Takoradi. The chapter also reviews causes and effects of traffic congestion in Takoradi. Chapter Two ends with the theoretical and conceptual framework that guided the study.

Chapter Three is devoted to the profile of the study area and the research methodology used. The profile of the study area-includes the geographical location and size of the study area, discusses the sources and techniques population growth and economic characteristics of Takoradi while the methodology used in collecting and analyzing data gathered from the field.

Chapter Four presents findings from the data gathered. Specifically, the chapter outlines the socio-demographic characteristics of the respondents, variations of traffic congestion in the metropolis, effects of the traffic congestion and measures taken to remedy the situation.

The last chapter, Chapter Five is devoted to the summary, conclusion and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW AND THEORY

2.0 Introduction

This chapter discusses the trends in traffic congestion at the global level as well as in Africa, Ghana and the City of Takoradi in Ghana. The causes of and ways to mitigate traffic congestion and its negative effects on socio-economic activities are also discussed. As regards the theoretical framework, the study uses the Ullman (1980), theory of spatial interaction as its main theoretical basis. The final part of this chapter presents a conceptual framework which outlines the factors that cause interaction among nodes in a transport system as well as causes of road traffic congestion.

2.1 Trends of Traffic Congestion

2.1.1 Dimensions of Traffic at the Global level

As the world becomes increasingly urban, densely populated areas are faced with dramatic and seemingly intractable transportation issues. Fifty percent of the global population already lives in cities and, according to the United Nations (2012), this number will approach 70 percent in the next 40 years. If current trends continue, people's reliance on cars will only increase, particularly in emerging markets (UN, 2012). As people become more affluent, the number of vehicles on the road worldwide will triple, to as many as 3 billion by 2035, according to the UN (2012).

A good deal of this increase will be due to magnified urban sprawl (urban sprawl or suburban sprawl describes the expansion of human populations away from central urban areas into high density, mono-functional and usually car-dependent communities). Many already overcrowded cities will not be able to simply build-up to accommodate new

residents, so they will have to stretch their borders and build-out. Statistics shows that cities like Istanbul, Mexico City, Rio de Janeiro, Moscow and Salvador are the most congested places in the world. The rating of the top 10 most traffic congested cities according to a TomTom International survey (2014) showed no city in Africa. African cities, however, also experience huge traffic congestion on the roads. The 10 most congested cities in the world in 2014 are shown in Table 1.

Istanbul topped the chart with 58% while Los Angeles emerged the tenth and last with 39%. Most countries in the West experience high traffic congestion due to the high rate of industrialization, particularly in the cities.

Table 1: Ranking of the 10 Most Traffic Congested Cities in the World

World Rank	Filter Rank	City	Country	Congestion Level
1	1	Istanbul	Turkey	58%
2	2	Mexico City	Mexico	55%
3	3	Rio de Janeiro	Brazil	51%
4	4	Moscow	Russia	50%
5	5	Salvador	Brazil	46%
6	6	Recife	Brazil	45%
7	7	Saint Petersburg	Russia	44%
8	8	Bucharest	Romania	41%
9	9	Warsaw	Poland	40%
10	10	Los Angeles	United States	39%

Source: TomTom International BV (2014).

In other words, levels of traffic congestion in countries like Turkey, Romania, United Kingdom, Australia, USA, Brazil and others are higher, compared to the congestion levels of most African and Asian countries due to the higher levels of industrialization and other socio-economic activities in the more advanced countries. However, according to Downs (2004) more advanced countries like America do experience high traffic congestion levels

yet are better off in terms of management of the situation than the developing countries. The fragile roads in the developing world, particularly Africa are “simply not the best and hence cannot be compared to those in the developed countries” (Addo, 2002).

Furthermore, most researchers’ works corroborate global trends showing the evening rush hour is the most congested time of day, with bottlenecks nearly doubling journey times (Cortright, 2014) over such time periods (Cortright, 2014). For instance, in 2014, the average commuter spent an extra 100 hours a year travelling during the rush hour. According to Palma and Lindsey (2002), congestion levels have increased everywhere in the world during peak hours with three major reasons accounting for the increase. These include: variation in demand for road usage, relatively fixed supply of transport services and unsustainable transport services provision. Another trend observed by Addison (2012) is that congestion levels on non-highways are remarkably higher than on highways, resulting in commuters spending up to 11 days per year sitting in traffic especially during peak periods which the Mentro Denver Economic Development Corporation (2007) described as congestion occurring daily, weekly and seasonally.

The rankings of the most congested cities in the world as indicated by the circles in figure 3 by TomTom industry, however, are not consistent with what Cortright thinks they should be. That is, to Cortright (2014), the measure of congestion worldwide is not accurate. He made this statement "I take these ratings with a very large dose of salt because I don't think they're terribly accurate". In the rankings, Vancouver was rated the 20th most congested city in the world and the most congested in Canada, followed by Toronto, Ottawa and Montreal. The rankings used the GPS devices to measure how long it takes commuters to travel a route during the rush hour, compared to the time of the trip when there is no traffic,

which Cortright (2014), said limits the sample. Another problem with the data is it uses percentages to measure congestion, meaning an increased time for a short trip accounts for a larger percentage than a longer drive. This brings to our minds the numerous methods of measuring traffic congestion, among which some are preferred to others. However, the measure by TomTom in 2014 if not accurate at all gives us some spatial information of traffic congested places in the world.

2.1.2 Trends of Traffic Congestion in Africa

In Africa, Cape Town in South Africa is considered the most highly congested city with regards to traffic flow. Locally, Cape Town has an average of commute taking 72% longer than anywhere else in the country. Remarkably, however, in the TomTom global rankings Cape Town appears at a distant 55, with Johannesburg, whose commuters spend up to 59% of their commuting time in congestion, coming at a farther 77 Cities like Bleomfontein, East London, Durban and Johannesburg follow respectively (TomTom International BV, 2014).

The case of West Africa is rather appalling as the roads are mostly not motorable. Nigeria for instance has its major cities Lagos and Abuja also highly congested, however the dynamics of the effects of road traffic congestion in

Sub-Saharan Africa to a larger extent can be attributed not only to natural causes but also to mismanagement and poor planning. The greater number of people within the tropics (including Ghana and Nigeria) prefer to live in the cities and these areas have so many challenges with forecasting of city growth and functioning that the emerging populations find themselves ‘locked-up’ in traffic whenever they use the road (Chakwizira et al, 2014).

Evidence of increase in the number of vehicles, stated in the report, Statistical Indicators of Public Transport Performance in Africa by the African Association of Public Transport (UATP, 2010) showed that there are approximately 194.81 cars per every km square of urbanized centre in Africa. Increase in vehicle population and other factors such as inadequate transportation system, rising unplanned retail activities, economic mismanagement and others according to Mahama (2013), hamper economic activities and create hindrances for development in most parts of Africa.

2.1.3 Situation of Traffic Congestion in Ghana

The vehicle population ratio in Ghana grew steadily from 31 vehicles per 1,000 populations in 2002, to about 44 vehicles per 1,000 populations in 2008 (Addison, 2012). It is also estimated by Addison (2012) that, Accra has the highest number of registered vehicles of 605,739 followed by Tema 256,956 and Kumasi 200,116 as at March 2012. The total number of registered vehicles in Ghana as at March 2012 stood at approximately 1,425,900. In the year 2013, however, the number of vehicles on roads in the country increased by nearly 23 percent between January and December, (MoT, July, 2014).

Unfortunately, however, the expenditure of the Government of Ghana to cater for the increase in vehicle importations (as shown by the Government's allocation to the Ministry of Road and Highways) was down by GH¢200million in 2013. In 2014, the number of vehicles registered by the Driver and Vehicle Licensing Authority (DVLA) was 174, 234, which was 22.86% higher than the previous year's figure. At the same time the DVLA inspected about 946,284 vehicles for road-worthiness in 2014, which brings the total vehicle population in the country to nearly a million, with concentration again in the two

biggest cities, Accra and Kumasi (GSS, 2012). Plate 1 gives us a pictorial impression of how traffic congestion is consuming the newly constructed major corridors in the country particularly in Accra. The N1 road at the Tetteh Quarshie inter-change from Lapaz today becomes very difficult to access during evening peak period from 4:00pm to 8:00pm. Other major inter-changes like the Circle interchange in Accra also experience similar situations (MoT, 2011).



Source: Business and Financial Times (2013).

Plate 1: Picture of the Tetteh-Quashie Interchange (Circle) to East Legon Road in Accra congested in the evening around 5:00pm.

The Government's resource allocation to the Ministry of Roads and Highways reduced again by 22 percent that is from about GH¢907 million to GH¢706 million in the year 2014, drawing concerns about efforts to reduce congestion on the roads and employee-stress arising out of traffic congestion. Studies have shown that traffic congestion and poor transportation systems are the top causes of stress and declining productivity among Ghanaian employees. "No business wants employees turning up to work already exhausted

and stressed out, unable to function properly during the working day,” (Business and Financial Times, June, 2012).

2.1.4 The Case of Takoradi

Takoradi being the largest and most vibrant city in the Western Region of Ghana benefitted enormously from the establishment of a port and railway lines. The railway system, once constructed, enjoyed considerable support from Ghana’s first president, Dr Kwame Nkrumah after Ghana gained independence (1957-1966) but things changed during the 1970s (Tsey, 2013). The use of vehicles has ever since remained the main means of transportation in the city. This has been due to several factors, notably the influence of the colonial authorities. For instance, the railway lines were built in Southern Ghana, focusing on centres of resource abundance, and not in the drier, resource-scarce northern parts of the country. Thus, the railway lines were never intended to promote uniform development (Tsey, 2013).

Furthermore, according to Obeng-Odoom, (2014, p. 428) “the political elite oversaw an overt, systematic program to reduce the vibrancy of rail sector, following a series of railway worker strikes. As the sector became a nuisance to successive governments, it no longer attracted sufficient central support and local governments were unable to fund the railroads. The 1980s witnessed a new approach to Ghana’s development problems, identifying State managerial inefficiencies at the core and hence the need to adopt private sector management to enhance economic vitality. Such investment in the railways did not materialize; nonetheless, the political class continued to pay lip service to revamping the rail sector”.

The automobile alternative on the other hand, from its beginning was encouraged as a more viable transport mode and symbol of modernity. The first road was completed in 1895 and the first car arrived in 1902 (Ministry of Education, 1991). Today, most goods such as manganese and bauxite which used to be transported by rail are now transported by road and the situation is putting pressure on the already fragile roads, besides the increased accidents involving such vehicles (Ghana News Agency, 2012; Assomaning, 2010). In fact Ghana's quest for more roads in its cities at the expense of salvaging the rail sector finds expression in the modernist theory of economic growth which argues for medium-term growth with maximum returns. The World Bank (1994) report stated that the return on newly constructed roads (29%) was far higher than rail (20%). As a result the World Bank recommended that the management of rail should be left to market forces, with support to road construction and maintenance done by government (Obeng-Odoom, 2014).



Source: Author's Construct, (2015).

Plate 2: Road around the Market Circle, in Takoradi with Traders jostling for Space with parked Vehicles.

The streets in the city of Takoradi are also old, and only functioned optimally back in the 19th century. Other factors that account for the worsening traffic situation in Takoradi, according to Armah, (2012), cited in a Ghana News Agency report (2012), include “the oil find, which is attracting several people to the city, the presence of the harbour, which serves as a transit for the export and import of goods [as well as a market-place for the] services rendered by the banks, traders, manufacturing and construction firms and finally transport terminals such as Accra and Takoradi Stations”.

2.2 Causes of Traffic Congestion

The causes of congestion are numerous. Among such causes include: “too many vehicles, land use patterns, employment patterns, income levels, car ownership trend, infrastructure investment, regional economic dynamics. In the view of Taylor (2000), causal factors of congestion can be categorized into two, namely, micro and macro or recurrent and non-recurrent. Micro-level factors are those that relate to traffic on the road and macro-level factors those that relate to overall demand for road use (ECMT, 2007, p. 14). Recurrent factors occur when demand for road transport approaches the technical maximum capacity on a link or in the network and non-recurrent factors are unexpected, unplanned or large events (e.g. road works, crashes, special events and so on) and cannot be easily predicted.

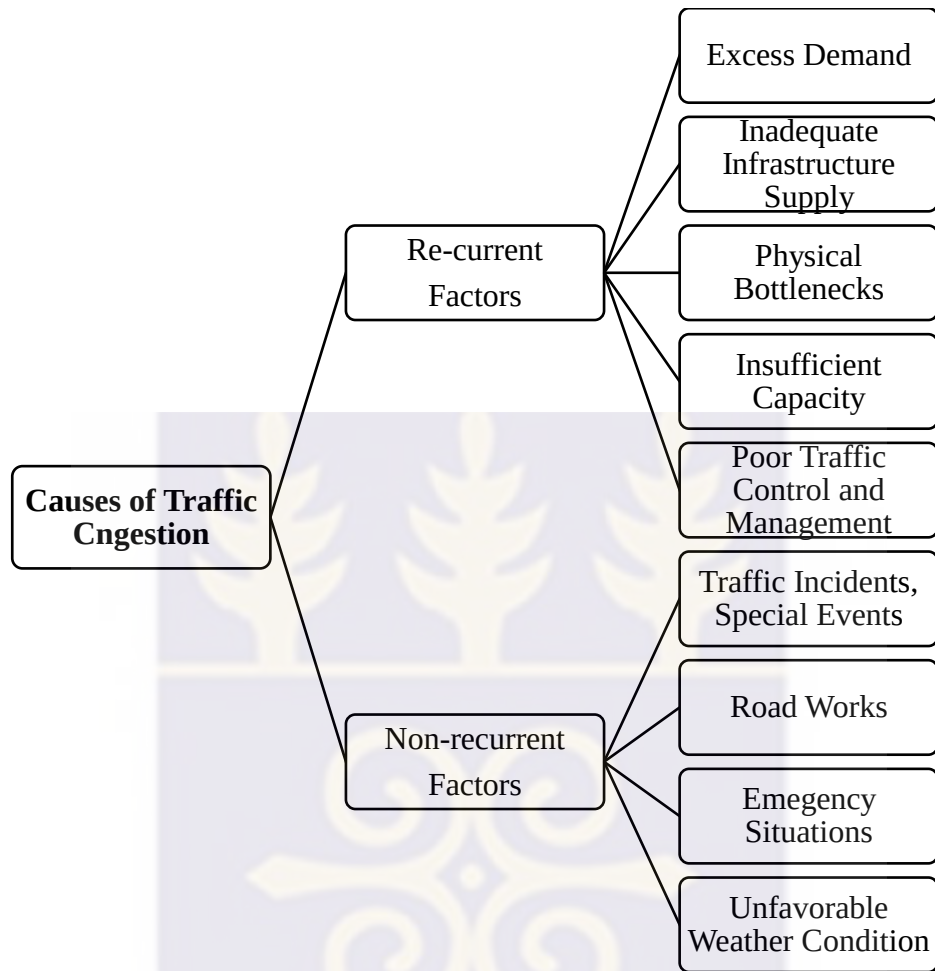
According to the engineering theory of traffic congestion, congestion could be caused by obstruction, or the inefficient use of the roads (Thomson, 1998, p. 94). Hon (2005, p. 19) agreed with Taylor (2000), on the basis that the causes of traffic congestion can be grouped into recurrent and non-recurrent causes. To Hon (2005), the recurrent factors include excess demand for travel and shortage of infrastructure supply whereas non-recurrent causes include unexpected events such as accidents or other emergency events.

Hon (2005) further identified some causes which further raise the demand for roads. These include population and economic growth, desire to travel by private vehicle, unawareness of the full costs of driving, influence of land use pattern and concentration of work trips in time. Lack of investment in transport infrastructure and reduction of road space due to road construction and maintenance are two other identified factors which are some of the leading causes of the shortage of transport infrastructure supply. Hon also mentioned that improper traffic controls and management represent intervention failure and are considered as two of the major causes of traffic congestion.

Furthermore, the Department of Transportation, United States (2005, pp.1-2) also explained that, congestion is the result of seven root causes. These seven sources as illustrated in Figure 1 can be grouped into three broad categories, namely: traffic influencing events, traffic demand and physical highway features. Traffic influencing events include traffic incidents, work zones and poor weather conditions. Vehicular crashes, breakdowns, debris in travel lanes, events occurring on the shoulder of the road or roadside are few examples of traffic incidents. Construction activities on roadways also impede visibility with their road signs.

Bright sunlight on the horizon, the presence of fog or smoke, wet, snowy or icy roadways are examples of poor weather. High traffic demand may be caused by fluctuations in normal traffic such as day-to-day variability in demand and special events such as football tournaments. These may increase the congestion in the surrounding streets of the stadium. Physical highway features include poor traffic control devices and physical bottlenecks (capacity) of the road (Taylor, 2000).

Figure 1: A Diagrammatic Represent of the Causes of Traffic Congestion



Source: Modified from Taylor (2000).

2.3 Socio-Economic Effects of Traffic Congestion

A. Economic Effects

2.3.1 Work

Traffic congestion affects work in many ways. A typical example is labour productivity since productivity deals with the ratio of volume measure of output to the volume measure of input and input of labour. This is further directly related to the supply of labour (OECD, 2006), implying traffic congestion which reduces man hours needed to work further

reduces the ability of labour to provide optimum input to yield an equal output. Nadiri (1996) & Takyi et al (2013), agrees with the statement that, productivity is an investment by a State in transportation while output is the gross domestic product (GDP). For instance, a study by Metro Denver Economic Corporation showed that in Metro Denver, Mountain Resort Region, Colorado, a 0.5% decrease in man's productivity due to congestion resulted in a \$728 million decrease in national GDP (Development Research Partners, 2007). A State that invests efficiently in transportation will therefore ensure adequate supply of labour.

Furthermore, road traffic congestion affects the ease to distribute goods and services within the city. In other words, congestion impairs people's free movement and therefore affects a wide range of activities such as the distribution of goods and services and market opportunities in the cities, which can best be delivered through transport mobility (May and Marsden, 2011). Congestion further reduces productivity through increased inventory holding by manufacturers and retailers as a result of unreliable travel conditions within cities. This is because business activities depend on the timely delivery of logistics, but productivity in most cases is hindered by the delay in the delivery of freight. Weisbrod et al (2003), concurred with the statement by proposing that increased traffic congestion leads to higher costs incurred by commuters and thereby negatively affects business operations.

2.3.2 Transportation

Transportation as an activity is affected in many ways however for the purpose of this study the cost of transport caused by congestion is examined. This is mainly as a result of the fact that, whatever the effects of congestion may be they can be expressed in monetary or cost terms. For instance it is estimated by the Development Research Partners (2007) that the

Mountain Resort Region in Colorado lost a total of 85% of its revenue in 2005 due to time lost to congestion. More often than not the impact on the travelers (the added time) as well as the increase costs of vehicle operators (fuel and spare parts) are the key components of travel system inefficiency (NRC, 1995).

Eddington (2006) argues that travel or economic cost of congestion takes the form of time wasted through travel delays and unreliable transportation conditions, extra fuel, inability to forecast travel time, environmental damage and related cost to human health. For example, it has been shown that a 15 percent reduction in average speed in built-up areas may reduce fuel consumption by 20 to 25 percent (Baker, 1994 and NRC, 1992). Furthermore, six times more gasoline is required for a vehicle to start from a complete stop than it does if the vehicle doesn't come to a complete stop (Baker, 1994).

2.3.3 Infrastructure Dilapidation

Pressure on road infrastructure such as bridges and interchanges due to traffic congestion can cause their dilapidation. Bridges on such roads carry rest weights of vehicles that have to queue on them. This puts excessive stress on the roads and causes them to wear out. More often than not these roads develop pot holes and failed portions due to the weights of over-loaded articulated vehicles; with time, decay sets in earlier than expected (May and Marsden, 2011; Atash, 2007).

B. Social Effects

2.3.4 Effects on Health

Most of the vehicles on the roads now are powered with derivatives from fossil fuel and other hydrocarbons. The carbon monoxide emitted by them warms up the environment so

much that the ozone layer is so badly affected and the infrared wave now penetrates the atmosphere causing greenhouse effect. The Ozone layer has been seriously depleted resulting in global warming which causes changes in the climate. The emissions from motorized vehicles not only affect the environment but also the health of the individuals. The effect of carbon monoxide on human and animals is devastating. Choking as a result of air pollution, high blood pressure and tension due to road rage are all after-effects of prolonged stay in road traffic congestion (Worldwatch Institute, 2008 and SATC, 2014).

Al-Morgrin (2005) asserted that lead poisoning occurs more frequently due to traffic. He further identified the symptoms of lead poisoning to include vomiting, constipation or bloody diarrhea with central nervous system effects such as insomnia, irritability, convulsion and even death. For instance, a recent survey on effects of traffic emissions on pregnancy outcomes linked exposure to emissions to adverse effects on gestational duration and possibly also intrauterine growth (Pereira et al, 2010). Other symptoms include headache, weakness, stress and constipation and death due to road accidents (Kayode, 2015 and Tamakloe, 1989).

2.3.5 Education

School-related traffic congestion and risks such as congestion pose threats to the safety of students, teachers, parents, residents, and motorists in and around school locations and this has become a major problem in communities throughout the world. The most obvious cause of traffic congestion around schools is too many vehicles, and the biggest source of those vehicles is parents' dropping off and picking up their children from school. In the United States, roughly three-quarters of school-aged children are taken to school by car (National Center for Chronic Disease Prevention and Health Promotion, 2001). In the

United Kingdom, the share of children taken to school by car is estimated to be between one-third (Derek Halden Consultancy, 2002), and one-half. In both countries, the rate of increase in car transportation of children to school has been significant, often creating serious traffic congestion problems (Kearns and Collins, 2003).

Other factors include changes in school purposes and populations, new school construction, the addition or elimination of busing, and the overall physical infrastructure, street layout, and traffic signs and signals surrounding a school. School traffic congestion is a source of problem for students, school staff, residents in and around schools, and local police charged with enforcing traffic laws and responding to problems raised by residents and schools. More importantly, congestion can be a source of traffic crashes, child pedestrian injuries and death. Child pedestrian injuries due to traffic are more likely to occur in settings with high traffic volume and on-street parking, with children often emerging “masked” from behind parked cars (National Highway Traffic Safety Administration, 2006; Abane, 2011; Adarkwa, 1991).

2.3.6 Religious Activities

Developing countries such as Ghana do experience quite heavy traffic on days when a majority go to church. According to Buah (1998), Ghana has close to about 70% of her citizens being Christians. Also in Takoradi, the STMA (2012), estimated about 83% of the population being Christians and as such on Sundays in particular and during other Christian festive seasons the roads leading to the church zones get congested with vehicles transporting people to the church premises. This kind of congestion is temporal in that after the service, there is no traffic on the roads. However, effects of traffic congestion on church

activities include the possibility of people joining different denominations or churches, which in most cases are not be pleasing to them or can to lead to members breaking their promises. Such experiences could be challenging as they could even lead to others not attending the church anymore (Buah, 1998).

2.3.7 Recreation

Although initially congestion issues were not addressed within the main tourist road transport externalities, recent trends tend toward a higher use of private or hired cars in tourism destinations (Palmer, Riera, & Rosselló, 2007) and the popularization of the city-break holidays have led to a growing concern about and interest in the contribution of tourism to road traffic congestion. For this reason, city authorities in recent times have become conscious of how the presence of congestion can damage tourist image and how congestion has been recently pointed out as one of the main negative impacts of tourism (Cui & Ryan, 2011). Aguiló, Palmer, & Rosselló, (2012), mentioned that, currently cities are developing interest in applying economic instruments for the regulation of tourism activities in order to yield optimum returns.

This is of special relevance because each country has its own image which is part of its tourist product, but is also susceptible to the effects of transportation problems (Teye, 1992). Traffic congestion being one major setback of tourism, can reduce the time available for participation in tourist activities and could be perceived as an unsatisfactory experience by visitors. According to Alegre & Cladera, (2006), traffic congestion can have a negative effect on a possible future visit by influencing visitors to seek out alternative destinations (Dickinson & Robbins, 2008). For example, there was a \$25 million business revenue

reduction in Colorado after the percentage of visitors decreased by 1% in 2005 (Development Research Partners, 2007).

2.4 Ways of Mitigating Traffic Congestion

Different strategies are being adopted across the globe to mitigate the ever-growing road traffic congestion problem, especially within the cities of the world. Developing countries like Ghana have resorted to common measures such as the adoption of the proposed Bus Rapid Transit System and the expansion of existing roads (Agyemang, 2009). The following sections discuss in brief some measures, benefits and costs to mitigate traffic congestion. The measures examined include expanding roadway capacity, expanding transit services, increasing residential densities, use of toll ways, and use of ramp metering.

2.4.1 Expanding Roadway Capacity

In recent times, the need for building more capacity on roads has become essential in mitigating traffic congestion (Downs, 2004). Roadway Capacity Expansion or Road Expansion refers to the process of physically expanding a road network at the edges in order to allow for more usage of vehicles on the road. This in economic terms is meant to provide optimal supply to meet demand for the road. This approach is criticized immensely by writers such as Downs (2004).

Downs (2004) in his theory entitled 'Triple Convergence Rule' stated that, mere expansion of the road does not eradicate the congestion entirely as traffic over time begins to mount due to increase in demand for the road space. This raises eye brows to the overall effectiveness of the method (Downs, 2004). Nonetheless, the method is understood by scholars to be essential when considered within the short term as it relieves congested

corridors of the challenges associated with traffic congestion. For example, in Bay Area, San Francisco, commuters experienced an average of 74 hours of delay in 2006 resulting from traffic congestion, but after several freeway expansions and improvements the average annual delay for Bay Area commuters fell to 50 hours by 2009 (Downs, 2004).

Another study by Balaker and Staley (2006) revealed that, traffic congestion reduced drastically in Houston as a result of increased roadway capacity. Between 1986 and 1992, Houston's average annual delay per peak commuter fell from 60 hours to 30 hours, as the number of freeway lane miles added per year increased exponentially from 35 in 1985 to a peak of 130 in 1988. Although much success is chalked in the short term as noted by Downs (2004), the strategy is very expensive. For instance, Litman (2011) estimated that, urban highway expansion projects cost, on average, between \$10-20 million per a mile of road when cost of right of way expenditures is added in Los Angeles. That is, in practice, Los Angeles will spend approximately \$68 billion to eliminate gridlock conditions throughout its roadway network. The expenditure, according to Balaker and Stanley (2006) does not usually include environmental costs, which include the cost of consuming additional land for roadway expansions and the cost in terms of the emission of greenhouse gases during the production of asphalt and other common roadway materials.

2.4.2 Transit Capacity Expansion

The notion of transit capacity expansion is aimed at increasing the supply of road transport networks; this is usually done by providing an alternative mode of transport to commuters (Downs, 1992). Commuters are indirectly coerced to use transit services instead of their private cars as their mode of transport. This is achieved by enforcing unfavourable policies that deter people from driving their own cars especially in the cities.

Downs (2004) explained that transit patronage is less in situations where the majority of residents live in areas where residential densities are too low to be efficiently served by transit systems. For instance, highly dense cities, like New York City and San Francisco, as reported by the US Census Bureau (2010), have a very small percentage (5%) of commuters who use rail and transit services. This percentage of the commuters do not live in the densely populated parts of the cities hence do not need the services of transits. Expansion of transit capacity strategy which is mostly championed by governments through the provision of public transit reduces the severity of traffic congestion, as most drivers move to transit systems when traffic congestion worsens (Shrank et al., 2011).

However, expanding transit services, particularly rail services, are expensive to build and maintain. For example, Gordon and Richardson (2000) noted that the U.S. has been spending more than \$360 billion on public transportation annually since the 1960s, with many transit services requiring taxpayer subsidies to remain fiscally solvent. While the U.S. spent considerably more taxpayer dollars on roadways during this time as compared to transit, O'Toole (2009) argued that most transit services suffer from low ridership, making it a poor strategy, in terms of cost effectiveness, for reducing traffic congestion.

2.4.3 Increase in Residential Densities

Much credence according to Downs (2004) should be given to the need for increase in residential densities as it allow transits to efficiently service a wider swath of the population, thus removing demand for road space. Ewing and Cervero (2010), in a meta-analysis, established a case to buttress the point raised by Downs (2004) that, higher residential densities are associated with fewer vehicle miles traveled due to shorter distances between residential facilities and services provided in such areas. The policy

however did not yield the expected outcome after implemented in Portland and Los Angeles Metro Area (Shrank et al., 2011). In sum, literature regarding residential density and its effect on traffic congestion has shown different views. For instance, it is argued by Shrank et al, (2011) that, cost of increasing residential densities is a potential cause for traffic congestion to worsen as higher densities compress aggregate vehicle travel into a smaller area.

As a result of the mixed findings in the literature, Cervero et al. (2004) postulated the concept of “Transit Oriented Development”, which refers to the provision of residential density transits. This according to Cervero et al., (2004) will help mitigate traffic congestion in the cities. In support of this theory, Kolko (2011) stated that, proximity to rail services greatly increases the desire for its usage. For instance, in California, transit accounted for 7.2% of work commutes in communities within ½ mile of transit stations (Kolko, 2011). However, challenges such as limited parking space and high volume of pedestrian activity according to Litman (2011) may rather increase traffic congestion in the vicinities where the concept of transit oriented development are applied. O’Toole (2009) also added that transit-oriented development required large tax subsidies to encourage developers to pursue such development. A typical example cited by O’Toole (2009) is the City of Portland, where \$2 billion tax subsidies were provided to transit oriented development construction in the 1980s.

2.4.4 Use of Tolls

Tolls are special fees paid by drivers for using particular roads or entering some areas especially a congested roadway zone. The payment of the toll is meant to deter the drivers from using such roads in order not to add to the delay of all other users of the roadway.

The benefit of toll ways therefore, according to Downs (2004), is that, the “price of the roadway moderates demand for road space to a point where free-flow or near free-flow speeds are maintained”. For instance, congestion areas on State Route 91 in Orange County reduced by 40minutes after a toll policy was passed not to drivers for entering an uncongested roadway, but rather to charge those who enter the hot lanes. This charge is a cost for increasing delay to other users for entering a congested roadway (Downs, 2004). Use of tolls also helps in paying for the cost of constructing and maintaining toll roads (O’Toole, 2009).

2.4.5 Use of Ramp Metering

As established earlier on, traffic congestion increases on roadways when demand for the road exceeds the supply (Hon, 2005). A solution to this situation is the use of ramp metering. The method refers to the act of limiting the number of road users who use a roadway at a given time when the roadway becomes congested (Downs, 2004 and Weisbrod, 2009). Ramp metering therefore is used to reduce traffic congestion and improve travel speeds. For instance, in the City of Minnesota, the ramp meters were shut off in an experiment for a month and a half to observe and document its effects on traffic flow dynamics. There was a 22% increase in travel times and a 14% reduction in travel speeds throughout the freeway system with increase in carbon emission at the end of the experiment, (Cambridge Systematics, Inc., 2001).

In effect ramp meters are the cheapest means to deal with traffic congestion (Kang & Gillen, 1999; Texas Transportation Institute, 2001). However, the use of ramp meters on roads can lead to congestion on other roads if the queue of vehicles on ramps waiting to enter the freeway spill over onto the other roadways. Furthermore, the use of ramp meters

leads to higher consumption of fuel and travel time by vehicles waiting to enter the roadway than if they enter the roadway freely. For instance, Cambridge Systematics, Inc. (2001) calculated that, in Minnesota ramp meter saved 5.5 million gallons of fuel during the period for which the ramp meter was shut down.

In sum, even though it is established in this review that traffic congestion has a significant relationship with economic and social cost on commuters, residents and industries, the strategies employed by city authorities to mitigate the menace as discussed are also expensive. The situation thus reaffirms the need to answer the research question which seeks to examine the particular types of measures adopted to mitigate the traffic congestion. This basically follows from the argument that, cost of strategy adopted is directly influenced by its level of sustainability (Downs, 2004 and Stock, 2004). In other words, a mitigating strategy tends to be more expensive if the government is made to revisit the measure over a shorter period of usage. A typical example is the use of the ramp meters, that is, the cost of replacing these meters raises questions of sustainability as frequent replacement requires more expenditure.

2.5 Ullman's Theory of Spatial Interaction

Ullman's theory of Spatial Interaction, also referred to as the Ullman Triad is a theory developed by Edward L. Ullman (1980), to explain the differential linkages and flows among places in space. The linkages and flows between places are termed spatial interaction. Defined differently, spatial interaction is the movement of products, people, services, or information among places, in response to localized supply and demand. It is a transportation supply and demand relationship that is often expressed over a geographical space. Spatial interactions usually include a variety of movements such as travel, migration,

transmission of information, journeys to work or shopping, retailing activities, or freight distribution (Rodrigue, 2013).

2.5.1 Application of Ullman's Theory of Spatial Interaction

According to Ullman (1980), the interaction among the places or application of the theory can be done from three different perspectives. These include complementarity, transferability and intervening opportunities. Complementarity, or specific complementarity as it is referred to by Lowe and Mojadas (1975), postulates that movement or trade between two places will occur if there is a need for a particular product in one region for which the other region has the capacity to produce and supply.

Lowe and Mojadas (1975), cite the relation between urban industrial and rural agricultural regions and the industrialised and non-industrialised specialising in agricultural production and mineral resource extraction as examples of complementarity. Complementarity therefore emphasises the importance of need and ability to supply rather than mere area differentiation between places. However, it is possible for complementarity to exist between two places without any movement occurring between them. This can happen as a result of the existence of an alternative, closer and more accessible source of supply between two complementary regions (Lowe and Mojadas, 1975).

The alternative source of supply is known as intervening opportunity. Existence of intervening opportunity serves to restrict or prevent movement between two complementary regions (Reissman, 2002; Hickman, 2010 and May, 1998). Because of this writers consider the concept negative. In addition, it can encourage sub-optimization, and

the ability to encourage people to choose an inferior yet adequate alternative rather than the former location (Lowe and Mojadas, 1975).

Transferability, on the other hand, revolves around the concept of movement and the variance of transportation factors. For example, complementarity may exist between two places, yet no movement or interaction will take place between them as a result of the lack of a transportation facility linking the two places. Transferability, measured by the real cost of transfer, is dependent on the commodity in question. For example, sand and gravel are said to have low transferability compared with diamond because of the low value per unit of weight of the former (Rodrigue, 2013 and Lewis, 2008). In other words in transferability, if time and money costs are too great interaction does not occur and hence buyers will seek substitutes or go without the product.

2.5.2 Critique of Ullman's Theory of Spatial Interaction

The basic assumption underlying most spatial interaction models is that flows are a function of the attributes of the locations of origin, the attributes of the locations of destination, the friction of distance between the origins and the destinations in context (Rodrigue, 2009). These assumptions could not be applicable to all cases. In other words interaction among places may not necessarily be induced by the three main conditions outlined by Ullman. In a typical city for instance not everyone gets attracted to the city centre because of a particular good or service. It is also not always the case that the benefit derived from a good or service is higher than the time and cost paid for the distance covered. In other words, the fact that a movement occurs between an origin and a destination does not mean that the costs incurred by a spatial interaction are lower than the benefits derived from such an interaction.

Some residents especially the middle, upper and higher class from the first and second class residential areas in a developed city may want to drive over a long distant just for a good which they could get at the corner shops but because they have the means to afford the cost of transport. This is partly an occurrence due to needs deriving from the attitude of commuters, which include the need to drive in one's own car. Attitude, according to Abane et al (2011) is an enduring predisposition towards a particular service or good such as transport or an environment (Ben-Akiva and Lerman, 1985; Llyes and Mallick, 1990) which influences the range of choices of several commuters.

In sum, it could be an over-simplification to predict and describe the nature of interaction among places using Ullman's (1980) theory of spatial interaction (Lowe and Mojadas, 1975). This, according to Rodrigue (2009) is as a result of the fact that the assumptions of the theory may not hold in all situations, that is, factors influencing the interaction among nodes for instance may not follow the assumptions discussed in the theory. However, it is no doubt that the concept is the most widely used and accepted by most writers (Abane, 2003). Practically, the theory explained above is used as the basis for conceptualizing the flow of commodities, services and effects of traffic congestion in Takoradi in subsequent sections of this study (see Figure 9).

2.6 Conceptual Framework

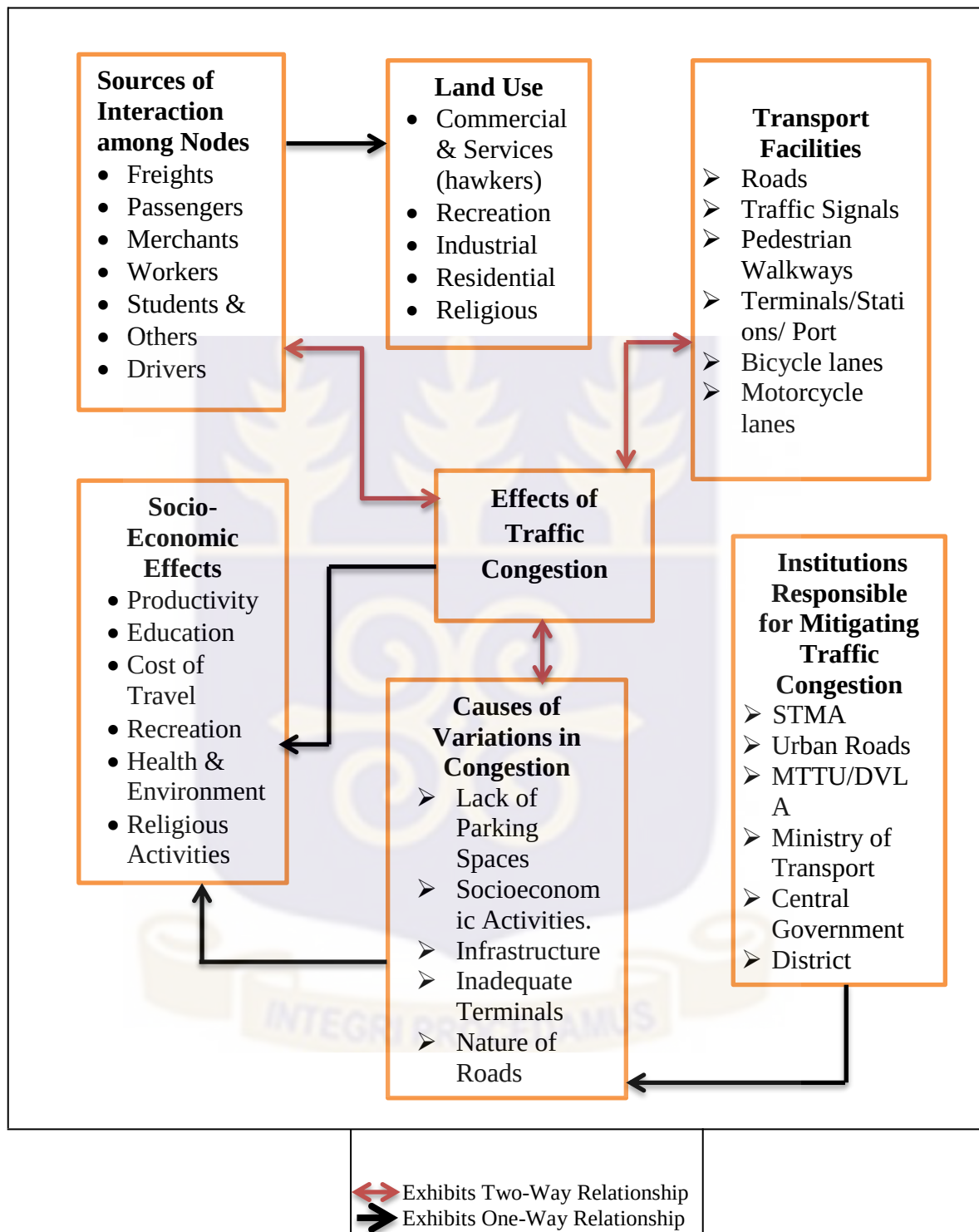
Traffic volumes, modal split and distribution of traffic over time and space usually describe travel behaviour (Abane, 2011; Van Wee, 2009). In terms of movement of people, location of activities and transport resistance factors such as transport cost play such a huge role (Van Wee, 2009). In the cities of the world particularly in developing countries like Ghana,

location of activities in the CBD attracts a lot of people from the surrounding towns to perform activities such as living, shopping and working.

Travel resistance therefore, comprises the cost of travel, discomfort, time and perceived risk. The needs, opportunities and abilities also affect the travel behaviour of road users. Travel behaviour determines the traffic volumes and how traffic is distributed over time and space (Abane, 2011; Van Wee & Maat, 2003). As a result, road users depending on their decision to travel are invariably exposed to challenges posed by the road; notable among them is traffic congestion. Figure 2 provides a summary of the theories and models explaining the interaction among nodes or centres in a typical CBD in an urban space. This is done to provide a quick visualization of the various variables that come to play in discussing traffic congestion and its effects in such geographical spaces.

From Figure 2, interactions among the towns adjoining the CBD are dependent on several factors. One major condition is the demand-supply relationship among the various towns. All the links or roads, one way or the other have access either directly or indirectly to the city centres. Users of the roads in the city centres namely passengers and workers travel to the CBDs for several reasons, either to offload freight, buy goods or commodities, transact financial businesses or attend to facilities such as hospitals, schools and recreation centres. Furthermore, the pattern of the interaction among the nodes in such cities to a larger extent depends on the land use and activities on the various roads. A typical example could be the case of Accra where you will find formal service industries like the Parliament House, the Supreme Court and the Headquarters of the banks situated at a section of the city centre and the market also on another side. Beneficiaries of these services learn the routes to

Figure 2: Conceptual Framework Illustrating the Causes, Land use Activities and Effects of Variations in Traffic in a Typical Central Business District.



Source: Author's Construct, (2016).

getting their services on time. This defines the people seen on such corridors and in such spaces.

Vehicular trucks are mostly spotted in the city centre offloading their wares at the edges of the roads, thereby slowing traffic on the road. This occurs because of the absence of enough and accessible warehouses in the city centres. The available ones are also often not used properly due to the inability of city authorities to enforce laws that restrict vehicular trucks from offloading along the roads. Again, traffic is seen high during the morning from all the roads to in most cities in Africa and the reverse is also true in the evening congestion peaks. This is because of the spatial arrangement of the cities. Most commercial activities are found within the enclave of the CBDs and outside the enclave are the residential settlements.

Furthermore, variations of traffic on the roads in these cities are caused by factors such as the nature of the roads, the distance of the nodes from the major services provision centres and activities along the roads. Even though most cities in Ghana are well-planned cities, they still have to fight against ever growing traffic congestion due to the inability of city authorities to implement road traffic regulations. This affects passengers en route to school, work, church, trade or to transact other financial and social activities. It is therefore incumbent on the city authorities including the central governments to help provide the necessary support in order to mitigate the ever growing traffic congestion.

In sum, the interaction between identified components of road traffic in most cities in Ghana as indicated in Figure 4 could either be a two-way or one-way relationship. For instance a one-way relationship exists between sources of interaction and land use, since,

what is transported depends on the land use at the place. Stated differently, land use activities such as schools attract students and not the other way round or both. Also, the intensity of the effects or the kind of effects realized due to the traffic congestion depends on what is being transported frequently (sources or agents) and the sources in turn depend on the effects of the congestion. For instance where traffic on the road is huge one will expect a lot of hawkers selling their goods to passengers and drivers. This happens especially during the rush hours.

Furthermore, the use of roads by merchants transporting goods in heavy loaded trucks will also result in the destruction of the roads due to the excessive stress put on the road. Also, a two-way relationship exists between the mode of transport and effects of the traffic congestion. For instance, traffic signals such as traffic lights can help regulate the traffic in order to prevent accidents and unnecessary delays. Stated oppositely, road accidents which an effect of traffic congestion can be prevented if there are functional traffic lights at the intersections. Institutions can also help reduce the congestion if they have ample knowledge of the causes of the congestions (indicating a one-way relationship), for as the adage goes '*problem known is problem solved*'. Finally, an effect of traffic congestion which is the main thrust of this study is defined on the basis of either social or economic outcomes.

CHAPTER THREE

PROFILE OF THE STUDY AREA AND RESEARCH METHODOLOGY

3.0 Introduction

This chapter provides data on the profile of the study area, Takoradi. It highlights information on subtitles such as history, population size, the spread of residential facilities and the economy of Takoradi. The chapter finally discusses the research methodology used in carrying out the research. That is, the philosophy behind the study, the research design, the strategy used in collecting data, types of data collected, techniques used in the sampling process and techniques used in analysing and discussing the data collected are all outlined in this chapter.

3.1 Brief History of Study Area

Takoradi is located within the Sekondi-Takoradi Metropolitan Area (STMA). The city of Takoradi began as Sekondi Town Council in 1903, under the Town Council Ordinance No. 26 and not until 1946 was it brought into the administrative area of the Council. In June 1962, Takoradi was elevated to the status of a city and is currently one of the six (6) metropolises in Ghana (STMA, 2010).

3.1.1 Area/Location

STMA covers a land area of 219 km² with Takoradi being the economic hub of the two cities and Sekondi as the administrative headquarters. The Metropolis is bordered on the West by the Ahanta West District, on the North by the Mpohor Wassa East District, on the East by the Shama District Assembly and on the South by the Gulf of Guinea. The Metropolis is located on the West Coast of Ghana, about 280km West of Accra and 130km

East of La Cote D'Ivoire. It is thus, strategically located considering its closeness to the sea, airports and accessibility to major cities by rail and road (STMA, 2012).

3.1.2 Climate

The average annual temperature of the city of Takoradi is 22°C. The mean annual rainfall is about 1,380mm and covers an average of 122 rainy days. Up to 70% of Precipitation occurs mainly from March to July. These rains are sometimes accompanied by storms with slight thunderous activities. There is a minor rainy season which occurs between September and November. It is very severe but of short duration. There are two dry seasons with the milder one occurring from August to September and the more extended one from December to February. These favourable weather conditions provide an atmosphere for crop and fish production in the Metropolis. Generally, the Metropolis does not experience severe weather conditions and is therefore favourable as a tourist destination (STMA, 2013).

3.1.3 Vegetation

Natural vegetation in the city has largely been degraded due to slash and burn farming practices and other human activities. The existing vegetation is broadly woodland in the north and central portions of the Metropolis. Along the coastal areas thickets intermingled with mangroves are constantly harvested, leading to the depletion of the mangrove along the banks of the rivers (STMA, 2012).

3.1.4 Topography

The Metropolis is characterised by a varied topography. The Central area of Takoradi is low-lying with an altitude of 6m below sea level. The numerous low-lying areas in the Metropolis are interspersed with ridges and hills ranging in height from 30m-60m. The

highest points of the city provide a panoramic view of the Metropolis. This type of undulating nature of the land makes it difficult for infrastructure development in the Metropolis due to the implied high costs (STMA, 2012).

3.1.5 Drainage

The Metropolis has five major drainage basins namely Pokuantra, Kansawura, Buwen, Anankwari and Whin. These basins are drained mainly by major rivers such as the Whin and Ayire and their tributaries. The Whin River with its main tributary, the Ayire, joins the Whin Lagoon before entering the sea and borders the Western part of the Metropolis. There are two major lagoons namely the Butua and Essei. The numerous basins, lagoons and rivers support inland fishing, urban agriculture and eco-tourism. The Metropolis also has a great potential for water sports, bird watching, dry season farming and aqua-culture. However, these drainage systems are gradually being polluted with waste (STMA, 2013).

3.2 Demographic Characteristics

The current population of the Metropolis is 404,041, according to the Ghana Statistical Survey (2010). The population of the city grew from 103,834 in 1970 to 249,371, in 1984 and to 369,166 in 2000.

3.2.1 Population Growth (2010-2013).

Table 2: Population Growth (2010 – 2013)

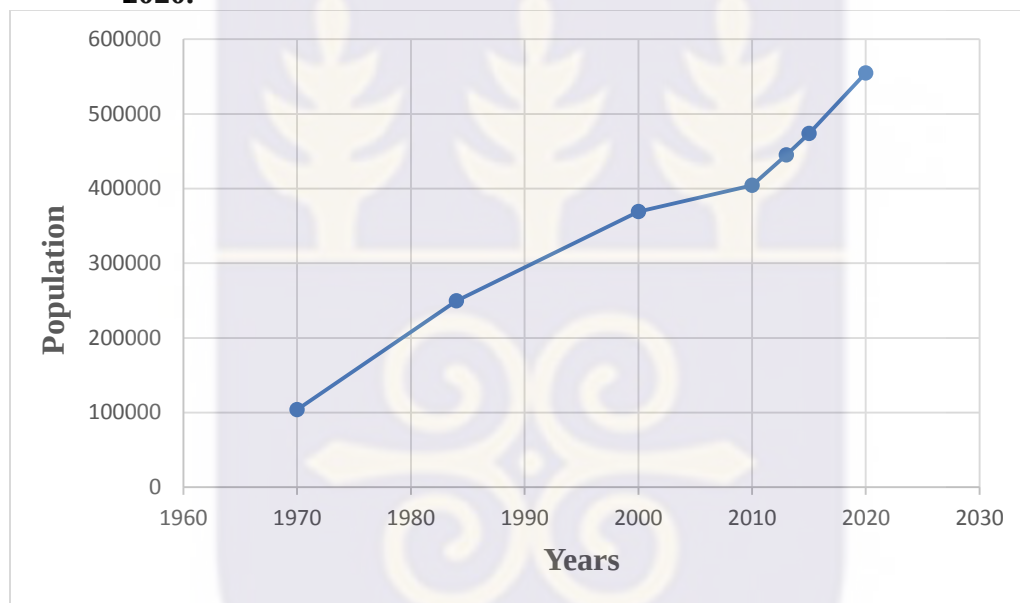
Year	Male	Female	Total
2010	200,206	203,835	404,041
2011	204,418	212,761	417,179
2012	211,066	219,679	430,745
2013	217,928	226,824	444,752

Source: Ghana Statistical Service (2012).

Table 2 provides detailed information about the sex distribution of the population of the Takoradi from 2010 to 2013. Generally, Takoradi recorded a population growth rate of 3.2%, that is, from 404,041 in 2010 to 444,752 in 2013 (GSS, 2012).

Figure 3 depicts the trend of the population of Sekondi-Takoradi Metropolitan Assembly from 1970 to 2015 and the projected population up to 2020.

Figure 3: Population of STMA from 1970 to 2015 and the Projection for the Year 2020.



Source: STMA (2013).

The background of the graph indicates the activities along the main streets of the Central Business District that make the road congested. In view of this new trend of development the Assembly is embarking on strategies to redevelop the Central Business District and also develop other satellites markets in the metropolis as a solution to the congestion of business activities in the CBD (Ministry of Transport, (MoT), 2014).

3.2.2 Age–Sex Distribution

Table 3: Age/Sex Distribution in 2010

Age-Cohort	Male	Female	Total	%
0-14	88,695	92,315	181,010	44.8
15-64	102,752	106,945	209,697	51.9
65 ⁺	6,534	6800	13,334	3.3
TOTAL	200,205	203,836	404,041	100

Source: Ghana Statistical Service, (2012).

The rationale behind the use of the gender data is to show the direction or distribution of gender in Takoradi and how it in turn affects the spread or distribution in the overall traffic congestion. A detailed discussion of this is contained in the subsequent sections (see Table 19 for example). As shown in Table 3, 44.8% of the population is below the age of 14 with 51.9% between 15 and 64 while those above 65 are only 3.3% (GSS, 2010). A programme to develop the human resource base has been proposed with particular emphasis on the provision of educational facilities for those in the 0-14 group.

Furthermore, with about 51.9% of the population within the age cohort of 15-64 years representing the work force, the Assembly has been pushing for the industrialization of the economy by providing technical and vocational training to facilitate the establishment of self-help jobs and the creation of an enabling environment for more job avenues. The Assembly has also realized the need for the establishment of specialised facilities to cater for the dependent age group (that is, the 0-14 and 65+ band), which makes up the remaining 48.1% of the population of the Metropolis (MoT, 2011).

3.2.3 Population Density

With a land area of 49.78km², the current population density of the Metropolis stands at 8,140persons/km². Settlements such as Takoradi, Effia, Effiakuma, Kwesimintsim, Tanokrom, Sekondi, Adiembra, Kojokrom, New Takoradi and Anaji have high population densities thereby putting pressure on existing infrastructural facilities in those areas. Farmlands are also being fast converted into residential areas particularly at the newly developed areas such as Butumajebu, Kansaworodo, Deabenekrom and North Kwesimintsim (STMA, 2013).

Table 4: Population Density

Year	Population	Density(Persons Per Km²)
2010	404,041	8,140
2011	417,179	8,380
2012	430,745	8,653
2013	444,752	8,934

Source: Ghana Statistical Service, (2012).

3.2.4 Culture

Traditionally, Takoradi could be classified into two main traditional areas namely, Sekondi and Essikado traditional areas. The traditional areas are ruled by paramount chiefs, who are seen as the traditional heads of the people. The traditional councils are made up of various sub chiefs and the councils meet regularly to discuss various issues related to the development of the traditional areas. The communal spirit is quite high especially in the peri-urban areas such as Assakae, Mpatado, Kansaworodo and Enoe. Urban areas such as Takoradi, Sekondi, Tanokrom and Kwesimintsim however have low communal spirit and

this is largely attributed to the cosmopolitan nature of these settlements with their varied backgrounds of their inhabitants (STMA, 2012).

The inhabitants of Takoradi as described by the STMA (2012), are very friendly and exhibit the proverbial Ghanaian hospitality. A majority of the population speak Fante but the main local dialects are Ahanta, Nzema, Wassa, Brosa, Gwira and Pepesa. English is however, the official language. In terms of religion, Takoradi for instance, has about 83.1% Christians, 8.9% being Moslems, 5.9 % no religion, 1.9% other religion and 1.2% traditional believers.

3.3 Settlements and Spread of Population

Takoradi has forty-four settlements, of which close to 13 have an average population exceeding 7,000. The major settlements are Takoradi, Effia-Kwesimintsim, Effiakuma, Anaji, Kojokrom, Tanokrom and Sekondi. As at 2000, about 69% of the population lived in the urban areas and 31% in the rural areas; however there has been a tremendous increase in urbanisation from 69% to 72.9% while the proportion of people in the rural zones had fallen from 31% to 27.1% as at 2010. There is a strong linkage with the adjoining districts as most of the people in the Metropolis feed on food crops from the Mpohor Wasssa East District, complemented by meat products from a modern Abattoir at Whindo, which also serves the adjoining districts (STMA, 2010).

Table 5: Rural and Urban Populations

Year	Total Population	% Urban	% Rural
1984	249,371	59.6	40.4
1996	357,431	73.6	27.4
2000	359,363	69	31
2010	404,041	72.9%	27.1%

Source: Ghana Statistical Service (2012).

3.3.1 Developing Settlements

The newly developing settlements in Takoradi exhibit characteristics which are in sharp contrast with the old settlements in terms of socio-economic infrastructure. The new settlements have poor roads, mostly with earth drains, inadequate supply of utility services, especially water, inadequate educational and health facilities. Residents therefore, always travel far for commerce and to acquire services such as education and health. These settlements are primarily dormitory settlements serving the core CBD where almost all economic activities take place (STMA, 2012).

3.3.2 Housing

Houses in Takoradi are mostly constructed and owned by individuals and families as well as estate developers. Typical examples of estate developers include Regimanuel Gray, State Housing Company and SSNIT. In recent times however, the housing units produced by these developers have been sold out to individuals. Even so, over 90% of the housing stock in the Takoradi are constructed and owned by individuals and families. There is thus a shortage of housing units for residential accommodation, thereby making rent very high.

The total housing stock in the Takoradi is 36,079 out of a population of 404,014. Houses in Takoradi are also characterised by very huge compound houses (47% of total dwelling units). Such houses are often rented out to low income families. The stock of houses are found in communities such as Amanful, Quarters, Essikafuabantem No 1, Kwesimintsim, New Takoradi, Effiakuma, and Bakaekyir (STMA, 2012). Generally, residential areas in the Metropolis are classified into three classes and these include, namely first class residential areas, second class residential areas, third class residential areas and fourth class residential areas.

3.3.2.1 First Class Residential Areas

The first class residential areas are mostly located in land areas that are State owned. Examples of such areas are Palm Lands Estate, Sekondi Ridge, GBC Area, Windy Ridge, Airport Ridge, Chapel Hill, Beach Road, Anaji Estate. These areas have good roads, adequate power supply and good water and sanitation services. Plot sizes are large varying from half an acre to over one acre. Population densities are generally low and range between 30-40 persons per acre. Good landscape designs as well as clean environment characterize these areas (STMA, 2012).

3.3.2.2 Second Class Residential Areas

Within the Metropolis, second class residential areas are found in suburbs such as New Site, Tanokrom, Apremdo Apollo, West Fijai Ridge, Effia Nkwanta, Kweikuma, Essikado, Takoradi, Bakaekyir, Sekondi, Butumagyebu Ridge, Assakae New Site, Mpatado New Site, Whindo New Site, Mpintsin Ridge, Adiembra Ridge, Adientem New Site, Ntankoful New Site and Effia New Site. These areas have fairly good roads. Utilities such as water, electricity and telecommunications are also available. Land sizes are smaller than what

pertains in the first class residential areas and they range between 0.20 to 0.50 acres. Population densities are relatively higher and stand between 40-80 persons per acre. The environment within the second class residential areas is fairly clean with minor floral activities (STMA-MTDP report, 2011).

3.3.2.3 Third Class Residential Areas

The third class residential areas are poorly serviced in terms of water, power and telecommunication facilities. Large portions of such areas are inaccessible to vehicular traffic. Land sizes are very small and less than 0.20 acres. Examples of such areas are New Takoradi, Kwesimintsim, Aprembo, Effia, Essaman, Ekuasi, Adiembra Estate, Butumagyebu, Ketan, Ahenkofikrom, Kojokrom, Mpintsin, Essipon, Ngyiresia, Nkotompo, Ngyamoabakam. In sharp contrast to the first and second class residential areas, population densities are high and ranges between 80 to 150 persons (STMA, 2012).

3.3.2.4 Fourth Class Residential Areas

The fourth class residential areas are traditional or indigenous settlements and are poorly served in terms of basic social amenities. Such settlements are basically unplanned, leading to difficulties in physical accessibility. Such residential areas include Assakae, Whindo, Adientem, Mpatado, Anaji Fie, Eshiem, Twabewu, Sofokrom, Anoe, Ntankoful, Kansaworodo, Mampong and Diabene. The distinguishing feature between 3rd and 4th class residential areas is the housing type or condition as well as the population densities (STMA, 2012). The trend of urbanization is taking place at the core and gradually moving towards the Northern parts of the Metropolis.

3.4 Sectors of Takoradi's Economy

The local economy of the Metropolis could be classified into three major sectors namely industry, agriculture and service. Table 6 indicates the percentage of the population engaged in the three sectors (STMA, 2012).

Table 6: Sectors of the Takoradi's Economy

Sector	Percentage
Industry	19.1%
Agriculture	21%
Service	59.9%
TOTAL	100%

Source: STMA, Population and Housing Census Report, (2000).

From Table 6 above, 19.1% are engaged in the industrial sector. The Metropolis can boast of a number of manufacturing industries such as GHACEM, WAMCO, timber and oil and gas processing industries. However, this percentage is expected to increase with the booming economy due to the attraction of investors into the oil and gas industry (Ablo, 2015). The Western Region of Ghana, as a whole has witnessed a tremendous boost in economic activities after the discovery of oil at Cape Three Points. This transition in Ghana's history was announced by Kosmos Energy on the 18th of June 2007 after the discovery of oil and gas in commercial quantities off the coast of the city (McCaskie, 2008: Ablo, 2016).

According to Ablo, (2016, p. 5) "the discoveries were made in two deep water blocks: West Cape Three Points and Deepwater Tano, which are currently operated together as the 'Jubilee Field'. In December 2010, Ghana lifted its first oil from the Jubilee Phase I field,

with an initial output of 50,000 barrels of oil per day and an estimated 120,000 bopd at the peak of production''. Since then, several other discoveries have been made including the Owo field by Tullow, Dzata field by Lukoil, Banda-1 by Kosmos and Akasa-1 by Anadarko (Asafu-Adjaye, 2012).

These commercial oil discoveries in Ghana and many of the recent discoveries in the Gulf of Guinea can be attributed to the advancement in technology that has enabled petroleum exploration in ultra-deep water environments. However, among all these locations Takoradi's strategic location makes it an important hub for Ghana's emergent oil and gas industry, considering the fact that it is the location of the oil tanker terminal for the country's offshore fields (Obeng-Odoom, 2014c).

Agriculture on the other hand accounts for 21% of economic activities in Takoradi, with a majority of the inhabitants engaged in agriculture being in crop farming (14.5%) while about 6.5% are engaged in fishing. The service sector is the largest employer of the labour force in the Metropolis. It employs 59.9% of the active labour force who are mostly employed in white-colour jobs in private and public institutions. The economy is thus dominated by the service sector.

3.5 Transport Infrastructure

3.5.1 Rail Transport

The Headquarters of Ghana Railway Company is located in the Metropolis. The city is accessible by rail and it is linked to major cities and productive areas such as Kumasi, Tarkwa, Obuasi and Accra. The rail way has been the backbone of economic activities in the Metropolis especially from the 1960s to the early 1990s (Addo, 2006). In recent times

rail transportation has reduced due to dilapidation of trains and the rail lines (Assomaning, 2010; Tsey, 2013). Colonial planning efforts mainly utilized the rail facilities for the extraction and transportation of mineral resources such as manganese and bauxite. Today, however, transportation of these minerals is by road and the situation is putting pressure on the roads, besides the increased accidents involving such vehicles. The development of the railways brought considerable relief to labour and head porters, in particular, but it was never intended to ensure sustainable growth and development as its construction was mainly for exploitative purposes (Tsey, 2013).

3.5.2 Air Transport

Takoradi has an airstrip which is owned and managed by the Ghana Air Force. The presence of the airstrip makes it possible for easy movement by air from Takoradi to other cities in the country. Most flights to Takoradi are domestic ones. The Ghana Air Force also has Fokker planes and sky vans which are used for military duties (Obeng-Odoom, 2014; Department of Urban Roads, 2012). Currently however, Takoradi Airport is a significant piece of the city's infrastructure and plays a key role in Ghana's oil and gas industry. The airport was formerly a military base, but since the discovery and production of the offshore oil, is now one of the busiest airports for domestic travel in Ghana (Obeng-Odoom, 2014 in Ablo, 2016).

The airport currently handles daily domestic flights between Accra and Takoradi and has helped to significantly reduce travel time between the two cities; the flight between Accra and Takoradi takes just 30 minutes, while road travel takes between three to five hours. The airport hosts private jets belonging to foreign oil companies as well as helicopters owned by companies that transport oil rig workers offshore (Obeng-Odoom, 2014).

3.5.3 Road Transport

Due to the collapse of the railway system, road transport industry has been promoted as a more economically efficient transport mode and as a catalyst to the growth and development of the Metropolis. The first road was completed in 1895 and the first car arrived in 1902 (Ministry of Education, 1991 in Obeng-Odoom, 2014). Interest in road construction and the acquisition of more vehicles became prominent due to a clarion demand made in particular by inhabitants of the urban milieu that car ownership signified civilisation (Aniegye, 2011). Thus, road transport became a benchmark of what Vandenberghe (2008) termed “Deleuzian capitalism,” typified by the absorption of people’s private lives and culture into the fulcrum of capitalism.

Coupled with these was the postwar development of the global automobile industry that led to the importation of U.S. Ford vehicles into the Gold Coast during the 1950s. Britain also entered the competition to supply cheap used vehicles to its colony (Aniegye, 2011 in Obeng-Odoom, 2014), and at the time of independence, Ford dealerships operated in the five major Ghanaian cities (Chalfin, 2008). The Ghana Highway Authority, established in 1974, oversaw trunk road development before the Ministry of Roads and Highways was created in 1982. In 1988, a specialized urban road transport department, the Department of Urban Roads, was created to enhance the development of roads in the metropolitan, municipal, and district assembly (Ministry of Roads and Highways, 2013).

The planning of settlements and commercial areas also heightened the role of road transport in urban dynamics. It was road, not rail that was provided to connect newly built suburbs and commercial areas. After 1960, the urban road network was refocused on Sekondi-Takoradi’s new Market Circle and/or other “work precincts” such as the Harbor area.

(Aniegye, 2011). A large number of informal commercial activities were located in residential areas as well, but recent transport surveys show that these did not alter the flow of traffic that was mainly oriented toward the commercial and business centers (The Consortium, 2011). The city of Takoradi currently has a road length of 690Km of which 381km are sealed with either asphalt or surface dressed whilst 308km is either earth or gravel roads, thus most roads are paved (55%) and there are plans to upgrade the remainder (The Consortium, 2011). The need for more arises out of current trends influenced by modernization and greater mobility and hence the advantages of large-scale production.

Table 7: Current Road Condition

Description	Good	Fair	Poor	Total
Asphalt	27.31	3.72	31.02	62.07
Surface Dressing	165.77	12.75	140.27	318.78
Gravel	139.6	18.79	110.07	268.46
Earth	-	-	40.27	40.27
Concrete	-	-	-	0.47
Total	332.68	35.26	321.62	

Source: Department of Urban Roads, STMA, (2013).

Table 7 above gives a fair impression of the current road condition within the Metropolis. The city has close to a 50/50 split between surfaced and non-surfaced roads. Attendant growth of warehouses within and outside the boundaries of the city is also affecting transportation in the city. In view of the above and coupled with the increase in floating population into the city and its effects on road transport services, the Metropolitan Assembly has again and again been stressing the need for a well-planned transport system.

3.5.4 Arterial Development

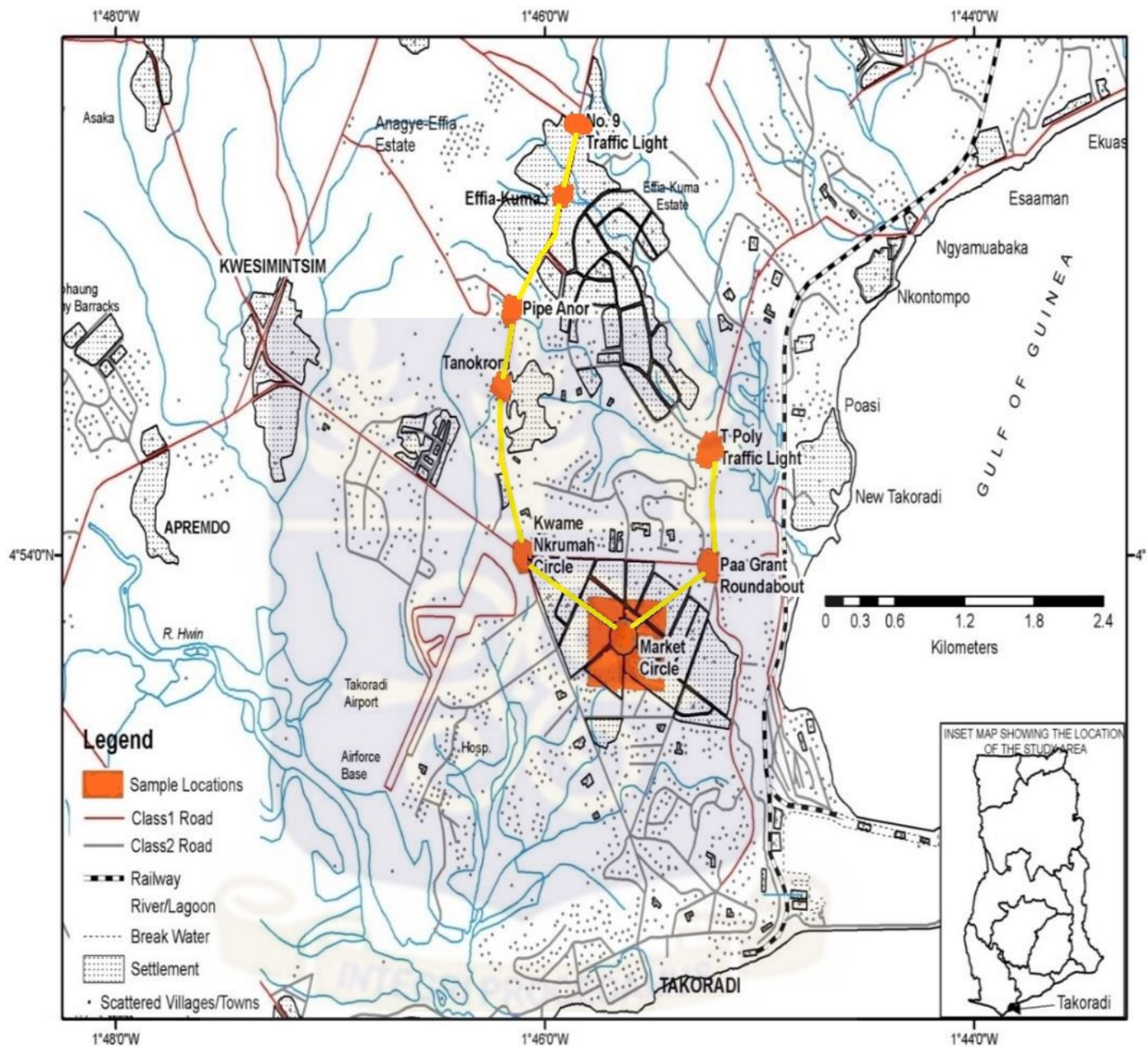
Due to the current capacity of the arterial roads the level of service on them has been reduced, thereby increasing transport operating costs and consequently raising the cost of doing business in the metropolis. The four major corridors within the twin city are:

- The Effia Nkwanta Hospital – Paa Grant Road
- The Sekondi Bypass (Kwame Nkrumah Circle – Ketan Junction)
- The Kwame Nkrumah Circle – Apremdu Road (To Agona)
- The Kansaworodo Bypass (Nkroful – Apollo Junction)

The current traffic levels at peak time are also high, with the attendant traffic delay problems. It is therefore a challenge which the Assembly has declared it is taking all the necessary steps to address (Department of Urban Roads, 2012). Figure 3 shows the map of Takoradi with a highlight of the sampled areas for the study. The CBD is shown in relatively large cover and highlighted in orange to indicate how widespread its sphere of influence in the Metropolis is.

The Paa Grant area, the Kwame Nkrumah Circle, Tanokrom (Pipe Anor Ano?) and Effiakuma suburbs are also coloured in orange. The areas coloured orange (Sample Locations) represent the five zones or areas sampled as major nodes by Mahama *et al* (2013) in the Metropolis. The roads or corridors studied which connect the nodes are also coloured yellow on the map. Other suburbs shown in the map include Kwesimitim, Anagye-Effia Estate and Apremdu.

Figure 4: Map of the Takoradi Study Area Showing Sample Locations



Source: Ghana Geological Survey (2015).

From Table 8, it can be seen that the roads in the Metropolis experienced most of the traffic in the evening, that is the PM peak hour period. The road leading to Tanokrom (AGIP)

from the Kwame Nkrumah Circle followed as the second most highly congested road in the CBD with a total AM and PM peak hour traffic of **4458**. However, the roads leading to the Market Circle or areas around the market get almost congested throughout the day, (UR, Takoradi, 2012).

Table 8: Average Traffic Volume per Zone at AM & PM Peak Periods from 2003 to 2008

Name of Zones	Zonal Description	Average AM Peak Hour Volume	Average PM Hour Peak Volume	Total
Zone 1	Areas in around Takoradi Market Circle	2267	2180	4447
Zone 2	Paa Grant Round about to T-poly Junction	1919	1705	3624
Zone 3	Effiakumah Traffic Light to Effiakumah Junction	1414	1346	2760
Zone 4	Ajep to Tanokrom Traffic Light	2089	2369	4458
Zone 5	Kwame Nkrumah Circle to market Circle	3138	3985	7123

Source: Department of Urban Roads, Takoradi, (2012).

Specific indicators including variation in traffic from 2003 to 2008 and estimated change in 2015, traffic count at peak times as shown in Table 9, shows data obtained from the Department of Urban Roads, Takoradi on the various corridors appraised. This served as a basis for identifying similarities and differences among the corridors with respect to traffic. Brief accounts of these are as follows:

A general traffic growth rate of 1.51% was obtained. Using the major roads also referred to as Master Stations (MS) showed an increase in traffic from the year 2003 to 2008 (Table 8).

3.5.5 Change in Traffic Volumes in Takoradi.

Table 9: Variation in Traffic on Major Roads at Peak Hours (2003-2008).

Master Stations	2003	2008	% Change (2003-2008)	Annual Growth Rate	Estimated Traffic for 2015
MS 1	-	9,862	-	-	-
MS 2	28,504	26,327	-7.64	-1.5	-27,433
MS 3	23,757	26,332	10.84	2.08	383,393
MS 4	-	27,487	-	-	-
MS 5	17,150	20,880	21.27	4.01	586,101

Source: Department of Urban Roads, Takoradi, (2012).

From Table 9, the Zone with the highest traffic volume count during the morning (AM) peak hours in 2008 was recorded at Zone 5 followed by Zone 1, Zone 4, Zone 2 and Zone 3 respectively (Mahama et al, 2013). Zone 5 still recorded the highest in the evening (PM) peak hours followed by Zone 4, Zone 1, Zone 2 and Zone 3 respectively. MS1, representing areas around the Market Circle recorded the highest traffic in 2003 followed by MS 3 and MS 5 also representing Effiakuma and Kwame Nkrumah Circle respectively.

Using the totals from Table 13 the conclusion made is that as at 2013 Zone 5 which represents the road from the Kwame Nkrumah Circle to the Market Circle was the most congested road so far as the peak hours of AM and PM were concerned. This road in question links the main road also from Kwesimintim Station to the Market Circle and hence experiences very high congestion around the circle especially during the AM hours.

3.5.7 Proportions of Different Modes of Transport at Master Stations in Takoradi

From Table 10 the amount of traffic caused by taxis recorded the highest with 41% on the five corridors adopted from Mahama et al, (2013), this is followed by the small, medium

and large buses also with 29%. Private vehicles recorded the third highest percentage of 15. The number of buses however, does not imply that there is higher use of public transit system in the Metropolis, since not all the buses counted were for commercial use.

Table 10: Percentage of Mode of Transport on Arterial Road Corridors in Takoradi

Master Stations	Bicycles	Motor Bikes	Taxis	Cars	Pick-up	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Truck Trailer
MS1	5.26	3.11	58.55	19.77	9.98	2.02	0.20	0.10	0.53	0.34	0.02	0.01
MS2	2.30	2.48	46.04	19.36	10.49	14.49	1.15	0.50	1.34	0.55	0.23	1.06
MS3	5.55	3.46	38.17	12.46	5.94	27.44	2.91	0.79	1.48	0.58	0.46	0.58
MS4	4.50	2.24	44.11	17.31	10.10	15.90	1.23	0.51	1.74	0.56	0.64	1.14
MS5	6.42	3.10	42.07	20.63	12.76	5.08	1.49	0.30	4.98	0.85	0.83	1.41
Total	24	14.4	245.8	89.49	49.27	64.9	83.2	2.2	10.1	2.88	2.18	4.2
% Total	4.04	2.4	41.5	15.1	8.31	11	14	0.4	1.7	0.5	0.36	0.7

Source: Mahama et al, (2013).

3.6 Research Methodology

3.6.1 Introduction

The methodology or approach used for gathering data for a research according to Kitchin & Tate (2000, p. 135) may be described as ‘a coherent set of rules and procedures which can be used to investigate a phenomenon or situation (within the framework dictated by epistemological and ontological ideas)’. Stated differently, the adoption of a particular approach to data collection is a function of concepts and theories underlying the study (Agyemang, 2009). This section therefore explains the philosophy behind the research method, approaches to data collected, types of data collected, reasons for data choice and methods used in analyzing the data gathered.

3.6.2 Research Philosophy

The thrust of this study, thus, explanation and prediction of spatial distribution and variation of the effects of traffic congestion on socio-economic activities in the city of Takoradi is no different from many studies carried out in many social sciences. The philosophical underpinnings of this research therefore depended on the objectives, research questions and theory guiding the study. All the philosophies used in any research however, fall under one or two epistemological debates or postulations (Rodrigue, 2013). Epistemological positions concern “the questions of what is (or should be) regarded as acceptable knowledge in a study or body of knowledge” (Bryman, 2001, Holt-Jensen, 2001). These include Positivism, Humanism, Realism and Pragmatism, Post-structuralism or Interpretivism (Del Casino, 2006).

Whilst many writers agree with Ragurman (1994), cited in Kitchin & Tate (2000, p.6), that such complex philosophical debates often lead to ‘a lot of apprehension, disenchantment and an uneasy feeling of being lost in a philosophical wilderness’, it is nevertheless recognised that such debates are helpful. Epistemologically, this study adopted pragmatism as the philosophical basis guiding the research. Pragmatism according to Creswell (2003), “arises out of actions, situations and consequences rather than the antecedent conditions in positivism. That is, pragmatism focuses attention on the problem to be investigated using pluralistic approaches to gather information” (Patton, 1990).

In other words, pragmatism allows the use of the mixed method approach to data collection (Morgan, 2007; Creswell, 2003). This approach in recent times, has become the most widely used means for collecting data for research (Bryman, 2001). Most researchers hitherto, conducted their studies using single research data (either quantitative or

qualitative) and suffered many limitations associated with such methods or from the specific application of the methods in question. Today, however, the use of the mixed method offers prospects which enhances confidence in research (Bazely, 2004; Bryman, 2007; Bryman, 1984; Clarke, 2009; Creswell, Plano Clark, Gutmann, & Hanson, 2003; Meetoo & Temple, 2003).

In this study for instance, the use of the mixed method helped to achieve convergence and corroboration of the data collected (Johnson and Onwuegbuzie, 2004). That is, each approach served as an overlap for the other. For example, interviews from participants from the Department of Urban Roads, Sekondi-Takoradi Metropolitan Assembly and terminals at Takoradi's CBD were used to support or corroborate patterns and measures obtained from the quantitative responses of the respondents within the research area. A specific example is the detailed explanation given by the head of the Physical Planning Department at STMA on the relationship between cost and traffic congestion. It was therefore easy to confirm the results of the test thereby lending more credence to the quantitative findings.

3.6.3 Research Design

This research adopted the correlational research design which is a type of non-experimental research design (Muaz & Jalil Mohammad, 2013). Correlational research design just like other types of non-experimental designs (such as comparative research and longitudinal research) according to Robson (1993), does not involve a manipulation of situations, circumstances or experience of participants but rather measures a range of variables. For this reason, correlational research designs are also called correlational studies, because correlational data are most often used in the analysis (Buckingham, 2005).

It is worth noting, however that, correlation does not imply causation, and rather identifies dependence of one variable on another. In simple terms correlation is defined as a relationship between two variables (Ader, Mellenbergh and Hand, 2008). In this thesis, the dependent variables (the socio-economic activities in Takoradi) are studied to identify how they are shaped or influenced by the independent variable given as the severity of traffic congestion. Again, according to Hanson, Creswell, Clark, Vicky & Petskin (2005), clarity must be made that correlation between the two set of variables can be positive or negative. That is, in the case of the relationship tested, for instance a positive correlation between the variables meant that when traffic congestion increases, its effects on socio-economic activities also increase.

Correlational design was used in this study because, it helped to identify the relation of one variable to another, and seeing the frequency of co-occurrence in two natural variables (congestion and economic activities) (Baker, 1990). In other words, the use of correlation helped to look for variables that had a relationship with traffic congestion, in order to be able to predict the changes in traffic congestion on socio-economic activities of the Metropolis. To Robson (1993), the use of correlational design often entails the use of variables that cannot be controlled. For example, one cannot control the occurrence of traffic and hence, congestion at the time of the survey, but with a measured relationship using the linear regression model a change in traffic was used to predict a change in the economic activities of the city. Another explanation is that the fact that the occurrence of such a phenomenal congestion cannot be controlled does not mean the whole correlation cannot be performed.

Furthermore, the use of correlational research in this study allowed the collection of much more data than would have been in an experimental research (Tashakkori & Teddlie, 2003; Abane, 2004). Also, because correlational studies such as this research take place outside of a laboratory, results obtained are more applicable to everyday life. Another benefit of using the correlational design is that, it opens up a great deal of further research possibilities to other scholars. When researchers begin to investigate a phenomenon or relationship for the first time, correlational research provides a good starting position. It allows one to determine the strength and direction of a relationships tested so that later studies can narrow the findings down and, if possible, determine causation experimentally.

3.6.4 Primary Data Sources and Data Collection Instruments

Primary data refers data gathered by the research directly from the field (Creswell, 2003; Hanson et al, 2005). In general, there are two main sources from where primary data can be obtained. They include qualitative and quantitative sources. Primary source of data for this study therefore included different methods of obtaining data from both qualitative and quantitative sources of data. These included interviews, personal observation and administration of questionnaires in the field. Brief descriptions of each type of data are given in the next sections.

1. Interviews

An interview is a good approach that helps researchers to gather in-depth attitudes, beliefs, and structures or policies from individuals in charge of certain subjects or endowed with some types of expertise (Joan & Fisher, 2005; Creswell, 2003). The interview sessions were conducted at different institutions with different key participants. In this study, interviews were organized for pedestrians, motorists, firms and other road users who live

within and around the towns within which the five corridors are located, since they use the road frequently either by walking along, crossing or boarding a vehicle from one place to another.

Limited resources meant that only the motorists, land users and pedestrians found within communities closely associated with the corridors were interviewed. For instance, on Corridor 2 staff and employees in Ajumakoman Press, Shell and Goil Filling Stations were interviewed. Key personnel from the Department of Urban Roads, STMA, DVLA, MTTU, Metro Mass Yard the major terminals in the city were also interviewed to provide technical input into the research. Most of the interviews were conducted within the duration of 45minutes. The breakdown of the participants interviewed is shown in Table 11.

The interviews were conducted using a semi-structured interview guide. Semi-structured interviewing was preferred because the technique provided a clear set of questions for the interviewers and also helped to provide reliable, comparable qualitative data (Bernard, 1988 & Dimitrou, 1991). The interview process was preceded by observation, informal and unstructured interviewing in order to allow the researchers to develop a keen understanding of the topic which was necessary for developing the semi-structured questions.

Most of the questions asked at the different study areas surveyed did not follow a strict order but rather were based on the interaction or dialogue between the interviewer and the interviewees. One example of such questions is, “Are you aware of any measure(s) put in place to curb the challenges caused by road traffic congestion”? This question for instance was a common follow-up question for drivers and passengers who had ample knowledge about the causes of changes in traffic situation in Takoradi, which was a main question on

the guide. This helped to obtain quality information from the interviewees. Key interviewees were served with letters of introduction stating the purpose of the study and an appropriate time was scheduled for each interview.

Table 11: Participants and Number of Interviews Conducted

Participants	Number
Assistant Director, Urban Roads, Takoradi	1
Director, Physical Planning Dept., STMA	1
Manager, Metro Mass Yard	1
Household Heads	4
Drivers & Station Masters at Terminals	7
Passengers (Trotro)	4
Passengers	4
Traders including Merchants	13
Staff (banks)	4
Staff (Schools)	2
Staff (Other Industries and firms)	5
Total	46

Source: Author's Construct, (2015).

2. Personal Observation and Visual Ethnography

Personal Observation on the field is an excellent approach to identify behaviours (Joan & Fisher, 2005). According to Tewksbury (2009:44), observation is a systematic gathering of relevant information about people, places and things through 'detail looking at and breaking down of actions and interactions'. On the field, observations of areas along the road under study were essential. These provided several key indicators of the effects of traffic congestion and the identification of activities prone more to the situation of traffic.

In all, 10 days, were used to observe and take pictures of interest on the five roads studied,

with two days allotted to each corridor. Notes were taken on indicators such as peak hours of traffic congestion, attitude of the road users during traffic periods and mechanical strategies road users adopt to escape the traffic jam.

Public transport (Bus and Taxi) were boarded to observe the state of the road and also observe human activities that have worsened the congestion and created unsafe conditions for road users. Another purpose of the transect observation was to observe vehicular movements and their relationship with other components that contribute to the congestion. A digital camera was used in taking pictorial data of observed phenomena and behaviour. The observation and photography provided essential information which aided in discussing the causes, effects and variations of the levels of traffic congestion in the city.

In addition, the use of photography and observation enhanced the analysis carried out, by making the research easier and more reliable, given the possibility to corroborate the pictures with data gathered from the questionnaire administration. Furthermore, personal observation of the flow of traffic helped to have a feel of the traffic congestion and to identify the reasons for their occurrence.

3. Questionnaires

The core of the questionnaires was designed to collect data on the effects of the traffic congestion on socio-economic activities in Takoradi. Other questions asked bothered on issues of demographics, variation of traffic on the major corridors, causes and effects of traffic congestion and ways to mitigate the traffic congestion. Participation in the survey was voluntary. A semi-structured type of questionnaire was used with both close-ended and open-ended questions. The close-ended questions limited the respondents to some

selected options while the open-ended questions allowed respondents to provide their own answers to the given questions, suggesting that a wide range of answers were expected and after that, the researcher grouped and arranged them to give them meaning and facilitate their interpretation. Typical examples of the questions included, “with which of the following modes of transport do you often make your daily trip to and from the Central Business District of Takoradi” ? and “ What factors do you think contribute to road traffic congestion at the Metropolis”?

Questionnaires were administered to drivers who used passenger vehicles (taxi and mini-buses (‘trotro’, in local parlance). Commuters working in the formal sector including banks, the Physical Planning Department at the Sekondi-Takoradi Metropolitan Assembly, the Department of Urban Roads and other companies. Workers in the informal sector included traders, hawkers, merchants at the market circle and finally, residents from the towns within and around the arterial roads and who ply the roads within Takoradi Metropolis.

Since the number of various vehicles plying the five road links under the current study were not fully established, it was impossible to construct a sample frame for the drivers and commuters. Also given the similar characteristics of the vehicles that ply the roads as established by the distribution rate of the traffic mix in the Metropolis (Table 11), a quota of 30 each was assigned to the different groups of respondents on each of the five corridors studied. In sum, six interviewees of each category of respondents were surveyed using the questionnaire on the five roads, making a sample size of 120. This is shown in Table 12.

Table 12: Number of Questionnaires and Categories of Respondents

Zones	Category of Respondents				Total
	Drivers (Private and Commercial)	Passengers	Traders Hawkers and Market Sellers	Formal Employees	
1	6	6	6	6	24
2	6	6	6	6	24
3	6	6	6	6	24
4	6	6	6	6	24
5	6	6	6	6	24
Total	30	30	30	30	120

Source: Author's Construct, (2015).

3.6.5 Population of the Study

The population for the study comprised of commuters, workers and residence in and around the five Corridors, Zones or Master Stations (MS) identified by Mahama et al (2013) in their study of vehicular traffic in Takoradi. The zones included:

Zone 1: Areas in and around the Takoradi Market Circle

Zone 2: Paa Grant Roundabout near New Takoradi and the Takoradi
Polytechnic (T- Poly) Traffic Light Junction.

Zone 3: Effiakuma Traffic Light popularly known as Number Nine Traffic Light.

Zone 4: Tanokrom Traffic Light also known as Pipe Ano Traffic Light.

Zone 5: Kwame Nkrumah Circle which is popularly referred to as Ajep
Roundabout,

These zones comprised arterial roads linking different areas within the Metropolis to the city centre and are located within some residential suburbs as well. For this reason, the questionnaire and interviews were administered not only along the roads but also in the

suburbs within which the roads are located. A typical example is New Site located around the road from Effiakuma Junction to Takoradi Polytechnic.

3.6.6 Sampling Technique and Sample Size

The simple random sampling technique was used to administer the questionnaires. In using the technique, the researcher sought the consent of respondents (including the different categories outlined in Table 12) before the questionnaires were administered. Questions were read and interpreted to particularly the traders at the Market Circle and hawkers on the various roads since most could not read and write. However, care was taken to ensure that the entire stretch of each road was evenly covered in order to ensure a highly reliable set of data was gathered. In other words, there was relatively an equal interval given on each stretch of road before the next hawker or employees in the firms along the road were surveyed.

The selection of respondents was, however done in a random manner with no preferences (but rather purpose) as the underlying focus. In other words, there was an attempt to pick respondents who were fit for the category of sample targeted for the survey. That is, both purposive sampling and the simple random technique were used to survey the respondents (Yates et al, 2008: cited in Spellman, 2011). From arguments made by De Vaus et al. (2002) & Downie (2008), in order to be fair with generalizations of the findings, that is making the respondents representative of the population and not necessarily increasing the sampling size since the population from which the sample for the survey was chosen was unclassified, the simple random technique was the preferred choice.

Secondary data were obtained from published texts, journals, and institutions such STMA, the Department of Urban Roads and the Ministry of Transport. All documents reviewed have been duly referenced.

3.6.7 Techniques of Data Analysis and Discussion

i) Qualitative Data

Interviews conducted from the field were transcribed, analysed and discussed using the narrative technique. There was a translation of interviews into English where necessary. The translated and transcribed interviews were later added to the findings of the study where they provided insight into the discussion done without altering the statements made by the interviewee. This helped to follow the participants (interviewees) “down their trails” (Reissman, 2002 & Teye, 2007). That is, in using the narrative method of interview data analysis the opinions of the interviewees were presented as they were stated by the interviewees without altering them. Unlike conversation analysis, which focuses attention on moment-by-moment interchange, or grounded theory method which looks out for patterns in the interviews, the narrative analysis put together the “big picture” about experience with traffic congestion as the participants understood them (Silverman, 2006).

It was made easier to understand the complexity of issues (Dubois and Gadde, 2002) regarding traffic congestion in the Metropolis. There was also discussion of the observations made on the field. A typical example was the siting of dustbins along the roads at the central market. The participants’ observation of the flow of traffic and images captured with the camera also served as a basis for comparing the traffic volumes of on the major corridors studied.

ii) Quantitative Data

1. Test of Hypothesis

In order to identify the strength of the relationship between the severity of traffic congestion (cause variable or Independent Variable (IV)) and the socio-economic activities (Dependent Variable) in Takoradi, a simple linear regression was performed. Simple linear regression is basically used to analyze and predict relationship between cause and effect variables observed in a research (Atindabilla, 2013; Button and Hensher, 2001). Using the Statistical Package for the Social Sciences (SPSS) indices of the independent variable on the various corridors studied were explored with the attendant dependent variables to determine the degree of significant relationship or otherwise among them. That is, the dependent variable α was determined by the degree of the independent variable X . This is mathematically illustrated below;

$$\text{Linear regression model } \alpha = \beta x + c,$$

Where α = Dependent or Response Variable (Socio-economic Activities),

X = Independent or Explanatory Variable (Severity of Traffic Congestion).

β = the slope or gradient of the line. C = Regression Constant, the intercept (the value of α when $x = 0$).

The level at which test was regarded significant, that is 'p' value is 0.05%. Both the dependent variable and the independent variable were ranked using the Likert scale 1 to 5, where for severity of traffic, a value of 1 represented very low congestion, 2 represented low congestion, 3 represented moderate congestion, 4 represented high congestion and 5, very high congestion. In the case of socio-economic activities a scale of 1 represented very low effects, 2 represented low effects, 3 represented moderate effects, 4 represented high

effects and 5 for very high effects. The Likert Scale according to Cohen et al., (2000), is a psychometric response scale which provides a range of responses to a given statement and is used basically to measure respondents' attitudes or preferences.

This shows that the Likert scale gives the respondents several options to choose from, which makes it objective in soliciting responses (Cohen et al., 2000 and Muller, 1993). It implied that for the severity of traffic congestion to have a positive relationship with the effects (socio-economic activities) the beta value from the regression model has to be positive and a negative value of the beta also represented a negative relationship between the two variables. A key advantage of this technique is, it made it easier to study the individual influence of the cause variables (traffic congestion) on the socio-economic effects (Abdal-Salam, 2008). In other words linear regression was preferred to other tests such as multiple regression because the test focused on the degree of relationship between a dependent variable and one or more independent variables (Atindanbilla, 2013: Simon, 2003).

2. Use of Descriptive Statistics

Furthermore, the use of descriptive statistics, specifically the standard deviations of the average means of severity of traffic congestion among the roads was conducted to identify the road with the highest severity of congestion. This was performed to tell the differences in the levels of traffic congestion in the corridors studied and also to compare the responses of respondents on the severity of traffic to the actual data of traffic count by Mahama et al in 2013.

3.6.8 Challenges Encountered in the Research

Ethical considerations in research concerns the need to ensure that practices during and after a research are devoid of bias for such biases make the findings of the research not reliable, valid and reflexive (Rudestam & Newton (1992). It is therefore, no doubt that every good research work aims at producing knowledge which is not only valid but reliable as well. This study is no exception to that ideal. The term reliability in scientific research is defined by Rudestam & Newton (1992) as the ability of a measure to produce consistent results. Validity, on the other hand, indicates that a measure in fact measures what it purports to measure (Kitchin & Tate, 2000, p. 34). The third concern, reflexivity, also concerns the awareness of the researcher's contribution to the construction of meanings throughout the research process, and an acknowledgment of the impossibility of remaining 'outside of' one's subject matter while conducting research (Rudestam & Newton, 1992).

For instance, the use of the qualitative research instruments, namely, the interviews and the participant observations in this study, made it imperative for the study to be more reflexive. Reflexivity then, demands the need 'to explore the ways in which a researcher's involvement with the survey influences, acts upon and informs the research (Nightingale & Cromby, 1999; p. 228 cited in Ryan, 2005, p. 3).

Concerning the use of the key personalities in interviews, there was a high risk of being misled by the key personalities' sometimes biased information (Mikkelsen, 2005). There was also the tendency on the part of the management of the Department of Urban Roads, DVLA, MTTU and STMA for instance, to offer explanations that suit their political offices and preferences, that is speaking only the politically correct language and to polish up their

own mistakes while exaggerating on other information such as the causes of the congestion and measures taken by their outfit to mitigate them.

This unequal power relation did affected the quality of data derived from the interview. Dowling (2000) therefore in an attempt to find a solution to this challenge proposed the need for the identification and efficient negotiation of such power relations. Perhaps the use of the interviews helped to create the necessary rapport that enabled the best possible responses to be obtained in spite of the unequal power relations. As much as possible, the purpose of the research was explained in detail to the interviewees and their informed consent was sought before commencing with the interviews. All these procedures were deliberately followed to assure the respondents of utmost confidentiality, and in some cases, anonymity where it was so desired. This was to ensure that the respondents ~~will~~ would out of their own volition, provide the right and reliable kind of information for the study.

There was also the tendency for offering biased and untrue explanations to the personal observations made because of the unfamiliarity of the study area. This could also be as a ~~results~~ result of the different responses obtained from the field which affected the ability to completely detach personal views, opinions and prejudices in the course of discussion of the findings. Finally, the traffic growth rate calculated from the traffic count done by the Department of Urban Roads for the period 2003-2008 does not imply valid figures estimated for 2015 (refer to figures 8 and 9). Notwithstanding the challenges outlined, the analysis made in the study can be said to be of relatively high validity, reliability and reflexivity.

3.7 Operationalization of the Concept of Traffic Congestion

The concept of traffic congestion is ambiguous and hence several meanings have been given to the phenomenon by different scholars in recent times. For instance, it is operationalized by the Federal Highway Administration (FHWA) (2007) as “the level at which transportation system performance is no longer acceptable due to traffic interference”. Lomax, Turner and Schunk (1997) added that “the level of the systems performance may vary by the type of transportation facility, geographic location (metropolitan area or sub-urban area, rural area) and/or the time of day”.

Furthermore, the concept is measured more specifically in some other circumstances. For instance in the state of Minnesota, traffic congestion is considered more precisely as traffic flowing below 72.42km/45 miles per hour for any length of time in any direction, between 6am and 9am or 2pm and 7pm on weekdays. However, since other types of roadway congestion depend upon the area, facility and “acceptability” (the subjective notions of ideal speed and mobility), methods of measuring and tolerating congestion vary (Abass, 2008 and FHWA, 2007). For instance, this paper is specifically guided by the dimension offered by the Texas Transportation Institute as congestion occurring during peak hours (Monday-Friday, 6a.m.-10a.m. & 3p.m. - 7p.m.).

Again, the European Conference of Ministers of Transport (ECMT) (2007) gives us a version as, a situation in which demand for road space exceeds supply. To the Victorian Competition and Efficiency Commission (VCEC) (2006), it is the inconvenience vehicles impose on other vehicles due to the speed-flow relationship in conditions where the use of a transport system approaches capacity. Furthermore, vehicular congestion arises when traffic is delayed because of the presence of other vehicles (Link et al. 1999, p. 9). It usually

relates to an excess of vehicles on a portion of roadway at a particular time resulting in speeds that are slower, sometimes much slower than normal or "free flow" speeds (Department of transportation, U.S., 2005, p. 1).

Additionally, congestion is essentially a relative phenomenon that is, linked to the difference between roadway system performance that users expect and how the system actually performs. The European Conference of Ministers of Transport (1999) also stated that, traffic congestion can be referred to as long queues of vehicles which are constantly stopping and starting. Levinson et al., (1997) offer a similar concept as that of VCEC (2006) that, traffic congestion refers to a situation in movement where vehicles are impeded on a road and cannot move in a desirable manner. Another dimension of the concept is given as a condition of traffic delay (that is, the situation where traffic flow is slowed below reasonable speeds) because the number of vehicles trying to use a road exceeds the design capacity of the traffic network to handle it (Weisbrod, Vary, et al. 2003, p. 1).

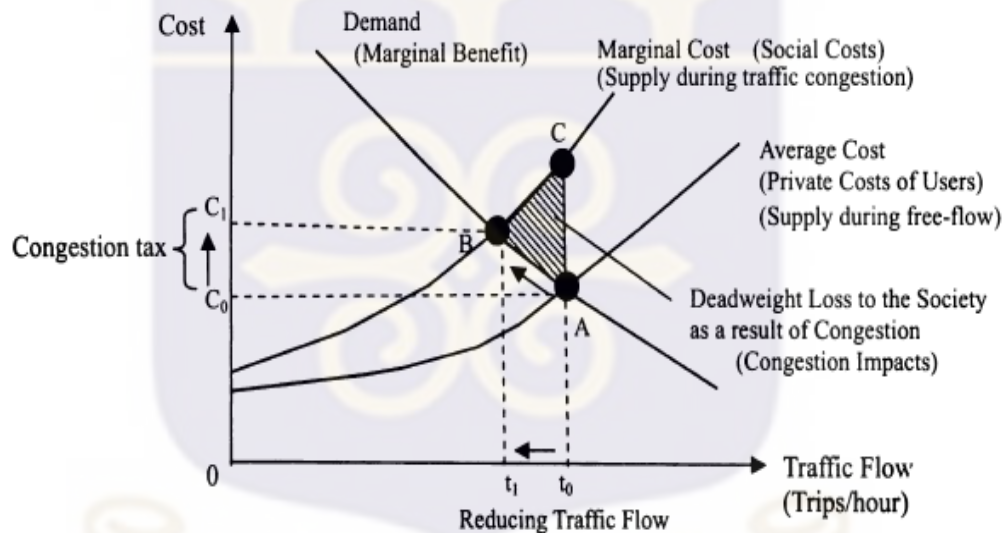
3.7.1 Economic Theory of Traffic Congestion

The concept traffic congestion is seen differently from the economic point of view. In the views of some economists, traffic congestion is a classic example of the overuse of a common resource (Blow et al., 2003, p.2). Stated differently, traffic congestion occurs from the use of roads above their carrying capacity. City authorities, who ignore the impacts of road traffic congestion impose on the road a marginal social cost. This occurs as a result of mass use of the roads by private car users instead of public vehicles; the cost of constructing a road as a result of this tends to be always higher than the utility derived from its use, (Hon, 2005, p.14). Figure 4 illustrates traffic congestion as an externality. From Figure 4, the equilibrium number of trips on the road per the expert's view best occurs at point A,

where average costs (private costs of users) equal marginal benefits (Blow et al. 2003, p. 2; Hon 2005, p. 15).

The unfortunate usually occurs during peak hours, when marginal social cost is taken into account and the socially optimal number of trips on the congested road occurs at point B, that is, a situation where marginal benefits equal marginal costs. This causes a decrease in the number of trips on the road from t_0 to t_1 and brings a deadweight loss shown by the shaded triangle, ABC. The deadweight loss unbearably is a cost to everyone in the society as a result of the slowed traffic flow (Takuldar, 2013).

Figure 4: Traffic Congestion as an Externality



Source: Blow, Leicester and Smith (2003, p. 2); Hon (2005, p. 15)

The numerous concepts of traffic congestion given above according to Agyemang (2009) seem to share some three basic features in common. The similarities identified include:

1. Congestion leads to the creation of extra cost on expenditure for all users of the transport facility, which is has been explained here by the economist as marginal cost (See Fig 2).
2. Transport facilities namely, terminals, routes, intersections or bridges, lanes or corridors have limits in terms of the capacities they were built to handle (also referred to as Maximum Road Capacity, (see Figure 1); and finally,
3. Congestion occurs on a repetitive basis (Cyclic and Regular) hence giving an indication of the activities that characterize an area.

Taylor (1999) grouped these characteristics of traffic congestion under a type of congestion referred to as recurring congestion while those that are caused as a result of special unfavourable occurrences on the roads such as road accidents, rainfall, presence of smoke, vehicle breakdowns, road works and others are referred to as nonrecurring congestion (Taylor 1999: Taylor et al., 2000). It is based on this observation that a comprehensive explanation which has gained much prominence among most of the concepts of traffic congestion in literature is offered by Taylor.

He stated that, “traffic congestion is the phenomenon of increased disruption of traffic movement on an element of the transport system, observed in terms of delays and queuing, that is generated by the interactions amongst the flow units in a traffic stream or in intersecting traffic streams. The phenomenon is most visible when the level of demand for movement approaches or exceeds the present capacity of the element and the best indicator of the occurrence of congestion is the presence of queues” (Taylor et al., 2000, p. 269). One other theme worth mentioning is that traffic congestion is dynamic and thus, varies spatio-temporally, that is to say, it varies with space and time.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.0 Introduction

This chapter is devoted to the discussion of the findings of the research. That is, the chapter specifically and exclusively presents the findings on objectives investigated in the study and also discusses the findings based on theory and reviewed literature. The findings and discussion include the demographic characteristics of the respondents, the spatial variation of traffic congestion, the effects of traffic congestion on the socio-economic activities appraised and measures taken to mitigate the traffic congestion. The chapter also discusses the use of Ullman's concept of spatial interaction (1980) as the theoretical basis of the study and test of hypothesis using the linear regression model.

4.1 Findings

4.2 Demographic Characteristics of Respondents

Table 13 shows the socio-demographic characteristics of drivers surveyed. In all 30 drivers were surveyed using the questionnaire on the 5 corridors. That is, six drivers from each corridor. The drivers included those who used private cars and those who drove public vehicles. These respondents were contacted at various car parks and terminals located around the Market Circle. A typical example is the taxi rank at Effiakuma Junction. Public vehicle services included trotro, medium and mini buses. From Table 13, 60% of the drivers were male while 40% were female. Also, a majority of the drivers (representing 37% of the sample population) indicated they had had formal education up to the primary level, with the least, 10% indicating had a tertiary certificate.

Table 13: Socio-Demographic Characteristics of Drivers (Private and Commercial)

Variable	Categories	Freq.	%
Sex	Male	18	60
	Female	12	40
Educational level	No formal education	8	27
	Primary	11	37
	Middle School /JSS	4	13
	SHS/ O'Level	4	13
	Post Sec./Tertiary	3	10
Age Groups	18-29yrs	13	41
	30-39yrs	6	22
	40-49yrs	5	17
	50-59yrs	4	13
	60+	2	7
Marital Status	Married	8	27
	Divorced	5	17
	Never Married	6	20
	Widowed	6	20
	Separated	1	3
	Co-Habiting	4	13
Migrant	Yes	17	57
	No	13	43
Period of Stay	1-5yrs	12	40
	6-10yrs	7	23
	11-15yrs	3	11
	16-20yrs	4	13
	21+yrs	4	13

Source: Author's Construct (2015).

Furthermore, 27% drivers were married while 3% were separated. Many of the drivers (13% of the respondents) had migrated from other parts of Ghana to Takoradi. A majority of the drivers (63% of the respondents) were residents of Takoradi, who had resided there for not less than 10 years. A similar percentage said they were within the ages of 18 to 39 years. This age represents active population as defined by the Ghana Statistical Service.

Table 14: Socio-Demographic Characteristics of Passengers

Variable	Categories	Freq.	%
Sex	Male	17	56
	Female	13	44
Educational level	No formal education	6	20
	Primary	8	27
	Middle School./JSS	6	20
	SHS/ O'Level	5	17
	Post Sec./Tertiary	5	17
Age Groups	18-29yrs	12	40
	30-39yrs	9	30
	40-49yrs	5	17
	50-59yrs	4	13
	60+	0	0
Marital Status	Married	10	33
	Divorced	2	7
	Never Married	10	30
	Widowed	5	17
	Separated	4	13
	Co-Habiting	0	0
Migrant	Yes	14	46
	No	16	53
Period of Stay	1-5yrs	9	30
	6-10yrs	12	40
	11-15yrs	7	23
	16-20yrs	1	3
	21+yrs	1	3

Source: Author's Construct (2015).

Table 14 shows the demographic characteristics of passengers surveyed from different stations within the Takoradi Metropolis. These passengers were relaxed in various types of public vehicles waiting for the vehicle to be fully loaded. The public vehicles included mini and trotro buses and taxis parked at the various terminals. Typical examples of the terminals included the Kufuor, Takoradi and Effiakuma taxi ranks and the Accra station. The team who conducted the survey made sure the respondents had ample time to complete

the questionnaire; thus in cases where an interviewer could not complete the questionnaire before the vehicle took off, he/she had to join the passengers until they finished the interview. Findings on the characteristics of passengers showed that 56% of them were female and 70% of them were within the age band of 18-39 years.

Table 15: Socio-Demographic Characteristics of Traders (‘Market Women’ and Hawkers)

Variable	Categories	Freq.	%
Sex	Male	7	23
	Female	23	77
Educational level	No formal education	4	13
	Primary	14	46
	Middle School./JSS	7	23
	SHS/ O’Level	4	13
	Post Sec./Tertiary	1	3
Age Groups	18-29yrs	12	40
	30-39yrs	11	37
	40-49yrs	5	17
	50-59yrs	1	3
	60+	1	3
Marital Status	Married	7	23
	Divorced	7	23
	Never Married	8	27
	Widowed	9	30
	Separated	4	13
	Co-Habiting	4	13
Migrant	Yes	13	44
	No	17	56
Period of Stay	1-5yrs	13	43
	6-10yrs	10	33
	11-15yrs	5	17
	16-20yrs	1	3
	21+yrs	1	3

Source: Author’s Construct (2015).

The few males surveyed under traders were hawkers particularly along the Tanokrom road to Kwame Nkrumah Circle. Most of them (40%) had had formal education up to the

primary level and as such could read properly and make meaning of the survey. A majority of the traders (56%) were also natives of Takoradi and had stayed in Takoradi for about 15 years.

Table 16: Socio-Demographic Characteristics of Workers in the Formal Sector

Variable	Categories	Freq.	%
Sex	Male	17	56
	Female	13	44
Educational level	No formal education	0	0
	Primary	2	7
	Middle School./JSS	3	10
	SHS/ O'Level	5	17
	Post Sec./Tertiary	20	67
Age Groups	18-29yrs	12	40
	30-39yrs	7	23
	40-49yrs	6	20
	50-59yrs	4	13
	60+	1	3
Marital Status	Married	12	40
	Divorced	8	27
	Never Married	5	17
	Widowed	2	7
	Separated	2	7
	Co-Habiting	1	3
Migrant	Yes	16	53
	No	14	47
Period of Stay	1-5yrs	14	47
	6-10yrs	9	30
	11-15yrs	4	13
	16-20yrs	2	7
	21+yrs	1	3

Source: Author's Construct (2015).

Table 16 shows workers employed in the formal sector in Takoradi. This sector included, banks, manufacturing industries and other finance and service institutions located along the roads in the CBD. Particular examples include Prudential Bank, Stanbic Bank,

Unibank, Ecobank and other firms located along the road from Kwame Nkrumah Circle and Paa Grant Circle to the Market Circle. Other firms include G-Extreme Computer Services, Deek Farm Guest House and the Ajumakoman Press House all located along Paa Grant road to Market Circle. Companies such as Baker Hughes-Oil Company located along Tanokrom road to Kwame Nkrumah Circle were also visited. The survey showed that, more males (56%) were employed in the said firms. In other words unlike the informal sector where there were more females than the males, the males dominated the formal sector.

4.3 Geographical Variation of the Traffic Congestion on the Arterial roads

4.3.1 Introduction

In finding-out the variations in road traffic congestion on the various corridors, certain variables such as activities that drew people to use the corridors, number of respondents who owned vehicles, means of transport often used by respondents on the corridors, reasons for use of such means, peak period of traffic congestion and the severity of the traffic congestion gave insights into why there were different levels of congestion on the roads. For instance, the severity of traffic congestion helped to identity the corridor with the highest mean of congestion during the peak period of traffic. The findings are presented in Tables 17, 18, 19 and 20 as well as Figures 6 and 7 in the subsequent sections.

Table 17: Activities that Attracts Respondents to Use the Arterial Roads

	Corridors				
Activities	1	2	3	4	5
Education	11	29	19	12	18
Work	17	31	21	16	31
Trade	36	7	17	23	24
Recreation	9	13	25	23	21
Church	17	18	7	18	5
Others	10	2	11	8	1
Total	100%	100%	100%	100%	100%

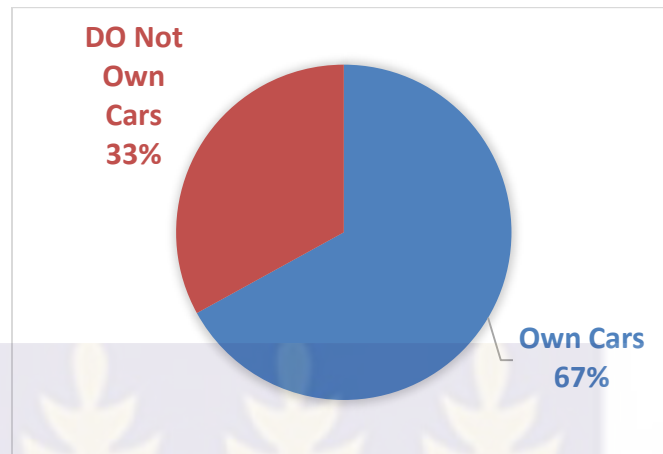
Source: Author's Construct (2015).

Table 17 shows socio-economic activities that drew respondents from Takoradi and its suburbs to use the roads in the city. In other words the findings are meant to provide major reasons for respondents' usage of the various corridors in the city. From the survey, as shown in Table 17, Corridor 1 representing areas in and around Market Circle, recorded the highest the need for training as the highest response (36%) from the respondents. From Paa Grant Circle to Takoradi Polytechnic, 31% users of the road indicated that they often drove on the road to work, while the next highest group (29%) indicated they traveled on the road to school.

Recreational activities recorded the highest (25%) of response on the road from Effiakuma Traffic Light to Effiakuma Junction. At Tanokrom Traffic Light, 23% of the respondents indicated they usually traveled from Tanokrom to the Market Circle to trade., A similar number (23%) also indicated they were traveled for the purpose of tourism. Kwame Nkrumah Circle to Tanokrom and Market Circle recorded highest response of 31% of respondents said they were traveled to and from work.

4.3.2 Percentage of Respondents Who Own Vehicles

Figure 6: Percentages of Respondents Who Owned Vehicles



Source: Author's Construct (2015).

With respect to vehicle ownership as shown in Figure 6, 33% of the respondents said they did not own a car, while 67% stated that they own vehicles but mostly use the taxis and mini-buses ('trotro') as means of transport from the house to the work and other places.

4.3.3 Means of Transport Usually Used by Respondents

Table 18: Means of Transport Usually Used by Respondents

	Corridors				
Means of Transport	1	2	3	4	5
Trotro	30	13	29	19	21
Taxi	31	29	17	17	30
Private Vehicle	12	28	19	21	12
MMT & V. Trucks	21	10	15	27	18
Company Vehicle	6	17	13	12	19
Others	0	3	7	4	0
Total	100%	100%	100%	100%	100%

Source: Author's Construct (2015).

In order to examine how means of transport contributed to traffic congestion, respondents

were asked to indicate the common means of transport they used over a month. This is shown in Table 18. In other words the expectation from this finding as illustrated in the Table 16 is to find out from the users of the roads, the most frequently used means of transport and the number of times they used such means on the roads studied. Roads in and around Market Circle named Corridor 1 had taxis (representing 31% of the cases) being the major means of transport. On the Paa Grant Road to Takoradi Polytechnic stretch and the Kwame Nkrumah Circle to Market Circle, taxis again dominated the means of transport, recording percentages of 29% and 30% respectively. Private vehicles followed as the second most frequently used means of transport (28%) on Corridor 2. Trotro were however, recorded as the most frequently used means of transport on the Effiakuma Traffic Light to Effiakumah Junction segment. On the Tanokrom Road to Kwame Nkrumah Circle stretch, Metro Mass Transit (MMT) buses and vehicular trucks were recorded as the-most frequently used means of transport by respondents (27%).

4.3.4 Reasons for Means of Transport by Sex of Respondents

Table 19: Reasons for Choice of Means of Transport by Sex of Respondents

	Males Corridor 1-5					Females Corridor 1-5				
Reason	1	2	3	4	5	1	2	3	4	5
Comfort	12	7	12	21	11	39	15	2	17	35
Affordability	13	13	45	7	17	6	23	10	5	33
Availability	16	17	27	33	27	2	12	24	2	12
Reliability	19	13	1	7	2	29	15	26	16	7
Timeliness	7	15	2	12	7	8	21	12	18	3
Safety	15	21	4	0	11	1	12	7	5	9
Accessibility	17	14	9	9	23	7	1	12	23	0
Other	1	0	0	11	2	8	3	7	19	1
Total (100%)	100	100	100	100	100	100	100	100	100	100

Source: Author's Construct (2015).

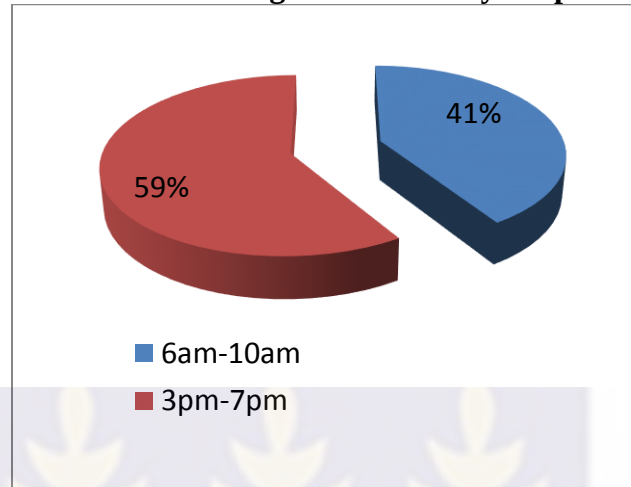
Table 19 shows respondents' use of the roads in Takoradi, set out as sex against differences in attitudes towards the various means of transport. On Corridor 1, 19% of males indicated it was reliable while 39% of females said it was comfortable. The common means of transport on Corridor 1 was taxi (Table 18) hence, a conclusion made is that most females 39% preferred the taxi because it was comfortable or that females preferred using comfortable means of transport while men went with the available and reliable one.

Other reasons including transport being relatively cheaper (45%) was recorded on Corridor 3 by males and safety (21%) on Corridor 2 also by males. On Corridor 2, 23% females said they used the preferred means of transport because it was affordable while on Corridor 3, 26% stated it was reliable. Again, an observation on Corridor 3 under females is that a majority of the respondents (26%) comprised of "market women", traders who usually traveled from the suburbs of the CBD to the Market Circle.

Thirty three percent of male respondents on Corridor 4 claimed they always used the available means of transport, just like 27% of respondents on Corridor 5. Twenty three percent of females on Corridor 2 on the other hand, stated that they used the means of transport which was easily accessible while 35% of respondents on Corridor 5 said their choice was based on how comfortable was the means of transport. Less important among the reasons for the choice of means of transport included the timeliness of passengers (7%), which was recorded by for males on Corridor 1. Deductively females, in most cases stated that they used a means of transport because it was comfortable.

4.3.5 Peak Periods of Traffic Congestion

Figure 7: Peak Periods of Traffic Congestion Noted by Respondents



Source: Author's Construct (2015).

From the field survey as shown in Figure 7, majority of the respondents (59%) claimed most of the traffic on Corridors 1, 2, 3 and 5 occurred during the evening peak hours of traffic. This is different from the scenario in 2013, when the period between the 6a.m. to 10a.m. peak hours of traffic recorded higher traffic counts on most of the roads (Corridors 1, 2, and 3) than the 3p.m. to 7p.m. peak hours, as indicated in Table 9.

4.3.6 Severity of Traffic Congestion during Peak Periods (6am to 10a.m. and 3p.m. to 7p.m.)

Table 20: Severity of Traffic Congestion during Peak Periods (6a.m. to 10a.m. and 3p.m. to 7p.m.)

Corridors	N	Minimum	Maximum	Mean	Std. Deviation
1	24	1.00	5.00	2.6667	1.55106
2	24	1.00	5.00	2.0870	1.44326
3	24	1.00	5.00	2.6667	1.43456
4	24	1.00	6.00	2.9167	1.52990
5	24	1.00	5.00	3.5200	1.35769
Total	120	5.00	26.00	13.8571	7.31647

Source: Author's Construct (2015).

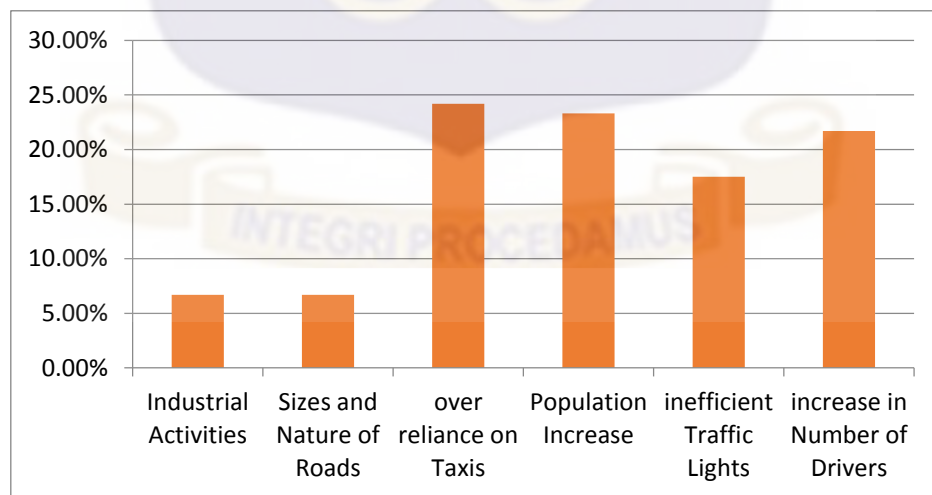
Responses of respondents on the severity of traffic congestion using the Likert Scale of 1 representing very low congestion, 2- low congestion, 3-moderate congestion, 4- high congestion and 5-very high congestion were examined. In all 24 responses represented by N on each corridor were collected, as shown in Table 18. From Table 18, the corridor with the highest mean is was Corridor 5 (Kwame Nkrumah Circle to Market Circle) of 3.52. Paa Grant Circle to Takoradi recorded the lowest mean of 2.

Corridor 4 representing Tanokrom Road to Kwame Nkrumah Circle recorded the second highest mean of 2.9, followed by Corridor 3 and Corridor 1 respectively with 2.6 each. Corridor 3 and Corridor 1 represent the Effiakuma Junction to Effiakuma Traffic Light stretch and the circular Market Circle road respectively.

4.3.7 Factors leading to Differences in Congestion Levels

Figure 8 shows the views of respondents on factors that contribute to the differences traffic volumes on the various roads appraised.

Figure 8: Factors that Contribute to the Differences in Levels of Traffic Congestion



Source: Author's Construct (2015).

Considering the responses from the survey as shown in Figure 7 a majority of the respondents (25%) claimed that increases in the traffic congestion at the CBD of Takoradi was due to the overreliance on taxis, while the tiny minority (6%) said it is was due to the increase in industrial activities and the small widths of the roads in the city. Other reasons given included, the rise in the population of Takoradi, reflected in the increase in the number of driving persons on the roads.

4.4 Effects of the Traffic Congestion on Socio-economic Activities

4.4.1 Effects of Traffic Congestion on Work

Table 21: Effects of Traffic Congestion on Work

	Studied Corridors	Effects in %					Total (%)
		Reduced Work Time	Difficulty in Distributing Goods and Services	Increased Inventory Holding	Inability to Work Efficiently due to Stress	Reduced output or City's Growth	
	1	23.7	35	15	14.3	12	100
	2	17	49.4	19	10.4	4	100
	3	18	23	17.8	11	30.2	100
	4	15	21	17.4	27.4	19.2	100
	5	36.3	35	9.3	12.4	7	100

Source: Author's Construct (2015).

Table 21 shows the effects of traffic congestion on workers in Takoradi. Much productive work time wasted by 36% of respondents indicated on Corridor 5, while 49% (representing the majority) of respondents on Corridor 2 (Paa Grant Circle to Takoradi Polytechnic) said they had difficulty in distributing logistics or in commuting to make appointments on time due to the accompanied stress they had to go through daily.

Again from Table 21, 30% of respondents on Corridor 3 stated that traffic congestion reduced output or expected GDP in Takoradi. On Corridor 1, a majority of the respondents (35%) stated that they were unable to distribute logistics or goods and services on time to their clients and customers. A majority of respondents on Corridor 4 (27%) stated that they became stressful and as such were unable to perform well at the work place.

4.4.2 Effects of Traffic Congestion on Transportation

Table 22: Effects of Traffic Congestion on Transportation

	Studied Corridors	Effects in %					Total (%)
		Increase in Time Spent on Roads	Increase in Fuel Usage	Destruction of Brakes and Accelerators	Inability to Forecast Travel Time	Environmental deterioration	
	1	23.7	35	15	14.3	12	100
	2	16.3	33.3	19.3	16.5	14	100
	3	17	13	17	34	19	100
	4	23	29	21	10	17	100
	5	31	14.6	4.4	35	15	100

Source: Author's Construct (2015).

Table 22 shows the effects of traffic congestion on transportation, expressed in terms of cost, time, the deterioration of the environment and the breaking down of vehicles. On Corridors 1, 2 and 4 (Market Circle, Paa Grant Road to Takoradi Polytechnic and Tanokrom Road) 35%, 33% and 29% respectively, said they bought extra fuel for driving on those roads.

Corridors 3 and 4, recorded highest percentages (34%) and (35%) respectively of respondents who were unable to forecast travel time hence could not make appointments on time. Environmental deterioration in terms of air pollution, noise and poor visibility was cited by the least number of respondents as deriving from the negative impact of traffic

congestion on transportation. For instance, on Corridors 1 and 2, only 12% and 14% respectively said they thought traffic congestion caused environmental deterioration. Similarly, only 13% of respondents on Corridor 3 held traffic congestion to be responsible for the increase in fuel usage. Again, only 10% of respondents on Corridor 4 cited road traffic congestion as being the cause of their difficulty in predicting travel time, while only 4.4% of the respondents on Corridor 5 said they thought traffic congestion was responsible for the destruction of brakes and accelerators of their vehicles.

4.4.3 Effects of Traffic Congestion on Education

Table 23: Effects of Traffic Congestion on Education

	Studied Corridors	Effects in %					Total (%)
		Issues of Safety	Low Performance Among Staff and Students and Parents	Increased Expenditure by Parents	Accident Resulting in Injuries and Death	Stress to Parents	
	Zone 1	23.7	35	15	14.3	12	100
	Zone 2	15.6	30	25.1	15.3	14	100
	Zone 3	17	23	18	11	31	100
	Zone 4	7.25	7.34	34.5	17	33.1	100
	Zone 5	12	14.5	29	7	27	100

Source: Author's Construct (2015).

Some residents complained of the impossibility of sending their wards to school early, especially during the hours of 7a.m. to 9a.m. due to the heavy traffic on the roads. They said they were therefore forced to leave home early, with the implied negative effects on the performance of the children at school and parents at work respectively. For instance from Table 23, 35%, 30% and 23% of respondents views on Corridors 1, 2 and 3

respectively indicated that, the major worry of traffic congestion to parents is was the need to wake up early to prepare for work.

On Corridor 4, 34% of the parents stated that they had to spend extra on fuel or car fares before getting their wards to school. On Corridor 5, 27% the majority of the respondents (27%) said traffic congestion made them stressed-up at work. Respondents on Corridors 1 and 2, however, experience the least effects of traffic congestion on education: 12% and 14% on Corridor 1 and 2 respectively. Corridors 3, 4 and 5 also had the least numbers of respondents (11%, 17% and 7% respectively) who named traffic congestion as the cause of road accidents resulting in injuries and death with.

4.4.4 Effects of Traffic Congestion on Recreation

Table 24: Effects of Traffic Congestion on Recreation

	Studied Corridors	Effects in %					Total (%)
		Reduction in Tourist Attraction	Decrease in revenue from Tourism	Reduction in Time Spent at Tourists Sites by Tourists	Reduction of Revenue Obtained by Tourists Sites	Road Rage	
	1	23.7	35	15	14.3	12	100
	2	17	19.4	34.1	2.23	27.3	100
	3	11	7.6	19	14.3	47.1	100
	4	2.3	22.7	17.7	22.4	35	100
	5	25	22.3	19.5	12	21.2	100

Source: Author's Construct (2015).

An enquiry into the effects of traffic congestion on social and recreational activities revealed that, hotels such as Akromah Plaza, Hill Crest, Vienna City Beach and Hotel, Allan Beach, Hide-out and the Takoradi Harbour all situated in built-up areas just on the

outskirt of the CBD attracted a lot of tourists, causing traffic congestion especially during festive seasons. From Table 24, 35% of respondents on Corridor 1 and 25% on Corridor 5 indicated that traffic congestion deterred people in the city from visiting such areas on festive seasons and 34% of the respondents on Corridor 2 also stated that traffic congestion reduced the time tourists spent at tourists sites, a factor which negatively influenced the level of spending at the sites. Stated differently, the less time spent by tourists at tourist sites the less amount they spend at the sites. The proportion of respondents on Corridor 5 who felt the same way was 12%.

On Corridors 3 and 4, 47% and 35% of the respondents respectively indicated that traffic congestion in Takoradi sparked road rage. On Corridors 1 and 2, 12% and 2% of respondents respectively (representing the minority in each case) stated that traffic congestion made them angry.

4.4.5 Effects of Traffic Congestion on Health and The Environment

Table 25: Effects of Traffic Congestion on Health and Environment

	Studied Corridors	Effects in %					Total (%)
		Headache	Choking and High Blood Pressure	Stress and Loss of Energy	Fear Caused by Road Rage	Others	
	1	23.7	35	15	14.3	12	100
	2	17	4	19.4	36	24.7	100
	3	23.1	32.2	17.4	11.3	16	100
	4	12	21	27	17	23	100
	5	37	14	29	27.2	33	100

Source: Author's Construct (2015).

Release of harmful gases into the air usually by worn-out vehicles was regarded as a critical challenge in the city of Takoradi. For instance, from Table 25, 35% and 32% of respondents on Corridor 1 and Corridor 3 respectively explained that traffic congestion in the city made it difficult for them to breathe, due to the inhaling of harmful gases from the vehicles. Almost two-fifths of the respondents on Corridor 5 complained of headache due to the difficulty in breathing the polluted air. On Corridor 2, 36% stated they experienced fear during long hours of traffic congestion while 27% of the respondents on Corridor 4 claimed they became stressed-up due to long stays in traffic.

The least number of respondents (4% and 14% on Corridors 2 and 5 respectively) linked choking which usually leads to high blood pressure. The column “Others” includes noise made from the vehicles and dust in the air especially during the dry seasons.

4.4.6 Effects of Traffic Congestion on Religious Activities

Table 26: Effects of Traffic Congestion on Religious Activities

	Studied Corridors	Effects in (%)					Total (%)
		Change of Place of Worship	Delay to Other Commuters	Noise	Increase Cost	Others	
	1	23.7	35	15	14.3	12	100
	2	17	44	19	6	14	100
	3	15	21	27	11	26	100
	4	16.2	23.2	17.7	27.4	16	100
	5	3	41.9	9	17	29.1	100

Source: Author's Construct (2015).

With respect to effects of traffic congestion on religious activities, 35%, 44%, and 41% respondents on Corridor 1, 2 and 5 respectively (as shown in Table 26) were uncomfortable

with delays in attending to religious activities, specifically at church and in the mosque. On Corridor 3, 26% of the respondents complained about noise made by vehicles during the early mornings. On corridor 4, however, 27% respondents (mainly Christians) said they were forced to pay higher fares taxis, especially on Sundays because they needed to travel from far distances like Tanokrom and Kwesimintim to places like Star of the Sea Catholic Church, located along Paa Grant Road. Those groups of people said they had no other alternative means of transport as most trotto drivers did not work on Sundays.

4.5 Test of Hypothesis

Table 27: Test of Hypothesis

Socioeconomic Effects (DV)	MS 1		MS 2		MS 3		MS 4		MS 5	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.
Lateness	.084	.611	.216	.268	.148	.474	-.050	.763	.423	.022*
R	.012		.058		.024		.004		.208	
Increase Fares	-.018	.927	-.373	.063	-.063	.633	-.283	.105	.451	.005*
R	.000		.156		.011		.115		.150	
Stress	-.006	.963	-.116	.604	-.437	.015*	.149	.334	.180	.398
R	.000		.013		.239		.042		.031	
Increase Prices	.400	.015*	.211	.242	-.063	.738	-.574	.000*	.024	.883
R	.062		.170		.005		.556		.001	
Lower Demand	.139	.494	.054	.764	-.049	.798	.159	.332	-.227	.181
R	.022		.004		.003		.043		.076	
Low Sales	-.012	.948	-.158	.341	.014	.943	.091	.780	.237	.247
R	.000		.043		.000		.004		.058	
High Fuel Cons.	.048	.780	-.046	.842	.190	.472	.149	.316	.246	.238
R	.004		.002		.024		.046		.060	
High Land Rent	.337	.061	-.250	.179	.007	.971	.138	.467	.193	.400
R	.150		.084		.000		.024		.031	
Rd. Dilapidation	.078	.620	.087	.679	-.070	.750	-.237	.192	.150	.446
R	.011		.008		.005		.076		.026	
Accident	.313	.012*	.401	.032*	.268	.152	-.293	.214	.047	.826
R	.111		.200		.091		.079		.002	
Ina. to Forecast	-.157	.359	-.105	.617	-.134	.470	-.054	.755	-.044	.849
R	.038		.012		.024		.005		.002	
Pollution	-.265	.147	.341	.041*	-.310	.130	-.314	.084	.088	.685
R	.093		.184		.101		.130		.007	
Reduce Worker P.	.325	.012*	-.280	.105	.148	.464	-.046	.767	-1.32	.268
R	.131		.120		.025		.004		.053	

NB: $p < .05\%$, R = R Square Value and * = highly significant relationship.

Source: Author's Construct (2015).

Table 27 shows the test of hypothesis which guided the study. The hypothesis is stated as follows: “*There is a significant relationship between severity of traffic congestion and socio-economic activities, namely, work, transportation, education, health, religious activities and recreation in Takoradi*”. The data as shown in table 25 was generated by asking all respondents interviewed, 24 each of the 5 corridors studied to indicate their views on the severity of congestion on the roads. This was done by using a Likert Scale as discussed under data analysis in Chapter 3. Using the same Likert Scale, the severity of traffic congestion was used to predict the major socio-economic effects acknowledged by the respondents as significant predictor of traffic congestion on the individual roads appraised.

The test which was performed with a significant value of 0.05% allowed for the determination of the level of relationship between severity of traffic congestion on the 5 arterial roads and socio-economic activities. As already stated a positive relationship means when traffic congestion increases severely, its effects on socioeconomic activities also increases, while a negative relationship means that when traffic congestion increases, its effects on socioeconomic activities reduces. From Table 25, socio-economic effects of traffic congestion represents dependent variables while the independent variable is represented by traffic congestion severity on the various roads.

Corridor 1, that is, areas in and around Takoradi Market Circle, recorded no significant relationship between delay to places, stress and fuel consumption. However, there is a significant relationship between probability of accident occurring (0.12) and reduction in

worker productivity (0.042) and severity of traffic congestion. Again, on Corridor 1 there is also a significant relationship between increase in prices of goods and services (sig. value, 0.015) and severity of traffic congestion.

On Corridor 2, that is Paa Grant road to Takoradi Polytechnic, a positive relationship was found to exist between severity of traffic congestion and road accident. On Corridor 2 again, pollution recorded a significant value of 0.041, indicating a significant relationship between pollution and severity of traffic congestion.

On Corridor 3, there is no relationship between severity of traffic congestion and almost all the socio-economic activities except increase in prices of goods and services. Thus, a negative relationship (beta value -0.574 and significant value 0.000) existed between severity of traffic congestion and increase in prices of goods and services. Respondents therefore indicated from the test that traffic congestion had little effects on activities along the road.

Corridor 4, (Tanokrom Junction to Kwame Nkrumah Circle) recorded a negative relationship between increases in prices of goods and services and severity of traffic congestion. No other statistical relationship was observed between variables on the corridor.

On Corridor 5 (Kwame Nkrumah Circle to the Market Circle), a significant relationship (indicated by a significant value of 0.022) occurred between lateness or delay to places notably work, school or market and severity of traffic congestion.

There is no significant relationship between increase in transport fares and higher severity of traffic congestion on all the corridors indicated, except and again on Corridor 5 where

there is positive and significant relationship indicated by a beta value of 0.451 and significant value of 0.05.

4.6 Measures Taken to Mitigate the Challenges Posed by Traffic Congestion.

Several projects were being embarked upon to mitigate the growing traffic congestion in the City of Takoradi by the time of this study. The said interventions are were being carried out by institutions such as the Sekondi-Takoradi Metropolitan Assembly, the Department of Urban Roads, the GPRTU, Residents, as well as the Central Government through the Members of Parliament and the District Chief Executives. Some of the said institutions, according to the PRO of STMA, were living-up to expectation, while others performed far below expectations. The head of the Physical Planning Department, Mr. Affum, mentioned some of the projects that being carried out to making sure that, challenges confronted by the metropolis due to congestion are mitigated.

He asserted the need to expand the carriageways in the Metropolis as well as the need to convert most single lanes into dual lanes. There 8.5km stretch of road from Aprembo Junction to Nkroful Junction was under reconstruction. It was a dual road meant to serve the people of Aprembo, which was earlier classified as a third class residential area. Another dual-carriage way (Effia Nkwanta Bypass to Fijai), was also under construction, as was the link from Ntankoful to Fijai. Finally, a new road was under construction from Assakai to Whindo to serve the people in the peripheral areas of the city. This is intended to reduce the number people who commute from the suburbs of the city to the CBD.

In addition to the measures taken by the STMA officials, there is also a partnership agreement between the STMA on one hand and different private firms on the other to

construct some interchanges in the Metropolis. There are also different Public Private Partnership (PPP) agreements between the STMA on one hand and different private firms on the other to construct more interchanges in the city. The Kwame Nkrumah Circle, Paa Grant Circle and Aprembo were mentioned as some of the initial places to construct interchanges. The interchanges according to Mr. Affum, would help ease traffic on the various roads leading to the CBD.

There were also proposals from the STMA with EIA (Environmental Impact Assessment) report dated 2015 to construct some major terminals in the city. A typical location in the report ~~is~~ was the area around Tanokrom, meant to make it easy for all heavy trucks which having nothing to do at the CBD to off-load their goods ~~to~~ at the market without necessarily driving through the CBD. Another terminal at Dabobasi - Aboankwanta earmarked for construction. The proposed policies and projects were proof of the need for heavy duty vehicle transit terminals to be constructed in the Metropolis.

The Kasaworodo bypass was also under construction, under the auspices of the Department of Urban Roads Department in collaboration with the STMA, with the final phase expected to be completed by December, 2015, according to Mr. John Owusu, Acting, Regional Maintenance Engineer, and Department of Urban Roads. He added that asphaltic overlay works on some designated roads in the city were underway, with the total stretch of roads that has had been newly asphalted (including the East Tanokrom road to Takoradi Polytechnic, which serves the people of Effiakuma) totaling about 30km.

Another asphalted road was the one west of Tanokrom, which joins the N1 Highway to Kasaworodo. The arterial roads in Sekondi, namely Ajembra Road and the Epuasi Road,

had also asphalted. Objectives for the asphaltic overlays were to protect investment on the roads and to improve vehicle operating costs, according to the City authorities. Other remedial initiatives included proposals for the construction of bus lanes (or BRT routes) and steps to establish companies to provide modern transport services as well as initiatives to set up regulatory bodies, according to Mr. Nii Ashitey Attram, head of the Transport Service at the Metro Mass Yard.

4.7 Discussion of Findings

4.7.1 Introduction

Discussion of the findings was strictly informed by the research questions formulated from the research objectives. That is the discussion sought to find answers to questions posed by the research. The discussion also bothers on the relationship between socio-demographic characteristics of the sampled population and traffic congestion in the city of Takoradi. Specifically, this section provides answers to the following questions:

- Which factors account for the variations in the traffic congestion on the arterial roads in Takoradi?
- How do the effects of traffic congestion on socio-economic activities vary on the various roads appraised; and lastly
- What costs are associated with the strategies adopted to mitigate the traffic congestion in Takoradi?

4.7.2 Socio-Demographic Characteristics of Respondents

The demographic characteristics of the respondents showed that, more males than females responded to the questionnaire and also more males than females were interviewed. For

instance, survey on drivers indicated 60% males and 40% females (Table 13). Comparing the demographic characteristics of the respondents to the Medium Term Report of Takoradi in 2013 and the survey conducted by the Ghana Statistical Service in 2012, the number of males in the city stood at 200,205 persons compared to 203,836 females (Table 3), showing that the population of females was just slightly higher than that of males. The population survey conducted by the STMA for the period 2003-2008 also indicated that there were more females than males in the city of Takoradi.

Furthermore, the population of the city generally recorded an increase with the highest growth rate of 9.45% ever in history from 2000 to 2010 (Figure 3). The females were 226,824 in number while the males were 217,928 (Table 4). One deduction, however, made from the differing statistics in this survey and that of the Metropolis as well as data from GSS is that, since this survey focused mostly on users of the roads namely, drivers, pedestrians and passengers there was a high probability of administering questionnaires to more males than females.-The reason is that more males drive and travel to the work place in vehicles than the females (MoT, 2011). Just like the questionnaire for drivers, a total of 59% males as against 41% females were interviewed.

With respect to the age cohorts, those in the 30-39 years band were the largest segment in all categories of respondents, that is 41% of drivers, 40% of formal employees, 40% of passengers and 40% of traders, notably ‘Market Women’. The second largest segment was the 16-29 years group, while the smallest group was the are those within the ages of 60 years plus (13%), of whom very few were targeted to either fill our questionnaire or be interviewed, given the fact that they constituted an inactive section of the population.

Also left out of the study sample were people aged below 18 years (in line with the sampling procedure adopted) and in conformity with STMA 2012 data showing that Takoradi population has more people within the active population. This study, therefore agrees with the assertion in the medium term report of the STMA to the effect that there is the need for the creation of more jobs to provide employment for the active population (MoT, 2011).

In almost all the categories of respondents, a majority claimed they were married while the minority claimed they were separated or co-habiting. For instance, 13% each in the category of drivers, passengers and formal employees stated they were are separated (Table 14 and 15 respectively). Furthermore, with Western education having been introduced earlier in Takoradi than most of the cities in Ghana (Addo, 1994); formal education is a common phenomenon in the Metropolis. Even though the metropolis cannot boast of any public university, the presence of one of the best polytechnic schools (Takoradi Polytechnic) and Senior High Schools like Ghana Secondary Technical School, Takoradi Senior High School, Archbishop Porters' Girls SHS, Secondi College SHS and Glandmo Vocational School are a source of evidence that the metropolis invest much in educating its population. A respondent in an interview remarked this as follows;

“The absence of a public university does not befit Takoradi’s status as one of Ghana’s vibrant urban spaces. This situation makes it difficult for most young graduates to pursue university education due to the high fees levied by the private ones. There is also the absence of public hostels or students accommodation to house most students within the tertiary schools in the metropolis notably T-Poly.

The students , as a result of this, are forced to rent private hostels in addition to the high fare they pay for transport and other utilities’’ (personal interview).

The composition of the sampled population made administration of the questionnaires quiet easier as most could read and write the English language. For instance, 13% of the drivers said they had had formal education up to JSS/Middle school and SHS level (Table 13). The category which made it a bit difficult for the survey team to complete the questionnaires on time is was the ‘Market Women’ group, of whom about 13% stated they had no formal education with the majority (46%) claiming they had completed only primary or basic school. Those employed in the informal sector namely drivers and traders at the Market Women did not work for fixed salary, meanwhile such people constituted the majority of workers in the city of Takoradi. It is no wonder that STMA in their 2011report referred to the economy of Takoradi as largely a service-oriented one. To position the Metropolis for higher growth prospects, the report suggested the need for industrialization of the Metropolis and the provision of vocational and career training to provide jobs for the unemployed.

In addition, only a relatively small percentage of respondents, stated they were indigenes of the Metropolis and have had lived some appreciable part of their lives in the city of Takoradi. For instance, 63% of drivers stated they had stayed in Takoradi for close to about 10years (Table 13). This implies that the population of Takoradi is made-up of mostly people who have migrated from other places for obvious reasons. Whereas most of such people were not natives of the towns, most of them had actually lived in the Metropolis over a long period of time. From Table 14 for instance, a majority of the passengers surveyed (63%) stated that they had lived in the Metropolis for more than 15 years. Thus

the probability on the part of respondents to have ample or some basic knowledge about the city of Takoradi was quite high.

4.7.3 Geographical Variation Traffic in Takoradi

4.7.3.1 Explanation of the Variation in Traffic Flow or Interaction in Takoradi using Ullman's (1980) Concept of Spatial of Interaction.

In discussing the geographical variations of traffic in Takoradi, the five (5) corridors studied by Mahama et al (2013) in their study were used. Having stated the sampling area of the research, in order to understand the variations and causes of the interaction among the corridors studied the Ullman Concept of spatial interaction (1980) as explained in the literature review served as a guide during the process of observation and interviewing of respondents to find their views on factors that influenced their decisions to use the roads in the city. Drawing on the assumptions and propositions of Ullman's (1980) concept of spatial interaction and the characteristics of Takoradi, the following link or relationship observed on the basis of complementarity, intervening opportunity and transferability of goods and services among the centres described in the subsequent sections gives reasons for the high level of interaction and hence differences in traffic congestion levels in the Metropolis.

1. Complementarity

Takoradi complements most locations or places not only in the Western Region but the country and the world at large. First of all, the harbour serves as a transit point to the city. In fact, in 1931, just three years after the commissioning of the harbour, Takoradi's population reached 5,478, bestowing on it an urban status. The population had since then increased significantly (see Figure 3). Rapid increase in the city's population has been

attributed mainly to jobs created within the port itself and to industries directly and indirectly related to the port (Amoyaw, 1999; Assomaning, 2010). Furthermore, in the city especially at in the CBD, there is the supply of several products, services and commodities which serve the suburbs of the CBD. Specific settlements in the Metropolis include Tanokrom, Kwesimintsim, Effiakuma and New Takoradi. The location of Takoradi Airport right at the edge of Kwame Nkrumah Circle draws people from not only the suburbs mentioned and other places to travel in and out of the city.

Other services such as the banks (Fidelity Bank, Barclays, FNB, UT, Stanbic bank, Ecobank, Energy Bank just to mention a few) especially along the Liberation Road (Alex Cobbinah Avenue) also help to create employment in the city. In fact, the city of Takoradi serves all purposes one can think of, ranging from radio stations (Asempa Radio at Kwame Nkrumah Circle), bus terminals (Takoradi Main Station, Harbour Taxi Station, Kwesimentsim Trotro Station and others) schools (Presbyterian JHS at Market Circle, Takoradi Polytechnic, Bompeh Senior High Technical School, Bethel Methodist School, Badu Ado JHS) hospitals and clinics (Rabbito Clinic near Ama Akroma Avenue, Effia Nkwanta Hospital and others), churches and mosques (All Saints Parish Church, Star of the Sea Cathedral, Bethel Methodist Church close to Challenge Book Shop, Assemblies of God Church also close to the Central Police Station) and other service providers such as police stations, hotels and pubs can all be found in the city. These services benefits several people from all walks of life, with the popular and common means of mobility being road transport.

2. Intervening Opportunity

Some opportunities have been opened up to the people of Takoradi especially following the discovery of oil at Cape Three Points in the Western Region (MoEP, 2010). Beginning with the Market Circle, the Effiakuma market (sometimes referred to as Number 9 Market) emerged as a result of the huge development of the settlements at the location. Most people at and around Effiakuma do hardly travel to the main market, Market Circle for their goods since they are offered similar products in the suburbs. The same applies to the Kwesiminstim Market which serves people in and around Kwesimintsim and Tanokrom. The 'All Needs' Supermarket located close to Paa Grant Circle also serves the people especially the students from Takoradi Polytechnic and residents from New Site. There are pellets of corner shops which offer services to residents within the various neighbourhoods.

Also, instead of one travelling say from Effiakuma or Tanokrom to the CBD to board a public vehicle, one may decide to use the Kwesimintsim Troto station, which may be closer to the traveler's neighbourhood, compared to the numerous terminals at the Market Circle. Even though banks are highly concentrated at the CBD, customers and clients have access to microfinance companies which are opened up in smaller containers within the various townships. Furthermore, the churches are also highly concentrated within the enclave of the main town (CBD), that is, from Paa Grant Circle to Market Circle, Tanokrom to Market Circle and from Liberation Road to Market Circle, but there are again several smaller churches (mostly charismatic churches) established just outside the various settlements.

'Big' churches like Assemblies of God, All Saints Parish Church, Star of the Sea Cathedral and others nonetheless still host some members but have lost many to the new churches. Due to the lack of a public university also, SHS graduates still patronize the Takoradi

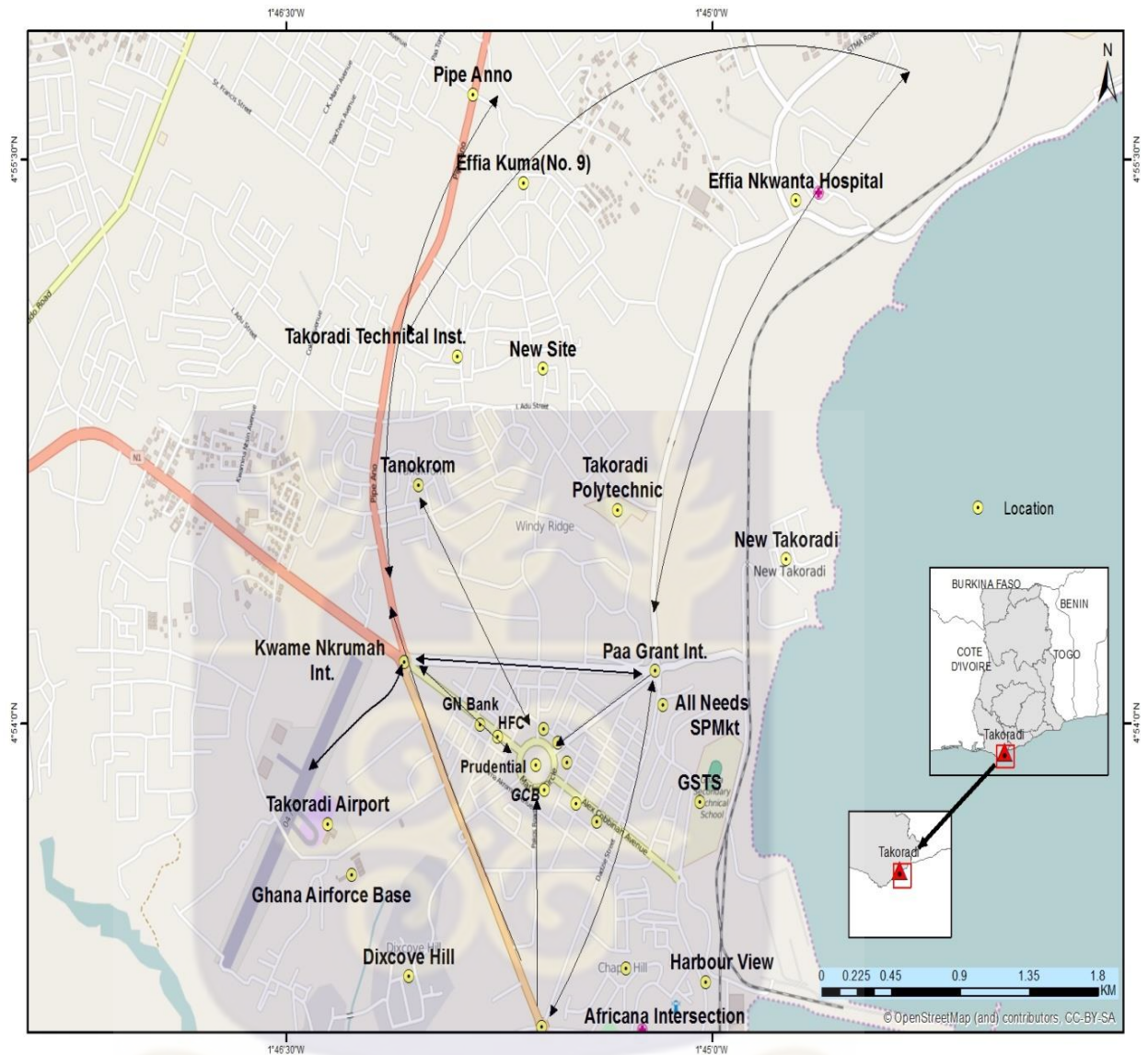
Polytechnic and a quite few a school leavers have patronize the public and private universities elsewhere in the country, such as the University of Ghana (Legon, Accra), the University of Cape Coast and the Ghana Telecom University. Others have also enrolled in the Takoradi campus of the Ghana Telecom University, which was recently sited in the city and located close to Star of the Sea Catholic Church.

3. Transferability

Goods and services possible for transfers are those transported by the merchants. There is movement of heavy loaded trucks for instance from the port of Takoradi to the Market Circle. A typical road popularly used for transporting such goods is Liberation Road. Other Goods are also transported from Kumasi and Accra to the Market Circle. Some freight is also transported to Sekondi the twin city and also from Sekondi to Takoradi.

These goods are transported over such longer distances because the returns from their sale is able to cater for the cost of the transport. That is the cost of the freight as discussed by Lowe & Mojadas (1975), is able to cater for the transport cost since they are transported in larger quantities. Hitherto, such freights were transported via the railway lines, however, the situation has changed, and the roads are now being used thereby increasing the cost of transporting the goods as compared to the use of the railway. Figure 9 shows the nodes of interaction in the City of Takoradi. The lines or roads from the points or nodes which have access to the Central Market shows the direction of the flow in the city.

Figure 9: Map of Study Area Showing Interaction among Nodes.



Source: Author's Construct, (2016).

4.7.4 Activities attracting Respondents to Use the Arterial roads

Roads around the Market Circle recorded the highest response of commuters claiming they visit the Market usually to trade (Table 17). This is very obvious as the basic purpose of commuters found within the enclave of the market is to either buy or sell something. Trading is one of the commonest activities found within Takoradi. The service extends to

even the farthest corners of the settlements in the city. Most of the traders resell goods bought from Kumasi and Accra at the Market Circle and other corner shops in the suburbs. The prices of such goods and services are therefore relatively more expensive compared to the prices in the cities of Accra and Kumasi. Some few persons though go to the Market Circle for other purposes such as visiting friends and taking a walk around the market. That is, according to Amoyaw (1999), the artisanal nature of the market is enough to attract tourists (MoT, 2014; Assomaning, 2010).

The most significant reason for the use of Paa Grant Circle to Takoradi Polytechnic by respondents (31%) is to move to their places of work or school in that order. This was also obvious as commuters in the rush hours in the morning and evening comprised of workers traveling to or from work and students struggling to attend school or get home from school.

Effiakuma junction to Effiakuma Traffic Light recorded a majority of the respondents (25%) who claimed the road was usually used by visitors to Takoradi, the reason being that the road serves as a link between other major cities like Accra, Tema and Kumasi and the city of Takoradi. The second category of respondents (29%) comprised of people going to or from work. The presence of a large number of residents in Effiakuma is understood to account for this scenario: About 60% of the residents in Effiakuma are employed in the informal sector and are engaged in activities such as trading and fish mongering. This is consistent with the statement that, the service industry is the largest sector (59%) of the economy of Takoradi (Population and Housing Census Report, STMA, 2000). Those in the formal sectors however drive to the city centre to work at formal institutions.

Tanokrom Junction to Kwame Nkrumah Circle also recorded 23% respondents travelling to the Market Circle to trade (Table 17). Some of the respondents drive all the way from Kwesimintsim to the Market Circle to acquire goods they do not get at Kwesimintsim Market. Another large number of respondents who use the Tanokrom road (23%) visit the recreational facilities like the Market Circle, Takoradi Harbour and Takoradi Airport. These facilities are quite easily accessible using the road from Pipe Ano. Hence the deduction is that, whereas most people who travelled to the Market Circle did so to trade, some of the travelers who traveled to the airport or the harbour also did so for recreation.

Kwame Nkrumah Circle to Market Circle road experiences higher traffic during the rush hours than all the corridors due to vehicles travelling from Kwesimintsim and Tanokrom which join the Kwame Circle before moving to the Market Circle. These settlements are residential areas for most workers within the CBD of Takoradi hence most of those who travel through the Circle do so because of work.

4.7.5 Vehicle Ownership

Regarding vehicle ownership in Takoradi, 67% of the respondents (constituting the majority) own cars or vehicles, as seen in Figure 6. Most of such people have given out the vehicles to other drivers for use as taxis and trotro. The drivers in turn make daily sales to them. This finding is consistent with the claim made by Addison (2012) and Addo (2002) that the ownership of vehicles in the cities of Ghana is on the increase with reasons such as trade liberalization and reduction in taxes for imported goods including vehicles of trade. These policies make it easy for vehicle importers to import more vehicles to add to the already existing ones on our roads.

The mini-bus drivers drive buses usually owned by other people. This gives a reason for the smaller percentage of those who own vehicles as illustrated in Figure 6. Again, the traffic congestion rate and statistics on the percentage composition of traffic on the major roads (Master Station (MS)) showed an increase in traffic and privately owned vehicles as well.

4.7.6 Means of Transport Usually used

As it is often argued that overreliance on private vehicles as means of transport increases congestion on roads as compared to the use of public vehicles (Addo, 2006), the study sought to find out the common means of transport used by respondents. The city of Takoradi is noted for high dependence on taxis, unlike the mini-bus (trotro) where different people from different places board the same vehicle to a location or different locations depending on the route used by the 'trotro'. For instance, from the survey, the highest number of respondents on Corridors 1, 2 and 5 (31%, 29%, and 30% respectively) cited taxis as their preferred means of transport, while the commonest means of transport on Corridor 3 was trotro (29% of the respondents) according to Table 18. In the case of the taxi, the situation is quite challenging since the taxi can only accommodate a maximum of 5 people (including the driver) hence there is always a need for more taxis to convey the passengers. Plates 3 and 4 respectively show some taxis (X, Y, and Z) in traffic congestion around the Market Circle at the CBD.



Plate 3
Plate 3 Images of Taxis (X, Y) in Traffic Congestion around the Takoradi Market Market Circle.

Source: Author's Construct, (2015).

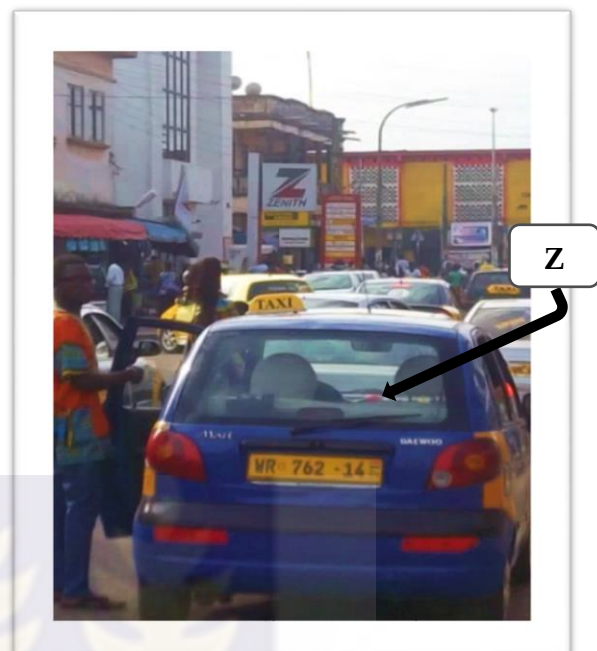


Plate 4
Plate 4 Images of Taxis (Z) in Traffic Congestion around the Takoradi Market Market Circle.

Use of taxis is a challenge in the Metropolis as explained by the transport officer from the Takoradi Metro Mass Yard. He wished the metropolis made use of more metro mass buses however such a system has entirely collapsed making it difficult to transport passengers and bulk freight. He further complained of the absence of bus lanes (BRT) which would attract more public buses into the Metropolis. The Bus Rapid Transit System was a brain policy of the then government of Ghana in the year 2000, however unfavorable factors such as little attention given to the enforcement and regulation of the policy of a *Metro Mass Transit (MMT)* Bus system contributed to its collapse.

Other challenges that led to the collapse of the policy include inadequate terminals for buses, lack of a proper regulatory framework; for instance, there were times when

passengers argued with the conductors that they were not supposed to pay fares for boarding the buses (Agyemang, 2009). In the case of Takoradi the policy just cannot work because of how small are the roads in the city. In order for the BRT to work there is the need for an overall examination of the policy to create additional lanes for buses.

On the Paa Grant Road to Takoradi Polytechnic stretch, a majority of respondents (40%) named as their preferred mode of transport, with the majority of passengers being students and residents living in areas like New Site and Effiakuma. Respondents on the Effiakuma Traffic Light to Effiakuma Junction corridor on the other hand, cited trotro as their major mode of transport (Table 18). This is due to the transportation of passengers and freight from far distances such as Accra and Tema to the metropolis. This occurrence according to Buah (1998) could be partly as a result of myth and the notion held by many Ghanaians that it is dangerous to drive one's own car over a long distance especially when on a visit or attending a particular programme (Buah, 1998). A passenger at the taxi station at Effiakuma Junction reiterated this assertion in a statement that,

“I have businesses running in Takoradi and Accra so I often trek this road to and fro. I just can't use my own vehicle because I am afraid of driving alone”.

Respondents on the Tanokrom Traffic Light to Kwame Nkrumah Circle corridor named their commonest mode of transport as MMT, mini and large- size vehicles. Also included in their list were trucks that were unloading freight from the Takoradi Port to companies in Tanokrom and around Kwame Nkrumah Junction and also from Kwame Nkrumah Circle to Market Circle.

4.7.7 Relationship between Sex and Means of Transport Preferred by Respondents

Attitudes, like perceptions according to Abane (2011, p. 23), ‘are influenced by people’s knowledge of issues, resources, beliefs, values and norms but can however occur without knowledge and experience’. It is, however, probable that the more information motorists and passengers have about the need to choose suitable modes to travel with, the more they are able to provide useful information on how much they spend on each mode in relation to other basic needs (Takyi et al, 2013; Adarkwa, 1991). In the case of Takoradi, both males and females shared similar reasons for using particular modes on the various corridors. For instance, on Corridor 1 the majority of the males (19%) used the trotro as their preferred means of transport because it is reliable while most females (39%) used taxis as their preferred means of transport because they found them comfortable (Table 19).

It is obvious that when it comes to means of transport such as public buses most Ghanaians according to Abane, (1993), opt for the most convenient and comfortable means. Such means include taxis and private cars, however, one’s choice for such means depends on his/her income and occupation (Abane, 1993). To Davidson & Knowles (2006), people who use public buses are disadvantaged due to delays and discomfort. For instance, 26% of the females (mostly women, rather than girls) said the use of trotro is reliable as it is always available to convey them to Market Circle on time.

4.7.8 Peak period of Traffic Congestion

Early morning traffic congestion was higher than the PM peak period. This pattern or observation agrees with Cortright’s (2014) claim that evening rush hour is the most congested time of day with bottlenecks almost doubling journey times (Cortright, 2014).

Palma and Lindsey (2002) in agreeing with Cortright (2014) stated that such congestion

levels are the same everywhere in the world due to variation in demand for road usage, relatively fixed supply of transport services and unsustainable transport services provision. An officer from the Physical Planning Department (STMA) in an interview also gave a reason for this occurrence. He stated that:

“The arterial roads experienced most of the traffic congestion in the evening because that is the time most of the market traders and staff from the formal institutions close from work. The PM period however, falls within 4p.m. to 8p.m. and the AM 6am to 9a.m. Hence, commuters in the morning often get to their destinations at different times so they can escape the traffic congestion making it a little easy for the traffic to flow”

Basically, from the interview it can be concluded that some motorists in Takoradi adopt ways to cope with rush hour traffic congestion. A major strategy motorists adopt in the city is using relatively empty roads to get to the same destination. The challenge of this strategy as explained by Downs, (2004) is that, overtime the empty roads will also get congested due to higher patronage by other drivers.

4.7.9 Severity of Traffic Congestion

The findings shown in Table 20 are consistent with the findings in Table 9 which represent the count in Takoradi as obtained by the Department of Urban Roads (2012). From Table 20 and Table 9, the Kwame Nkrumah Road to Market Circle stretch recorded the highest perception of traffic severity and count respectively. This is followed by the road from Tanokrom Junction to Kwame Nkrumah Circle. The least congested road however from is Paa Grant Circle to Takoradi Polytechnic (Table 20). Plates 5 and 6 show congestion around the Kwame Nkrumah Circle.



Plate 5



Plate 6

Plate 5 and 6 Kwame Nkrumah Circle Congested at 8:15am

Source: Author's Construct, (2015).

Furthermore, a significant observation in the traffic count from Effiakuma Junction to Number 9 Traffic Light is that, even though the road recorded the least traffic during the rush hours (Table 9), it had almost the same mean as that of the roads around the Market Circle (Table 20). This could be due to the high percentage of residents in Effiakuma and influenced by the market at 'Pipe Ano' serving as an intervening opportunity to the residents at the place. A taxi driver in an interview at the Effiakuma taxi rank gave the following reason for this occurrence;

‘Most residents at Effiakuma, buy their goods from the market established for them at the road side instead of travelling all the way to the Market Circle’.

Deviation of the means also indicate that traffic congestion on the roads is evenly spread on the entire corridors.

4.7.10 Factors that Contribute to the Differences in Levels of Traffic Congestion

In discussing the differences in levels of traffic congestion on the corridors studied, it is inevitable to investigate the factors that contribute to the congestion since these factors directly influence the flow of traffic on the roads. Roads leading to the Market Circle or areas around the market for instance, are usually congested with traffic throughout the day. According to some drivers at the Accra Station, traffic congestion on the road was caused as a result of the small widths of the roads and lack of parking spaces, forcing vehicles to park along the roads. Other factors that caused traffic congestion on the roads in the Market Circle included taxi stations and huge dustbins placed along the roads.

In addition, there a lot of waste was spread almost along the entire stretch of the road, where the dustbins had been placed. Health-wise it was unfortunate as traders (mostly women) were seated and transacting business with their customers very close to the filth. Plate 7 and 8 illustrates those challenges, which constitute what Taylor (2000) referred to as recurrent causes of traffic congestion. In fact, almost all factors that led to traffic congestion in Takoradi can be considered as recurrent factors.

Banks namely, Prudential Bank, Stanbic Bank, Uni Bank, Ecobank and other firms located at the Market Circle especially along Liberation Road, also contributed to the challenge, with their customers coming in their own vehicles being forced to park along the road, thus making entry and exit to and from the market quite difficult. Further, many vehicles (especially trotro and taxis, pick their passengers along the roads to the Market Circle due to inadequate space at the main terminals (See Plate 7). An officer of Ecobank expressed worry about the congestion as follows:

‘I come to work always scared of a vehicle crashing into my car or thieves breaking into the car because I am forced to park along the road with no security person watching over the car. Sometimes I have to come out to check whether something had gone wrong with the car’’

Kwame Nkrumah Circle recorded the highest peak hours of traffic congestion due to the location of the Circle. Very close to the Circle is the Takoradi Airport; there are also two petrol filling stations at the edge of the Circle. All these land use activities especially, the airport attracts many people to the Circle, which serves as a link to almost every place in the Metropolis, and also as a link to Accra on the N1, the Takoradi Harbour, Tanokrom, Kwesimetim and the Market Circle.

At Tanokrom, another scenario was observed. Companies such as Baker Hughes-Oil Company attract larger vehicles or articulated trucks, which offload some products from the harbor, thereby causing hold-ups in the traffic.

Effiakuma can be described as a nucleated or densely populated area as there are many houses built close to each other and inhabited by many residents. Even though, the road from Accra through Number Nine Traffic Light to Effiakuma bus stop experiences some level of traffic congestion, it is the least congested among the 5 corridors studied in the Metropolis. This is basically due to the fact that most feeder roads from the towns closer to the highway are inaccessible.



Plate 7: Cars Park along the Market Circle



Plate 8: Huge Dustbin Sited along the Market Circle

Source: Author's Construct (2015).

In addition, 24% of respondents (as shown in Figure 8) stated that Takoradi was experiencing growth in both population and industrial activities (urbanization), confirming statements by Amoyaw, (1999) and Assomaning, (2010) that the city of Takoradi is going through an industrial lift. A member of staff at the Physical Planning Department of the STMA confirmed this statement by saying that *“Takoradi is attracting many new firms particularly banks due to the boom in economic activities of the city”* Examples of the firms mentioned include oil companies such as Sea World Company, Tallow Oil, AFOL Oil Company and Schlumberger. He also listed some names of new banks such as Zennith Bank, Prudential, Energy Bank, Sahara Sahel Bank, Stanbic Bank and Opportunity International Bank and added that ever since oil was discovered in the Western Region the face of the Metropolis had changed.

New hotels, including 5 star hotels have also been built and old ones such as Akroma Plaza are undergoing face lift. All these firms employ labour, and usually give them new vehicles

to commute to the workplace thereby increasing the number of vehicles in the Metropolis. Furthermore 7% of the respondents indicated that the nature of the roads in terms of size also contributed to the traffic congestion (Figure 8). During the study lots of single lanes were observed in the Metropolis (for example, the Effiakuma Road to Paa Grant Circle stretch), thus making it difficult to use large buses on the road since the heavy vehicles travel slowly (see Plate 10). Visual observation of traffic at the intersections also showed that one major cause of traffic congestion was faulty or broken-down traffic lights in almost all the intersections within the study area, with most of them almost bent to the ground (see Plate 9). Most drivers thus spend some time waiting patiently for other lanes to ease before they can follow from the intersections.

However, a passenger at Effiakuma Junction in an interview said,

“I wish the traffic lights are removed from the intersections since they don’t work any longer and as such creates a lot of nuisance”.



Plate 9: Non-Functional Traffic Light at Pipe (Tanokrom) Circle



Plate 10: Large Truck Loaded from Tanokrom to Market Circle.

Source: Author’ Construct (2015).

In another interview with a station manager at the Accra Station, he said;

“One major cause of the traffic congestion is lack of alternative routes and terminals for taxis. Most of the roads apart from the major highways are not tarred and some are not accessible. They end at the entrance of some people’s residence and as if they were properties of some, they had established stores on them. Some of the roads also have taxi ranks created along them”.

Typical example is shown in Plate 11. This means that ‘trotro’ could not ply such roads hence residents are forced to use the taxis.



Plate 11 Taxis' Parked along the Road leading to the Market Circle.
Author's Construct (2015).

4.7.11 Effects of Traffic Congestion on Socio-Economic Activities

4.7.11.1 Effects of Traffic Congestion on Work

On average, the expected number of working hours of employees, employed in the formal sector (public and private) in the economy of Ghana is eight hours (Takyi et al, 2013; Lartey, 1977; Adarkwa, 1991). As shown in table 21, 23% of the respondents surveyed on Corridor 1 indicated they often reported late to work, a situation which Cortright (2014) termed as man productivity loss to time.

This finding is also consistent with the discussion by the OECD (2006) and Hon (2005) that traffic congestion affects labour productivity directly since input of labour is further directly related to the supply of the labour (OECD, 2006; Hon, 2005). Furthermore, traffic congestion according to a respondent on Corridor 5 reduces the economic growth of Takoradi. Hartgen and Fields (2009) in assessing the situation state that the effects of traffic congestion on cities' growth can also lead to a reduction of billions of dollars in productivity and output of the cities. It is therefore important for governments and employers to find ways of improving mobility in such cities since 'productivity is an investment by a State in transportation while output is the gross domestic product (GDP)', (Nadiri, 1996; Okoyo, 2010; Kayode, 2015).

To one passenger on a taxi, however, there was no need to link road rage or insults between motorists to traffic congestion in the Metropolis, since she thought such insults were common, if not widespread:

‘I hate watching some drivers insult each other and even to some extent daring each other to a fight. This attitude is irritating to me but I cannot do anything

about it since it is the attitude of almost all drivers in the metropolis if not the entire country''.

Such quarrels result due to anger caused by drivers not able to meet their sales for the day. Fares for passengers are again one of the challenges of the respondents. As mentioned, this study was conducted at a time when prices of fuel in the entire country fluctuated so often that passengers needed to be reminded about new fares by drivers and their “mates” almost on a weekly basis. (Ministry of Roads and Highways, June, 2014).

A hawker in an interview however, disclosed to the survey team a positive effect of the traffic congestion. This is what she had to say,

‘I make a lot of money during the late morning and evening because a lot of passenger vehicles use the road at these times. I therefore do not miss sales around this time at all’.

4.7.11.2 Effects of Traffic Congestion on Transport

Respondents who did not own cars explained that it was quite expensive to board vehicles in Takoradi, thus rises in transport fares was a major challenge to the household. A member of staff at the Department of Urban Roads described the situation in an interview as follows:

“The challenge of traffic congestion is rather appalling especially for private car users who drive over 5km to work, ‘I have to spend not less than 350.00 Ghana Cedis every month on fuel for my car which is more than 30% of my salary’”.

Eddington (2006), and Link (1999) referred to this occurrence as travel cost due to increase in travel delay and need for extra fuel. A household head from Tanokrom also reiterated that;

‘It is not advisable for residents to use their own vehicles from areas such as Sekondi to Takoradi to enjoy a particular service. We have no choice since that is the order of the day’.

Fuel usage and cost of spare parts which according to the NRC (1995) and Eddington, (2006) increases cost of driving is a challenge in Takordi as taxi drivers form the bulk of the drivers in the Metropolis.

The huge cost incurred by especially public transport drivers on fuel was also found to add an extra burden to their other financial responsibilities like school fees and government taxes and levies. For this reason 10% of the drivers confirmed evading taxes, thereby causing the Metropolis loss of funds which could otherwise have been used to provide infrastructure services. Fuel burnt in traffic is however also dependent on the attitude of the drivers in the process of driving. A member of the drivers’ union at Effiakuma Junction gave a reason to this occurrence:

‘Even though most people believe that being in traffic congestion over a long period resulted in burning of more fuel, most drivers especially those who have patience over the accelerators and accelerate at a slower pace save fuel in traffic since rapid acceleration rather consumes much fuel’.

This finding agrees with the theory explained by the NRC (1995) that driver-related factors such as the application of brakes and acceleration rather determines to a larger extent the amount of fuel consumed by vehicles. A no less significant observation made (as explained

by a female driver) had to do with gender bias seen during the peak hours of the traffic. She stated that:

“Most of the women drive gently and slowly due to the fear of running into accident and for that reason they spend more time in congestion than the men who try to escape the congestion by using other lanes which are quite emptier”.

4.7.11.3 Effects of Traffic Congestion on Education

A majority of the respondents on Corridors 1, 2 and 3 (35%, 30% and 23% respectively) complained bitterly about not being able to have the required hours of sleep because of the need to wake up early in order to escape traffic congestion, as indicated in Table 23. This results in their inability to perform well at work since they not only have to get to work early but also send their wards to school.

According to Porter and Abane (2008) one of the many ways to find solutions to such challenges is to increase children’s participation in transport planning. Most school opening hours are usually from 7:40 a.m. to 8:30 a.m. This is the same time workers also get to work, making some families skip their breakfast or take it while driving. It was shocking to hear from a parent in an interview that he sometimes received calls from teachers, asking her to come and take her son back to the house as punishment for his late-coming. She said:

“It's not like we don't leave early enough. I spend more than half an hour driving from Sekondi before getting to the school and my work place is at the CBD”.

While parents are having a very difficult time tackling the issue of traffic congestion around schools in Takoradi, schools are trying out different strategies to address the issue. For instance, Presbyterian JHS located in between the Market Circle and the Harbor Taxi Station called for a parent-teacher meeting recently to discuss ways to handle the problem of late comers. According to a parent who participated,

“A decision has been taken to get the service of an organization to train volunteers to regulate the traffic. Something has to be done. There are quite a few schools (public schools) in the vicinity, however, there is no attempt by the MTTU to regulate traffic on the roads”.

4.7.11.4 Effects of Traffic Congestion on Recreation

One major negative impact of traffic congestion in Takoradi is the reduction in revenue obtained by tourism operators especially during the festive seasons. The roads leading to recreational centres such as Takoradi Harbour and Allan Beach and Hotel attract a lot of traffic on the road, which deters tourists from visiting the location. Teye (1992) explained that such situations can lead to unsatisfactory experience by visitors. According to Davison and Knowles (2006), people without private cars or vehicles during festive seasons are disadvantaged in a way as they are compelled to travel by public buses with their attendant delays and discomfort. This can make the tourist feel bad especially when caught in traffic congestion (Cui & Ryan, 2011).

It is however, appropriate to consider that traffic congestion does not always create unfavorable conditions during festive seasons or during periods of tourists' visit. Some people do benefit from the traffic congestion. For instance most taxi drivers at the taxi

ranks in areas around Market Circle explained that they make a lot of sales during festive seasons because most passengers who wish to get to the recreational areas earlier use the taxis to avoid extra waste of time on the road. The challenge however is the difficulty on the part of tourists to pay the huge amount charged by the drivers. Fifty-five percent of the traders also at Market Circle stated that they make higher sales during such occasional seasons. A shopkeeper in an interview said:

‘Most customers prefer to buy around festive seasons like Christmas and they do that very early in the morning, that is during the rush hours since they believe that is the time they will get fresh goods especially the perishable ones to buy’.

4.7.11.5 Effects of Traffic Congestion on Health and Environment

Pollution from vehicles is usually inhaled by passengers caught in a traffic congestion and people working in firms and companies located around arterial roads (Al-Mogin, 2005). In Takoradi, however, people who inhale the unfavourable gases comprise of mostly sellers along the roads around Market Circle. A commuter in an interview explained the situation as follows:

‘I can’t stay long in traffic since inhaling of fumes from the cars chokes me’

This statement agrees with the assertion from the World Watch Institute, (2008) that prolonged stay in road traffic leads to choking due to pollution. Kayode (2015) agreed with Al-Mogrin (2005) that lead poisoning which is often caused by inhaling polluted air in a traffic congestion can cause headache, weakness of the body, stress, constipation and death. Most of the ‘trotros’, according to an officer at the MTTU, are not in good condition and therefore produced harmful gases such as Carbon Monoxide which are risky to inhale. An official of the GPRTU also expressed the challenge as follows:

‘I wish most of the ‘trotros’ that have out-lived their expected number of years are stopped from using the road but nothing like that has ever been done to regulate the types of vehicles on the roads since I began working in the Metropolis’.

4.7.11.6 Effects of Traffic Congestion on Religious activities

Most respondents as shown in Table 26 experience lateness in attending to religious activities (as shown in Table 26). A majority of this group which comprised of Muslims complained of heavy traffic during their festive seasons (Idir Fitir and Idir Adhar) because of the location of the central mosque. The mosque which is located around the Tarkwa Station and another one around Amanfo at the Segou area make the roads linking them to the residences congested with traffic during such seasons. The ‘Jumah’ prayers on Fridays also make such roads highly congested. An appeal therefore was made for the relocation of the mosque by one “Imam” (Prayer Leader) in the Metropolis. A resident at Effiakuma explained this as follows,

‘We hear the sound of trotros and their ‘mates’ shouting for passengers to board their vehicles making it difficult sometimes us to concentrate at church’.

4.7.12 Test of Hypothesis

Reasons given to the significant relationship between traffic congestion and reduction in worker productivity on Corridor 1 include: the time taken for workers especially those employed in the formal sectors to drive through the heavy traffic at the Market Circle before they get to their work places. This reduces their working hours and reduces economic growth of the city of Takoradi, (Takyi et al, 2003; Harten & Fields, 2009). This is also partly due to the what May and Marsden, (2011), referred to as uneasiness to moving freely and thereby affecting a wide range of activities such as distributing goods and

services in the city. Furthermore, there was no relationship between lower demand, low sales and high fuel consumption on Corridor 1. This finding is also inconsistent with the theory by NRC (1995) that delay in traffic leads to increase in fuel usage. However, the test implies that, it is expensive to rent or own a parcel of land, especially renting a store in and around the Market Circle due to rising demand for space by businesses and companies.

On Corridor 2 however, the significant relationship between traffic congestion and road accidents can be as a result of transporting cargo from the port to Sekondi using the intersection at Paa Grant Circle. The trucks produced so much fumes and moved slowly. This can also be as a result of the several roads joining the circle which make it imperative for drivers to be extra vigilant when joining the road. For this reason, officials from the MTTU are mostly assigned to the circle to control the flow of the traffic in order to prevent possible accidents.

On Corridor 4, the negative relationship between traffic congestion and prices of goods and services could be due to the fact that most shop owners along the road to Tanokrom patronize their goods from the Market Circle and resell them to the residents in the suburbs. The sellers do not increase the prices so much because it does not cost much to commute to the Market from their shops.

On Corridor 5, however, a positive relationship between traffic congestion and delays implies that passengers and drivers that used the road or the Circle in the morning rush hours get to their destinations late. This relationship is consistent with the data from the Department of Urban Roads that, Zone 5 is the most congested place among the 5 corridors

(Tables 8 and 9) and also the assertion by the OECD (2006) that productivity of labour is directly related to the supply of the labour. This finding is however not consistent with the proposition by Eddington (2006) that travel cost necessarily increases unreliable transport conditions which include increase in fares due to congestion.

4.7.13 Cost of Measures Taken to Mitigate Traffic Congestion in Takoradi

This discussion is based on the research question which sought to investigate the challenges faced or were possibly to be faced by the institutions providing mitigating strategies to curb the traffic situation in Takoradi. A greater challenge however for the Department of Urban Roads in Takoradi in the discharge of their work is the lack of funding. Funding for such projects, according Mr. Owusu, has to be reviewed by the Central Tender Review Board before money is released from the Ministry of Finance to embark on the project.

Mr. Owusu stated that, there have been some measures taken to curb traffic congestion which had yet to yield the expected results. He explained that;

*“The road network of the Metropolis are linked to each other from various traffic nodes, making transport services in the city the best planned in Ghana. An unfortunate aspect of the plan of the city is the location of the Central Market (Market Circle) in an ‘enclave. That is it lies between three major interchanges, namely the interchange joining the N1 and the Market Circle (**Kwame Nkrumah Circle**), the interchange joining Sekondi and Takoradi (**Paa Grant Circle**) which serves the Eastern gate of the port and lastly the **Africana Interchange** which serves the Western gate of the harbour. The plan is to get the N1 Highway which runs as far as Nigeria to Ivory Coast to pass through the CBD and instead of constructing*

overpasses it was decided to construct interchanges. This is to make it easy for people to transit the market but using interchanges which are not so much distant from each other and having a lot of roads terminating at them. This causes a lot of challenges as vehicles stopping at such interchanges due to the lack of parking spaces create traffic congestion''.

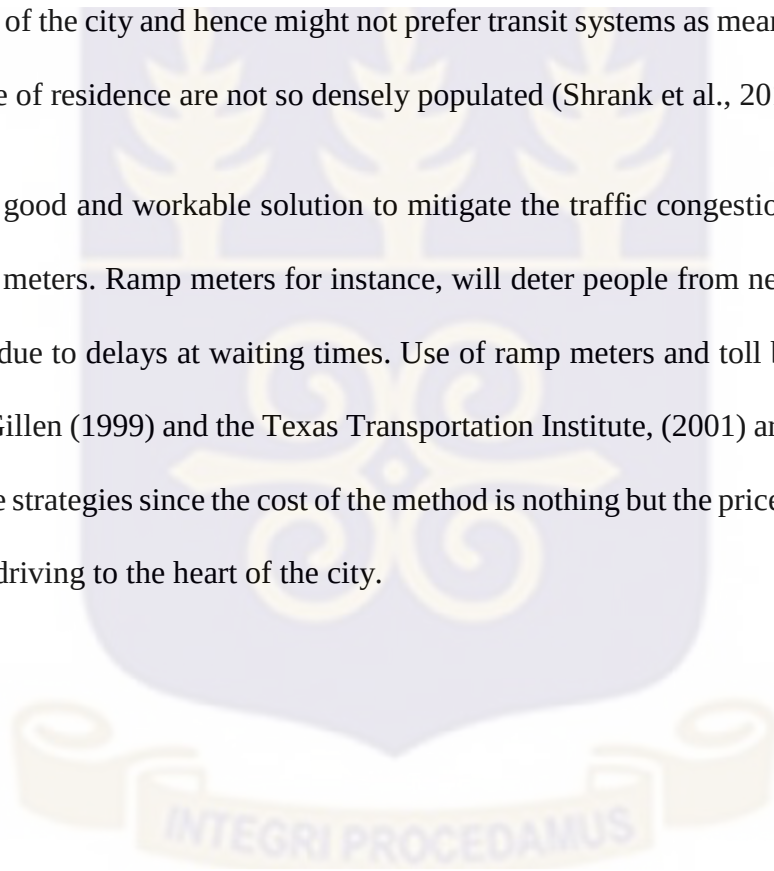
The DVLA office as noted poses a lot of challenges to the metropolis as management to a larger extent cannot regulate the inflow of vehicles in the region. The management was, however, evasive in its responses to questions about the processes drivers followed in obtaining licences for their vehicles. Most other challenges likely to be faced, are referred to in Downs theory (2004) of 'Triple Convergence Rule'. The expansion of roads such as Aprembo Junction to Nkroful Junction Road, per Downs (2004) theory which was buttressed by Shrank et al (2011), will only solve the challenge of traffic congestion within the short term. In the long term however, other road users who do not use such roads will begin to use them and hence re-invite traffic congestion on such roads. The argument by O'Toole (2009) also suggests that expansion of such roads will only result in low patronage within the short-run which defeats the purpose of the strategy and become expensive to adopt.

Furthermore, the partnership agreement to construct interchanges and provide asphaltic overlays at Kwame Nkrumah Circle, Paa Grant Circle, Aprembo Junction and Kasaworodo Bypass could be very expensive to construct. Balaker and Stanley (2006) in describing the cost associated with the provision of transport facilities such as the interchanges mentioned in the study said more often than not such projects and interventions do not factor in the

environmental cost of the facility. That is, such facilities consume additional land in the city and increase the emission of harmful gases due to the production of asphalt for asphaltic overlay (Balaker and Stanley, 2006).

In addition, the need for transit capacity expansion or BRT routes to allow the use of public buses as mentioned by the head of the Transport Service at the Metro Mass Yard can be very costly and environmentally expensive. Also, most residents in Takoradi do not live in the centre of the city and hence might not prefer transit systems as means of transport since their place of residence are not so densely populated (Shrank et al., 2011).

In sum, a good and workable solution to mitigate the traffic congestion is the use of tolls and ramp meters. Ramp meters for instance, will deter people from necessarily driving to the CBD due to delays at waiting times. Use of ramp meters and toll booths according to Kang & Gillen (1999) and the Texas Transportation Institute, (2001) are the ~~most~~ cheapest among the strategies since the cost of the method is nothing but the price paid by the vehicle users for driving to the heart of the city.



CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary, conclusions and recommendations to the challenges confronted by the people of Takoradi as a result of traffic congestion in the metropolis. The summary and conclusion basically includes the major findings of the study, while the recommendation provides some guidelines to help mitigate the challenges and also to ensure that the city of Takoradi is able to provide optimum transport services.

5.1 Summary and Conclusion

Using a study conducted by Mahama et al, (2013), on Vehicular Traffic Count in Takoradi, specifically, the Central Market popularly referred to as the Market Circle, this study sought to examine the effects of the traffic congestion on socio-economic activities in the Metropolis. The socio-economic activities included activities such as work, education, transportation, trade and commerce, land use, recreation, religious and industrial activities.

In review of literature and theoretical concepts, the Federal Highway Administration (FHWA, 2007), Economic Conference of Ministers of Transport (ECMT, 1999, 2004, 2007), the VCEC, 2006 and other documents and models fed the study with the meanings, causes, measurements of traffic congestion. Ullman's Concept of Spatial Interaction (1980) directed the theoretical underpinnings of the research.

With regards to the methodology, mixed methods of data gathering were used. The data used were obtained from both secondary and primary sources. The secondary sources included data such as the Sector-Medium Term Report of Sekondi-Takoradi Metropolitan

Assembly, Traffic Count of Takoradi by Mahama et al (2013) & the Department of Urban Roads, Takoradi, (2012) and data on the profile of the study area from STMA. With respect to primary data, qualitative and quantitative data (triangulation) were gathered with both given almost equal preference or weight. The qualitative data included semi-structured interviews, participatory observation and photo-images.

The semi-structured interview featured several key respondents such as staff members of some banks, traders and merchants, household heads, passengers, drivers, staff from the Physical Planning Department of the Department of Urban Roads. Quantitative data on the other hand, was obtained through the administration of questionnaires and the mapping of the roads through the use of the GPS which aided in the collection of the spatial points. In response to the research objectives the following major findings were made: the road from Kwame Nkrumah Circle to the Market Circle recorded the highest mean of 3.52 of perception of traffic severity out of a total of 13.8 on all the 5 roads appraised in the study. The road with the least perception of congestion severity was however recorded at Paa Grant Circle to Takoradi Polytechnic with an average of 2.08. Furthermore, a significant relationship was found to exist between delays, increase in prices of goods and services, accidents and pollution and traffic congestion on corridors 5,4,1 and 2 respectively.

5.2 Recommendations

Based on the findings and conclusion drawn from the study, the following recommendations are raised to help inform policy makers on decisions and plans to mitigate challenges posed by traffic congestion in Takoradi:

First of all, there is the need for the formation of minor companies to regulate the activities of ‘trotros’ and taxis in the Metropolis. The need to monitor the inflow of the taxis that influx the roads can be dealt with if the taxis are regulated by institutions and companies within the Metropolis. This recommendation seems quite difficult to achieve since there is hardly any such thing working anywhere in the country. If the Metropolis can have such a regularized system it will hinder a lot of people from becoming taxi drivers as they will be forced to meet some requirements and which can discourage them.

Furthermore, there is also the need to expand the roads to make way for the realization of the bus rapid system which has been on the heart of the government in recent times. Such a recommendation will allow space for large articulated trucks and vehicles (buses) that travel slow thereby causing traffic on the roads. Again, such a suggestion can be nothing but difficult to implement as most of the edges of the roads appraised are being put to several forms of land uses. For instance, there are schools, stores and offices located particularly along the road from Tanokrom to the Kwame Nkrumah Circle and the roads around the market circle. Expanding the roads to create dual carriages will lead to nothing but demolishing of the aforementioned structures.

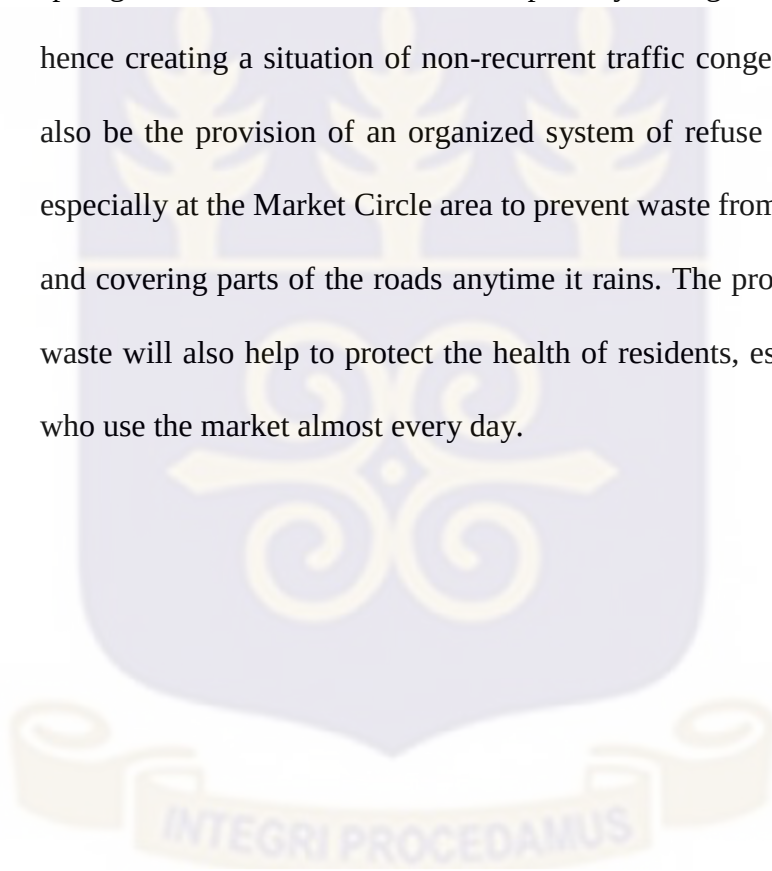
In addition there is the need for rehabilitation of the railway line to ease the pressure on the roads. Even though some of the railway lines, for instance the

railway line from Takoradi to Sekondi are been reconstructed, there is still the need to construct more efficient railways to transport the goods from the harbour to the neighbouring cities. This will again prevent the larger trucks from putting pressure on the fragile roads since most of the goods transported will now be transported by rail.

Firm regulations have to be made and implemented to discourage old vehicles from being used in the city, as they are a greater contributor to air pollution on the roads. Proper regulations also need to be made and implemented to regulate the number of vehicles on the roads. This can be met if the DVLA is well resourced to execute its mandate efficiently. The traffic light system also needs to be restored. Most of the traffic lights are out-dated and need to be replaced to allow smooth running of traffic at the intersections.

A more critical recommendation is the need to decongest the CBD. This could be achieved through the establishment of other market centres and other socio-economic facilities such as hotels and major market centres outside the CBD that is, areas closer to the Market Circle to serve as intervening opportunities for those who have to travel from far places within the Metropolis to obtain a good or service at the CBD. Decongestion of the city can also be done if other bigger transport terminals like the Accra station are established at the peripheral areas of the CBD. Again this will prevent everyone from unnecessarily travelling to the centre of the city on a public vehicle.

Finally, the building of settlements within the Metropolis should be well-regulated by the city authorities to make the roads easily accessible in the towns. For instance the Effiakuma settlement described as ‘Zongo’ (slum area) by the residents is partly caused by the building of houses and other structures on road ways. Drainage issues also need to be addressed as part of the provision of good and workable transport services as choked gutters cause spillage from drains onto the roads especially during heavy down pours and hence creating a situation of non-recurrent traffic congestion. There should also be the provision of an organized system of refuse or waste collection especially at the Market Circle area to prevent waste from choking the drains and covering parts of the roads anytime it rains. The proper management of waste will also help to protect the health of residents, especially the traders who use the market almost every day.



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QUESTIONNAIRE**Department of Geography and Resource Development****University of Ghana****Legon-Accra**

This research is being undertaken by a student of the department of Geography and Resource Development of the University of Ghana. The title for the study is, '**A Geographical Appraisal of Traffic Congestion at the Central Business District of Takoradi**'. The information is being gathered for academic purposes, publications, and conferences only and will therefore be held confidentially. (Please read full consent language for verbal consent prior to conducting the survey). **Please tick the appropriate answers where applicable.**

A. Socio- Demographic Data (for all respondents)					
A.1	Verbal consent given	[]	A.2	Time interview started	
A.3	Questionnaire No.		A.4	Code	
A.5	Name of Road and Neighbourhood				

A.6 Gender

a. Female []

b. Male []

A.7 Age of Respondent

a. 18-29 []

b. 30-39 []

c. 40-49 []

d. 50- 59 []

e. 60+ []

A.8 What is your highest educational attainment?

a. None []

b. Non-Formal Educ. []

c. Primary []

d. Middle/JSS []

e. SSS/'O' Level. []

f. Comm/Voc/Technical []

g. Post Sec./Nursing/Polytechnic []

h. University []

i. Other [] Please specify, _____

A.9 What is your marital status?

a. Married []

d. Widowed []

b. Separated []

e. Divorced []

c. Co- habiting /Consensual Union []

f. Single/ Never married []

A.10 What is your occupational status?

a. Employed [], specify, i) Formal, Specify

ii) Informal: 1. Trader []

2. Com. Driver []

Specify.....

3. Hawkers []

b. Not Employed [], Specify.....

A.11 How long have you lived in this community?

A.12 What is the size of your Household?

- a. 1-2 [] d. 7 - 9 []
 b. 3 - 4 [] e. > 9 []
 c. 5- 6 [] f. others

B. Livelihood Information (All Respondents)

B.1 Do you own a vehicle / car?

B. 2 Can you tell the average number of hours you spend in traffic during the peak hours of the congestion (morning and evening)?.....

B.3 From which of the following mode do you often make your their trip to and from the central business district of Takoradi? (Tick all that **apply**)

Source	Tick
1. Public vehicles (Trotor)	
2. Bicycles	
3. Motor bikes	
4. Private cars	
5. Walk	

B.4 How often would you say you use this mode of transport?

- a. Every day [] b. At least once a week []
 c. At least once a month [] d. Very occasionally []
 e. Others..... []

B.5 If you lived in any other community apart from this one, do you think the prices paid for transport will be different?

- a. Yes c. Maybe
 b. No d. Don't know

B.6.a Please explain your answer in B.12 above

.....

C. Variation of Traffic Situation on the Roads in The Community (all respondents)

C1. Which housing type do you live in?

- a. Compound ☐ b. Detached ☐
 c. Semi-Detached ☐ d. Apartment ☐
 e. Others.....

C.2 How many households live in this compound?

C.3 Would you say that the roads linking the housing units in this area are well planned and also in good state or conditions? (Materials used)

- a. Yes ☐ b. No ☐

C.3.1 If no, what makes the roads not suitable?

C.3.2 If yes, please explain

D.4 What do you think are some of the challenges that can hinder the usage of the roads in this area or community?

D.5 Rank your perception of severity of traffic congestion on this road against the options provided using the scale below;

Very High – 1, High – 2, Moderate – 3, low – 4, Very low - 5

Very High	
High	
Moderate	
Low	
Very low	

C.5.1 What do you think accounts for this situation?

D. Causes of Traffic Congestion (all respondents)

D.1 Which of the following peak hours of traffic do you experience traffic congestion the most on this road? a. 6a.m-10a.m. ☐ b. 4p.m.-8p.m. ☐

D.2 Which of the following do you think account for traffic congestion on the roads in this community

	Causes	Rank
a.	Presence of Industrial Activities	
b.	Presence of the harbor	
c.	Presence of Social Amenities	
d.	Natural increase in the population	
e.	Oil find	
f.	Presence of the central Market	
g.	Increase in number of driving persons	
h.	Inefficient traffic light systems	

D.3 Give a reason for your answer in D.2

.....

D.4 What other factors do you think contribute to the traffic congestion at metropolis?

.....

E. Effects of Traffic Congestion

E.1 Which of the following will you say is the major effect of the traffic congestion in this area? Rank in ascending order the rate of effects from 1-5.

E.2. Work

		Effects				
	Studied Roads	Reduced work Time	Difficulty in in Distributing Goods and Services	Increased inventory Holding	Inability to Work Efficiently due to Stress	Reduced output or Cities Growth
	Zone 1					
	Zone 2					
	Zone 3					
	Zone 4					
	Zone 5					

E.2.1 State reasons for your answer.....

.....

E.3 Transportation

		Effects				
	Studied Roads	Increase in Time Spent on roads	Increase in fuel usage	Destruction of brakes and accelerators	Inability to Forecast travel time	Environmental Damage
	Zone 1					
	Zone 2					
	Zone 3					
	Zone 4					
	Zone 5					

E.3.1. State reasons for your answer.....

.....

E.4 Education

		Effects				
	Studied Roads	Issues of Safety	Low delivery in Staff and Students and parents	Increased expenditure by Parents	Child Crashes and Injuries and death	Stress to Parents
	Zone 1					
	Zone 2					
	Zone 3					
	Zone 4					
	Zone 5					

E.4.1 State reasons for your answer.....

.....

E.5 Tourism

		Effects				
	Studied Roads	Reduction in Tourist Attraction	Decrease in Tourism revenue	Reduction in time of Tourism participation	Loss Incurred from Tourist Site	Road Rage
	Zone 1					
	Zone 2					
	Zone 3					
	Zone 4					
	Zone 5					

E.5.1 State reasons for your answer.....

.....

E.6 Health and Environment

		Effects				
	Studied Roads	Headache	Choking and High Blood Pressure	Stress and Weakness	Tension due to road rage	Others
	Zone 1					
	Zone 2					
	Zone 3					
	Zone 4					
	Zone 5					

E.6.1 State reasons for your answer.....

.....

E.7 Religious Activities

	Studied Roads	Effects				
		Change of Place of Worship	Delay to other Commuters	Noise	Increase Cost	Others
	Zone 1					
	Zone 2					
	Zone 3					
	Zone 4					
	Zone 5					

E.7.1 State reasons for your answer.....

.....

E.8 Rank from 1-5 where 1- Very High, 2- High, 3 – Moderate, 4 – Low, 5 – Very Low, the rate of the effects of traffic congestion on the following socio-economic indicators. (For All respondents).

Socio-economic Indicators	Very High	High	Moderate	Low	Very Low
Lateness					
Increase in Fares					
Stress					
Increase in Prices					
Reduced DD for goods & S.					
Higher Land Rent					
Rd. Dilapidation					
Accident					
Inab. to Forecast T. Time					
Pollution					
Reduced Worker Productivity					

F. Intervention and Measures to Mitigate Traffic Congestion

F.1 Do you know of any form of government intervention to help reduce traffic congestion in this community?

a. Yes [] b. No []

F.2 If yes, state what has been done.

.....

F.3 Has this intervention been successful?

a. Yes [] b. No []

F.4 Give reason (s) for you answer in

Q.H.3.....

F. 5 Do you know of any institutional intervention to help mitigate traffic-related challenges in the community?

a. Yes [] b. No []

F.6 If yes, please mention them and what they did.

.....

.....

F.7 Do you know of any office that you can lodge a complaint or seek assistance should you have any difficulties with regards to transport facility provision in this community?

a. Yes ☐ b. No ☐

I. Interviewer Details					
I.1	Name of Interviewer				
I.2	Time interview started			Time interview ended	
I.3	Respondent was...	Very cooperative	Somewhat Cooperative	Somewhat not cooperative	Not cooperative at all

Thank you for participating in this survey...

INTERVIEW GUIDE ‘A’

Traders (Retailers), Merchants and Customers

1. How would you describe traffic situation around the Market Circle?
2. What can you say accounts for traffic congestion in the CBD?
3. Which of the factors mentioned as the causes of traffic congestion are the most pressing ones and why?
4. Has traffic congestion improve or not?
5. How does traffic congestion affects you?

Focusing on

- a. Sales / Transport Cost
 - b. Pollution / Health Implications
 - c. Space or Convenience
 - d. Prices of Goods and Services
 - e. Religious Activities
 - f. Cost of Doing Business
6. Do you know of any union or association or organization responsible to making sure that the challenges of traffic congestion at the CBD are addressed?
 7. Do you know of any measures taken by the city authorities to at the market to reduce the impacts of the traffic on traders?
 8. What advice would you give to the city authorities to help reduce the challenges caused by the traffic in the metropolis?

INTERVIEW GUIDE 'B'

Commuters (Drivers & Passengers)

1. How long have you been driving or using this road?
2. Have you noticed changes in the intensity of traffic on the roads in the CBD?
3. Describe the traffic situation on the various arteries that connect to the Market Circle.
4. What will be your response if you were to compare the CBD of Takoradi to other cities in Ghana on the bases of traffic congestion?
5. What factors will you say accounts for the changes in the traffic situation at the CBD of Takoradi?
6. Which of the factors rate as the most pressing cause of the traffic situation in the metropolis?
7. Describe how the traffic situation on the roads leading to the CBD affects you.
Focusing on
 - a. Sales / Recreation
 - b. Education
 - c. Travel Cost
 - d. Health / attitude
 - e. Time spent in traffic and number of trips
 - f. Religious Activities
8. Are you a member or know of any organization or club (eg. Drivers Union) that meet to address challenges faced by users of the roads?
9. What will you say about the role of government institutions in making sure that transport facilities are provided and ensured in the city of Takoradi?

INTERVIEW GUIDE ‘C’

UR, STMA, GPRTU, Metro Mass Yard, DVLA

Knowledge about the Traffic Situation

- i) How would you describe the traffic situation in Takoradi?
- ii) Do you think the traffic situation is improving or not?
- iii) If you were to compare the traffic situation of the metropolis to other regions what will be your response?
- iv) Which areas in the region experience the most intense traffic congestion?

Knowledge about causes of the Traffic Congestion

- i) What factors will you say account for the traffic situation in the metropolis?
- ii) Which of the factors or the causes will you rate as the major cause of the traffic?
- iii) Do you think institutions responsible for mitigating traffic congestion in the metropolis are aware of the causes you have mentioned?

Effects of the Traffic Congestion

- i. What are some of the effects of the traffic congestion in the metropolis?
- ii. Focusing on
 - 1. Work (Lateness, Income, worker productivity, travel cost)
 - 2. Health related challenges
 - 3. Recreation or tourism
 - 4. Transportation Cost
 - 5. Religious Activities
 - 6. Education
- iii. How does the traffic congestion in the city personally affect your work?
- iv. Do you think traffic congestion have adverse effects on cost of running businesses and land rent in the metropolis? How?

Stakeholders Response to the Traffic Congestion

- i. What are some of the mechanisms put in place by your outfit to tackle the traffic situation in the metropolis?

- ii. Do you think this department or organization has done her best in responding to the demands of the transport system in the metropolis?
- iii. How do you see the future of transport system of the metropolis?

