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THE STATE OF URBAN ROADS AND THE IMPLICATIONS ON MOBILITY AND ECONOMIC PROGRESS

Location: City of Bamenda; North West region of Cameroon

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ABSTRACT

A well-established transportation system is not only key to national growth but also a catalyst for economic development of a country which provides a high level of accessibility that maximizes urban residents' access to economic and social opportunities (Todd, 2020). Across the world, traffic congestion has been a significant issue to most cities like Bamenda. As cities continue to thrive and as population increases, it is inevitable that managing traffic congestion will become more critical. The socio-demographic and population explosion experienced by the Bamenda city has changed its settlement pattern, coupled with the deplorable nature of the road network. This examines the state of urban roads and the implications on mobility in the city of Bamenda. Through a quantitative and qualitative methodological approach, a descriptive research design via random and purposive sampling techniques is used for primary data collection from observation and conducted interviews over field realities. The targeted population consisted of drivers, motorists, pedestrians, vendors and stakeholders in the transport sector. 210 questionnaires were administered to Bamenda I, II and III. Secondary data was collected from published and unpublished scientific works. Findings reveal that the nature of the urban road network is the major cause of traffic congestion in the city representing 55.3 % among other factors. Out of the 562.1km length of roads in the city, 475.9km are poorly constructed, characterised by potholes that impose speed breaks to moving vehicles. The roads are deplorable, made up of patches of tar, covered with dust and mud in the different seasons of the year. Only 13km of the roads are well constructed and tarred, which hinders sustainable transportation. The proposed planning measures include the improvement of the road system, installation of traffic signals, provision of traffic guidance, enforcement of parking rules and regulations, as well as increase in the use of the bus system, among others. The study further recommends that the Government of Cameroon should provide regional transportation authorities with more powers and resources to plan, coordinate and implement all urban infrastructure projects in the city. This will ensure planning for congestion that will effectively be in line with the land use plan of the city.

Introduction

Urban transport constitutes a major share of an economy's infrastructure. The amount of investment in this area in any country is immense. While cities present an engine for growth, roads constitute the main infrastructure serving urban connectivity carrying at least 80% of goods and 90% of passengers. These Roads are fundamental to development in a large scale and have profound and personal impacts on individual lives (Habitat III New Urban Agenda Report, 2017). Urban transport promotes development, link people, connects local communities and facilitates trade within an urban area. The world would be severely limited in development without transport means.

A current global trend of the world population growth is about 50 million urbanites each year, roughly one million a week (World Cities Report, 2016). About 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050 (Yuhui *et al*, 2020). More than 90% of this growth is occurring in developing economies which places intense pressure on urban infrastructure particularly transportation

In the context of today's ever growing development challenges, the United Nations 2030 Agenda for Sustainable Development (SDGs), perceive road transport as the ultimate means to a sustainable solution that supports development in Inland transportation, whereas, traffic congestion tends to increase with increase in wealth as consumers purchase more vehicles whereas the supply of land does not increase. Therefore roads and parking compete for land that is increasingly expensive due to demand for other uses.

Urban areas of the third world countries become increasingly automobile dominated and face growth in transport related challenges including pollution, congestion, public transport decline and lack of accessibility to the urban poor. The high rate of transportation activity has generated negative effects on the population who are experiencing numerous traffic problems. In Cameroon, traffic congestion is commonplace problem rocking inner and outer city areas and increases where there is an inverse relationship between road users to road size, density and number of nodes (Fogwe, 2020).

In 1996, Road Fund of Cameroon was created to implement the government policy on the road sector. During this period, government focus was to improve upon the condition of Cameroonians roads network of about 27,000km. In order to meet up the expectations of roads users, the public authorities set up a high value added and maintenance approach in 2016 to improve the service level of the infrastructure sector (Road Fund Annual Report, 2016). That notwithstanding, there is still need to improve the sector performance so far, some of which relate to the operationalization of the institutions and performance work in the sector. The operationalization and the performance level of these roads within the urban cities is the concern for the present study as some of these major or manor roads are either over or under used base on their capacity that bring in the issue of traffic within the cities.

In the North West region of Cameroon, traffic flow remains a daily huddle especially in the activity-population concentrated sections along whose roads lead to other towns and areas of the Region like Bafut and Wum leading to Menchum Division, then Bambui, Bambili, Babanki, Mbingo, Njinikom, Fundong in Boyo Division to the North East. This implies that traffic flow towards these areas suffers from car traffic jam pressure to transport goods and persons (Fogwe, 2020).

In the city of Bamenda, much attention in managing traffic congestion and road sidewalks has often been given to the commercial avenue street (Central Business District, (CBD)) with less

regard to neighborhood streets which are recently impaired by curb parking. It has been observed that congestion has become a crisis in the Bamenda metropolis which has emerged as bourgeoning trails of economic, social, cultural and intellectual undertakings. This results in too many vehicles, bad roads, vehicle breakdown and on-street parking affecting all age cohorts of urban users. According to Yemmafouo (2019), Stakeholders (municipal councils and transporters) assumed that the decongestion of the urban centers by removing travel agencies and other bus stations at city entrances will reduce the incidence of traffic congestion and free up commercial centers. From the background of the study, such transportation issues will be appropriately addressed with the support of academic research and the influence of policy makers.

Statement of the Research Problem

Traffic demand within the city of Bamenda appears to be one of the urban problems in the study area. This is clearly demonstrated by the rapid development of the city and the increase in the number of car owners. The nature of roads within the city of Bamenda, illegal parking, inappropriate use of road sidewalks and poor traffic management on major urban road networks present the progressively worsening traffic condition of the city.

The urban population of the city of Bamenda has increased from 9000 inhabitants in 1950 to about 1,279,904 inhabitants in 2020 (projection, 2020) which is projected to increase to about 1,488,759 inhabitants by 2035 (projection, 2035). The Socio-demographic population explosion seem to have led to increase in the number of dependent people and changed the density in settlement spreading to new areas across the municipalities where road infrastructural development has not been planned. This appears to increase the concentration of the urban population on the limited roads. The Road infrastructural development within the city has not been sustainable in order to sustain the economic activities or transportation demands of the growing population. These roads are deplorable in such a way that they have been reduced to patches of tarred surfaces.

During the rainy season, the roads are largely abandoned and dilapidated so much such that these roads are usually covered with mud while they remain dusty in the dry season. This is often after a series of renovation works to at least keep the roads functional which usually leave the roads in no better conditions. The nature of these roads has an implication on the traffic situation of the city. The speed of moving vehicles on these roads is slowed down and creates long traffic queues as the vehicles are confronted with gallops, potholes and narrow roads that inconvenience movement. This has created a situation whereby there is recurrent traffic jams within the city at particular hours of the day on a daily basis. The nature of the urban roads and their contribution to traffic congestion in the city is an issue that cannot be overlooked in planning.

Also, inadequate and inefficient implementation of parking rules and regulations by the city managers such as the Bamenda City Council and the three Sub Divisional Councils within the city is a problem. This inefficiency in planning has a bearing on the traffic and parking situation of the city as vehicles owners both privately owned, taxis and motor bikes tend to park haphazardly on sidewalks occupying road spaces without any considerations for other road users. Furthermore, unregulated loading and offloading by land transport agencies located along roadsides in the city are hindrance to free traffic flow that give way to traffic jam within the city. The practice of illegal parks created at each street, such as at Hospital Round About, City Chemist, Mobile Nkwen, Amour Mezam and Manda Nkwen junction by motor bike riders and commercial taxis drivers, the sitting and location of transport agencies close to major roads axis such as Moghamo and Vatican agencies at Sonac street, the construction of buildings by the road without setbacks that all appear to affect mobility.

Sidewalks within the city of Bamenda have been turned into commercial stop points. Business persons use these sidewalks and even part of the road to display their goods leaving pedestrians with no choice but to use the roads reducing the road lane available to vehicles.

Traffic management within the city is inadequate. The timing of markets such as Nkwen market, Food market, Main market and Ntarikon market located at road sides coincides with that of the opening and closing of office hours, and this increases traffic congestion problems.

Research Question

What are the causes and implications of traffic congestion within the city of Bamenda?

Purpose of Study

The aim of the study is to bring out the variables responsible for traffic congestion in Cameroon by examining the causes (bad roads as a major cause) and implications of traffic congestion in the city of Bamenda.

Location of study area

Bamenda is located in the north-western plateau of Cameroon and is the capital city of the North West Region. The city is situated between longitude $10^{o}08^{'}45^{"}$E and latitude $5^{o}57^{'}34^{"}$N, at an elevation of 1413m above sea level. Bamenda covers a surface area of 71.23 square kilometers and it is the administrative seat of Mezam Division, the Regional Headquarters of the North West and the largest town in the North West region. Bamenda is a socio- economic, political and commercial hub for the region and also connects other suburban areas. It has three sub divisional councils with a population of about 74,127 inhabitants (projected population from the 2005 population census). The urban part of the city is made up of three villages which are, Mankon, Nkwen and Bamendakwe. However, it is surrounded by other suburban areas and

villages. It is bounded by Bafut in the north, Tubah to the east, Santa subdivision to the south, and Bali and Mbengwi to the west (Tening, 2013). These suburban areas are fast growing and sometimes considered as part of Bamenda city. Figure 1.1 present the location of Bamenda city.

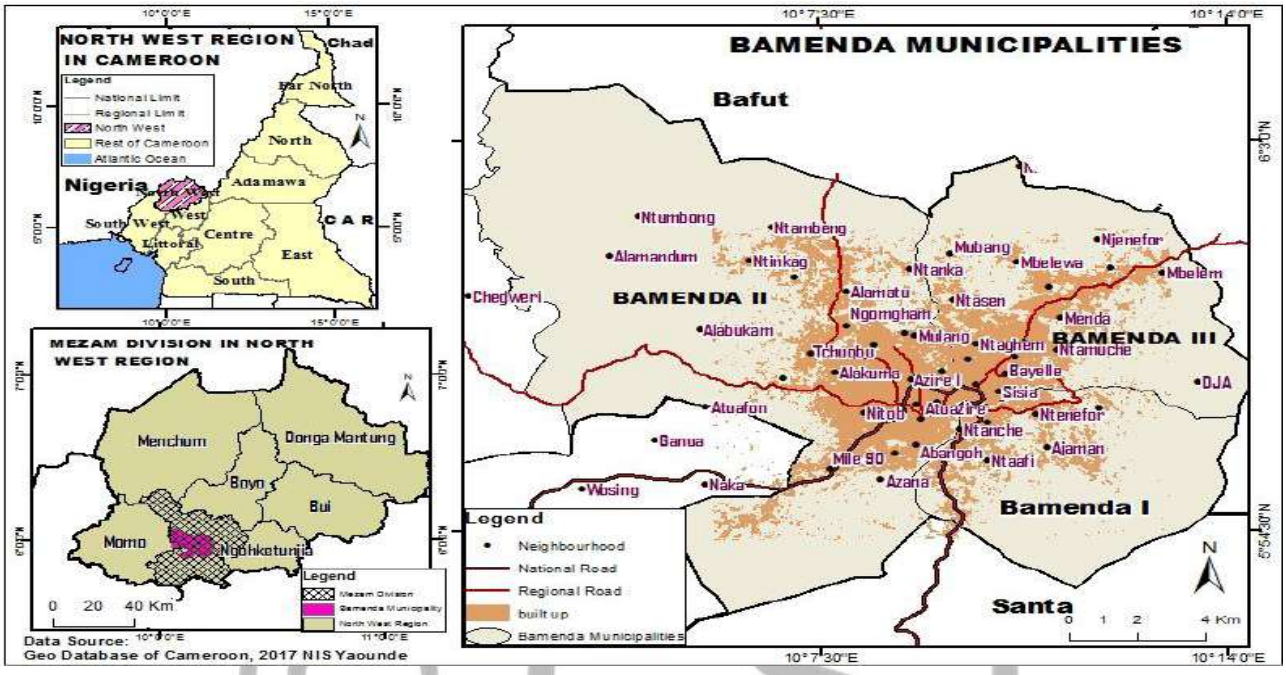


Figure 1. Location of Bamenda City in Mezam Division of the North West Region of Cameroon

Literature Review

Mobility is a crucial functionality of cities as it affects their socio-economic activities, hindrance to effective mobility is the phenomenon of traffic congestion. Traffic congestion remains a global phenomenon that affects the cities of the world, especially developing countries arising from poorly planned road network and land use (Kayode, 2015). Traffic congestion in both perception and reality impacts the movement of people and freight and is deeply tied to the history of high level of accessibility and mobility. There is no agreed definition of traffic congestion because it is both a physical and a relative phenomenon (Downie, 2008). It causes are varied and are broadly classified into two (Down, 2005), that is, micro and macro levels factors. These factors affect millions of commuters of all income levels from the stand point of the economy, quality of life and road safety.

Traffic congestion on Nigerian Roads defined traffic congestion as impedance of vehicles imposed on each other due to speed flow relationship in conditions where the use of transport system approaches capacity Raheem *et al*, (2015). Lomendra *et al* (2018), opines that traffic congestion refers to the way the movement of vehicles is delayed by one another because of limited road capacity. Due to the incongruity, this study therefore perceives traffic congestion as a relative phenomenon where there is a difference between road performance and road users expectation caused by multiple factors, some being unique to a given location. Any city that is economically active and vibrant will rarely be free from traffic congestion. Up to a limit, crowds and queues signal mobility, prosperity and economic growth. According to Nigerian Ministry of Economic Planning and Budget (2013), it is probably impossible to expand transportation infrastructure to operate with zero congestion at all times of the day and year. Several studies identified the causes of traffic congestion as follows

Rao and Rao (2012), identified two causes of traffic congestion which are the macro and micro level factors. The macro level relates to the overall demand for road use where by congestion is triggered at the micro level and driven at the macro level as many people want to move at the same time. Macro level factors are triggered by land-use patterns, employment patterns, income levels, car ownership trends, infrastructure investment and regional economic dynamics that lead to congestion. Micro level factors involve many people and freight wanting to move at the same time, too many vehicles for limited road space. In the city of Bamenda both the micro and macro level factors act together to trigger congestion on the urban roads. The insufficient infrastructural investment has limited the number of roads in the city making the few available roads to be used beyond their carrying capacities which therefore result to congestion.

In another perspective Agyapong and Kolawalo (2018), writes of two causes of traffic congestion, recurrent congestion and non-recurrent congestion. These two causes of congestion are evident in the study areas such as Hospital Round About, Sonac Street and Mobile Nkwen. Tilak and Reddy

(2016), held that, Economic development is one of the causes to traffic congestion. Road congestion in cities is mostly the result of prosperous economic development that encourage accommodation, careers and social programs bringing individual to work and live together in urban areas leading to a rise in traffic volumes, e.g. in India. Lomendra *et al* (2018). Closely linked to economic development is the increase in car ownership and use of motor bikes alongside population increase. The demand for road space arises from the universal desire to own and use motor vehicles (Yuhui *et al*, 2020). In addition to this, the dominance of low capacity minibus taxi for commercial purposes has aggravated the situation (Kayode, 2015). A World Bank study revealed that the most popular form of public transport in most African cities is the minibus taxis.

Planning in transportation can have a quality of meaningfulness, realism, applicability and aimfulness if it is realized by taking the different conditions of each urban area case into consideration. According to Koelak and Dagmara, (2018), unplanned cities are the cause of traffic congestion in developing cities of the third world countries. Unplanned cities is a common feature across many urban regions in the developing world with the presence of critical congested areas due to poorly planned road networks resulting to present day hot spot areas of traffic congestion (Dorina and Dominic, 2015). As cities grow in an ad-hoc manner, no provision is made towards scaling road capacities, eventually resulting into several bottleneck roads, which remain congested for extended periods of time as noted by Assel *et al*, (2019). Most often, traffic impact assessments are not carried out before facilities are located in the cities (Absar and Faisal, 2013). Apart from unplanned cities, Santos *et al*, (2019), identified poor discipline and or General indiscipline as a cause to urban traffic congestion. This is experience in the city of Bamenda where indiscipline exhibited on the roads leads to congestion. Motorists and pedestrians in Bamenda city perceive law enforcement as weak hence, are quick to disobey and obstruct traffic flow on the roads.

According to Turon *et al*, (2017), Road checkpoints in cities are one of the causes to urban traffic congestion. These check points caused the roads to be narrowed and greatly slow down traffic to a bottleneck situation (Kayode, 2015). The city of Bamenda in the current insecurity, necessitating the presence of security checks, often ends up in induced traffic on the narrowed roads in the city. Several studies have been carried out on the causes of traffic congestion in urban cities with the above literature chosen to be specific to the study area. Some of these studies include, Amals (2004), Narathorn et al (2016), Rodrique *et al* (2009), Agyapong and Kolawalo (2018), Raheem *et al* (2015), Kayode (2015), Dorina and Dominic (2015), and Rao and Rao (2012) are among the many published research works that discussed the causes of urban traffic congestion. Looking at the detrimental impacts of traffic congestion, Patricia Bass noted that congestion is a waste of time, money, a cause of pollution and stress, a detriment to economic productivity. It was estimated that in 2002, traffic congestion wasted $63.2 billion in 75 urban cities due to extra cost on fuel consumed and time lost amounting to $829 per person (Narathorn *et al*, 2016). Others have such as Agyapong and Kolawole (2018), perceive the impacts of traffic congestion to be positive, since it can be used

as an indicator of to economic growth and as an urban lifestyle. Carvero (1998) noted that congestion may be evidence that a community has a healthy growing economy as such, has restrained from over investing on roads.

Conceptual Framework

The three phase Traffic theory seeks to describe in precise mathematical way the interactions between the vehicles and their operators (the mobile components) and the infrastructure (the immobile component). This theory is an indispensable construct for all models and tools that are being used in the design of highways and operation of the urban streets characterized by the flow of traffic in many facets in the transport sector. Traffic flow theory forms the foundation for all the theories, techniques and procedures that are being applied in the design, operation, and development of advanced transportation systems. The Three Phase Traffic Theory of Boris Kerner, (2012) explains traffic flow by the phase transition in the traffic system. The three phases in traffic consist of free flow and two congested phases which are the synchronized flow and wide moving jam. This three phase offers qualitative features of traffic congestion phenomenon and emphasis the understanding of empirical traffic congestion which occurs on unsignalized freeway that affect traffic management. It therefore has three parameters for understanding the empirical features of three phases which are Velocity (v), density (p) and flow rate (q) of vehicles.

In free flow, there is no significant speed drop; the flow rate is nearly proportional to the density (its slope tends to decrease as the density increases). At this phase, congestion mostly occurs at the bottleneck while in the congested phase, the average speed of vehicles drops. Moreover the variance of the points in congestion states is much larger than free flow state. At this stage, the synchronized flow in the congested phase is the source of variance.

The three phase traffic theory divides the congested states by two; synchronized flow and wide moving jam. After the congestion transition occur, free flow change to synchronized flow (The term synchronized reflects the synchronization of speed of the vehicles in different lanes). In the synchronized flow, the speed of vehicles drops significantly, but there is no noticeable change in the flow rate. This is due to the increase in the density of vehicle so that the product of the speed and the density remains nearly the same. The downstream front is mostly fixed at the bottleneck. The synchronized flow can be divided by three patterns according to the evolution of the downstream front and the upstream front.

According to Kerner, the wide moving jam can only spontaneously occur through synchronized flow. At this stage, both flow rate and velocity drops significantly, and they become relatively uniform than synchronized flow. Therefore, empirically, large variance in the density-flow rate plane consists of synchronized flow. Wide moving jam which propagates backward with mean velocity that passes through the next bottle neck. When this occurs, the cycle repeats itself and the town experience continuous congestion. The three phases stated therefore explain the theory of Traffic Flow that bring about traffic congestion in urban cities.

Table 1. Summary of the parameters in each of phase in the three Phase Traffic Theory

Phases	**Speed**	**Flow rate**	**Density**

Free flow	High	High	Low
Synchronize flow	Low	Close to free flow	Middle
Wide moving jam	Ignorable	Ignorable	Highest

Source; Moon Jip Park (Boris Kerner, 2012)

This theory is specific to the main objective of the study looking at the causes and implications of traffic congestion. The theory at the level of free flow and congested flow explain explicitly the causes of congestion in an urban area. According to Fogwe, (2020), the variance in congestion is much larger than free flow in the city of Bamenda as it is common along the road axis from Bambili towards Nkwen. Along these roads, vehicles accelerate at a relatively high speed because traffic is low especially as one move from National Polytechnic in Bamenda. The speed of vehicles usually drops towards Mile 4 and much more towards AMOUR MEZAM and MOBIL Nkwen. This is the hot spot of traffic congestion because the density of vehicles is high with relatively low speed and the flow rate ignorable as vehicles move in haphazard manner.

In synchronized flow, the speed of vehicles drops significantly in the city, but there is a noticeable change in the flow rate observed. Along the Nkwen - Bambili road, this occurs at Mile 4 Junction where although the speed of the vehicle drops, traffic density and flow is moderate since there are trucks which occupy the road forcing the cars to slow down. Wide moving jam propagates backward with mean velocity especially at MOBIL Nkwen; traffic density is highest at the commercial street and the food Market Street. This is due to the narrow nature of the road as well as the high concentration of commercial activities so that cars and motorbikes accelerate at variable speed. The commercial Avenue Street is characterized by moving jam with high vehicles and motor bikes density there by slowing down the speed and flow rate of moving vehicles. This is a similar situation experienced at the Food Market Street and the Meta Quarter Street all leading to Hospital Round About junction. This theory base on the three variables of velocity, density and flow rate therefore depicts the traffic situation of Bamenda city with the various streets experiencing any one of the given variables at specific periods of time explained by different factors.

The Concept of Sustainable Transportation

The concept of Sustainable transportation stems from the root concept of sustainable development (Velazquez, 2015). This concept have distinct meaning to people in different settings that conceive sustainability and acts toward it depending on their knowledge, background, experience, perception, values and context, gave way to the formulation of the sustainable transportation concept. The concept of sustainable transportation means the cheapest point to point transport available, reliable and fast that use the least amount of energy or resources to fulfill the task. A definition fitting in the general definition of sustainable transportation is given by the Organization for Economic Cooperation and Development (OECD, 2002), as “one that does not endanger public health or ecosystems and meets mobility needs consistent with the use of renewable resources at below their

rates of development of renewable substitutes. The concept unlike that of sustainable development operates in the context of social, economic and environmental considerations.

Social dimension. Sustainable transportation should benefit the society and be safe, not impairing human health while minimizing disturbance on communities Innes and Sebastian, (2008). This dimension plays a crucial role in planning for transport modes in urban areas. Besides distributional impacts and matters of inequity, the main implication of the social dimension of sustainable transport is public acceptance. This dimension promotes access to goods and services for many people as possible while regulating unsustainable modes which are costly. The public discussion on the social dimension of the sustainable transportation concept is complicated by very emotional arguments of the involved users, such as the fear of being confined, if no flexible means of transport are available, or affordable, or of a supposed change in one's lifestyle.

Economic Dimension. Since the eighteenth century, the importance of transport was highlighted by Adam Smith. In the Smithian concept, transport was a productive branch that creates value in economic activities. The economic dimension of the concept of sustainable transport reviews that transport leads to opportunities and benefits of economic and social influence throughout the economy. When transport system is lagging behind losses occur in an economy due to decreased international trade. Transport plays an important role in the development and diversification of trade between countries worldwide, by assumed role, is an important part of material production shaping the other sectors of the world economy; therefore sustainable transportation is a premise in achieving economic cooperation agreements, in order to bring in world circuit regions around the globe, by creating a distribution system opened to needs of potential beneficiaries. In the current period, countries interrelation is based to economic resorts, by transport activity which is one of the main elements of globalization. Based on the concept of sustainable development of society, the sustainable transport has a significant importance for the balanced development of economic and social systems of a country (Nistor and Popa, 2014).

Environmental Dimension. A reduction of the environmental impacts of transportation is a strategy for sustainability. Transportation contributes to harmful emissions, noise and to climate change and as vehicles are becoming environmentally efficient, the global fleet of vehicles is also increasing. The concept of sustainable transport considers the amount of waste generated in the sector that must be reduced, reused and recycled.

This concept is in view of the third specific objective of the study concerned with adaptive and mitigation measures to traffic management. The concept propagates the use of fast, reliable and efficient transport modes for many people as possible. The mitigations measures are geared towards enhancing sustainable transportation system in the city of Bamenda, in the use of vehicles and motor bikes or walking while minimizing the economic, social and environmental cost of the various modes. The concept is applicable in the study areas as the public transport services such as taxi and motor bikes are cheap and reliable to carry the population to their desired destinations. Table 2.3, presents the variables of the concept in the study area.

Table 2 **Operationalization of the Concept of Sustainable Transportation in Bamenda city**

Concept	Dimensions	Variables	Indicators
Sustainable transportation	Social	• Public acceptance	• Number of persons using each mode of transport
	Economic	• Car pricing • Connectivity	• Public transport tariff • Number of economic activity within each street corridor
	Environmental	• Pollution • Aesthetic	• Type of energy used in each vehicle • Number of vehicles paying pollution tax • Number of environmentally friendly trees on each street

Source; author's conception, 2020

Table 2. indicates the significance of public transport sustainability from the stand point of social and economic sustainability as the dominant mode of modern transportation in the city with specific focus on the provision of streets, having sidewalks to ensure environmental sustainability.

Research Design

This study made use of the survey, historical, correlational and descriptive research designs. In the survey design field surveys were carried out in the three municipalities of Bamenda I. II and III, of the city. From the survey, data for cartographic work was obtained by identifying and classifying the urban road networks of Bamenda pertaining to the purpose of study. It also aided in the collection of traffic count variables, the identification of streets with recurrent congestion and the factors responsible for the congestion. Through the historical approach, the study analyzed the past and present trends of population growth and car owners from 1996 to 2020 and their consequent effect on congestion in the city of Bamenda. The period 1996 is specific to this study considering it as the year when the National Road Fund was created to improve on the nature of roads in the national territory, the city of Bamenda equally benefited from the initiative. Through the use of correlational design, chi-square and the Pearson's product moment correlation statistical test were used to test the first and second specific objectives of the study to establish the relationship between the main variables in the study. A descriptive survey design methodology was used to investigate or describe the characteristics of a particular sample of individuals at one point in time, and to analyze and discover occurrences. The design assisted in collecting self-reported opinions, and characteristics of past and present causes of traffic congestion and its implication in the city of Bamenda.

Data Collection

The study involved the collection of both primary and secondary data from different sources in order to attain the research purpose, and achieved by the use of selective sampling procedure, sample size, sampling strategy, sampling source and tools. This considered target locations of Bamenda I, II and III, and targeted number of individuals for the administration of questionnaires. The literacy levels of all the age groups involved were considered in the data collection process, and some were assisted by the questionnaires administrators as guided and in the presence of the respondents as it necessitated. Purposive sampling was used to determine the target respondents including but not limited to heads of services of Urban Development at the Bamenda City Council, Regional Delegation of Housing and Urban Development, Regional Delegation of Public Works, Regional Delegation of Transport, Bamenda Driver's Union, and workers of the Bamenda City Council.

Targeted Population. The study focused purposively on drivers, motorists, business vendors and pedestrians of all age groups who have a better mastery of the occurrence of traffic congestion and the obstruction of pedestrian's paths aggravated by the increase in the urban population, vehicle population and motorists. Also, the Municipal authorities of Bamenda City Council and police were part of the sample frame since they are in charge of managing traffic in the city. The targeted population therefore consisted of 444 inhabitants from which 40% were sampled given a total of 210 sampled inhabitants. The 40% sampled population was taken to represent the total population due to time and financial constraints. This was appropriate for the study with the use of random sampling that gave a representation of the total population.

Sample Population. Oso and Onen (2008) sees sample population as a part of the target population or accessible population that has been procedurally selected to represent the whole population. For the purpose of this study the sample population was inclusive with the sampling range being idiographic. The appropriate sample size was small and flexible, based on this; the respondents were subsumed into an anonymous part of a larger whole. 40% of the targeted population (Bamenda City) was used to get the sample population and the sample size was taken from the sample population using a percentage of 2. According to the 2005 population census, the city of Bamenda had a total population of 53,329 inhabitants and the projected population for 2020 was drawn using the Michael Keenan's (2017) projection method to obtain the total population for 2020. The sample population of the three subdivisions of the municipality was drawn using the formula by Robinson (2013) following their population size. Accordingly, the formula used to obtain the sample size for the administration of 210 questionnaires using the 40% of the targeted population detailed thus: Bamenda-I had a total of 12.1%, Bamenda-II had the highest percentage of 45% followed by Bamenda-III with 42.9%. See table 3 below.

Table 3. Questionnaire administration by Sub Division

Council area	Population per municipality	Number of questionnaires administered	number of questionnaires retrieved	Percentage of questionnaires retrieved
Bamenda I	67,778	26	26	12
Bamenda II	771,704	95	95	45

Bamenda III	440,422	89	87	41
Total	1,279,904	210	208	98

Source: fieldwork (2020)

The population in each municipality on table 3.1 was projected using the 2005 population census data with a growth rate of 2.6 based on the assumption that the growth rate between 2005 and 2020 was constant. This assumption was done based on the inconsistency in the growth rate of the three municipalities in the city. The projected population for the municipalities therefore gave the basis for the distribution of questionnaires

Data Analysis and Presentation

This study made used of four hypotheses. To verify these hypotheses, data collected from the field was sorted manually and computed in to Microsoft excel (2010, version) and word (Microsoft word 2010, version) for treatment. Both descriptive (qualitative) and inferential (quantitative) statistical tools were used to analyze the data using the Statistical Package for Social Sciences (SPSS version 20) to transform data in to statistical tables, cross tabulation and figures. Results obtained from the analysis of questionnaires were presented in the form of figures, tables and maps.

Objective one of the study was analyzed descriptively using figures and frequency tables to show the percentages of respondents perceptions on the causes and implication of traffic congestion in the city of Bamenda with texts provided for the explanations of the tables. Statistical test of chi square was used to test the first hypothesis of the study. This test was used to determine if there exist a significant relationship between the nature of the urban road network and the occurrence of traffic congestion in the city of Bamenda.

Inferential statistics were used to undertake the Analysis of variance also called ANOVA, specifically the use of Manova for the second study objective using Statistical Package for Social Sciences. The testing of the second hypothesis was carried out using the product moment correlation on both the ordinal and interval scale. The Pearson Correlation was used to determine the strength of the relationship that exists between parking and the use of sidewalks on traffic congestion in the city of Bamenda. This statistical method was appropriate for the study because the number of questionnaires distributed was reliable and equitable in the three municipal areas of the study. The correlation also assumed the populations involved in the study were normally distributed as this was assured by the projected population of Bamenda city, the targeted population and the sampled size of the study. Based on the view of the population, the Pearson correlation enabled the stated objective to be attained through the tested hypothesis and to generalize the result in the study area.

The third hypothesis was tested with the aid of the Regression Model Analysis. This statistical method was used to establish the relationship that exists between stakeholders in traffic management in Bamenda city and to compare the existing measures toward traffic mitigation in the city as well as to validate the proposed measures. This model with the aid of an abnormally graph provided information that was useful to identify the significant measures to be prioritized during implementation.

Traffic congestion has been an issue in the city of Bamenda for decades. This phenomenon has progressively worsened as the city goes through the urbanization cycle, the influx of commercial

taxis, motor bikes, the use of private vehicles and the associated need for parking. Considering the causes and the implications that congestion has on the urban population and the city's economy, the Road Fund was created in 1996 to construct and maintain urban roads as an attempt to reduce congestion. In 2008, the urban status of the town was upgraded to a city level and has ever since been accompanied by many transportation ills with traffic congestion being the most disturbing. This is reflected in the number of actors involved in the usage of the urban roads ranging from private vehicles, commercial vehicles, truck drivers, motor bikes, hawkers and pedestrians. As a result, there appeared to be only fewer areas of fluid mobility within the city (Cow Street, Ghana Street, Up Station and Savannah Street) as compared to the more numerous areas of stuffed circulation (Food Market Street, Ngeng Junction, Hospital Roundabout, Veterinary Junction, MOBILE Nkwen to AMOUR MEZAM EXPRESS, and Mile 4 Nkwen, Commercial Avenue and Ntarikon (Fogwe, 2020.) The focus of the chapter is to examine the causes and implications of traffic congestion in the city of Bamenda from 1996 to 2020. The first part of the chapter dwells on the socio-demographic characteristics of the respondents and the second part on the causes and implications of traffic congestion in the study area.

Socio-demographic correlates of sampled population

Information from the field was obtained from respondents who were both male and female with diverse demographic characteristics as presented on Table 4 below

Table 4. Socio-demographic correlates of sampled population

Sub division	**Frequency**	**Percent**
Bamenda I	26	12.5
Bamenda II	95	45.7
Bamenda III	87	41.8
Total	208	100.0
Marital status		
Marital status	**frequency**	**Percent**
Single	136	65.4
Married	63	30.3
Divorced	9	4.3
Total	208	100.0

Source; Field work, 2020

Table 4 presents summary statistics on the characteristics of individuals in the sample revealing the variables, frequencies and percentage involved. Overall, the sample consisted of 210 questionnaires distributed to the targeted population of the three sub divisional council areas of the municipality. Bamenda I had the least percentage of 12.5%, followed by Bamenda III with 41.8% and Bamenda II with the highest percentage of 45.7% questionnaires. The high percentage of questionnaire administration in Bamenda II was accounted for by the fact that it has the largest population in the city with the majority of the roads found in this part of the city. Individuals in the sample were more likely to be single (65.4 %), married (30.3%) and less divorced (4.3%).

Road Network Distribution in Bamenda City

Urban roads in Bamenda have been classified into: regional roads, primary distributor roads, secondary distributor roads, collector roads and access or local roads. The hierarchy of these roads is categorized based on their function and capacity. At the top of the hierarchy are limited access regional roads that provide largely uninterrupted travels to connect the city to other regions. The primary distributor roads link the city to neighboring suburban areas of Bafut, Bali, Mbengwi and Bambui. The secondary distributor roads are the major roads that are expected to carry large volumes of traffic in the city while Collector roads collect traffic from local roads, and distribute to arterials. At the bottom of the hierarchy are local streets or access roads which are the unclassified roads that carry the urban population in to the various quarters within the city. These roads record the least speed limit, and carry low traffic volumes. Figure 4 shows the road hierarchy network that supports traffic flow in the study area. According to data obtained from the field, there exists a total of 562.1 km length of road network in the city of Bamenda. 13.3km (2.3%) of the road that support traffic flow in the city are well constructed whereas 67.1km (11.9%) length of the road network are poorly constructed and are not sustainable to support the demand for free flow of movement. Ongoing construction projects occupy 5.8 km (1.1%) length of the roads and greater lengths of 475.9km (84.7%) roads are poorly constructed and unclassified. Bamenda II municipality that hosts the CBD of the city has a high concentration of roads with one National road that cut through the municipality, one Trunk A road and thirty streets. Apart from the CDB, Bamenda II municipality is a host to many administrative offices such as the Bamenda City Council, Bamenda II sub Divisional council, Macro Finance offices that attract the population bringing about congestion. This explains why this municipality experience high congestion and recurrent traffic hotspot areas. The distribution of road network is least in Bamenda III municipality with the presence of about five tarred streets and other local streets. This is accounted for by the fact that the municipality has experienced the effect of urban sprawl in the periphery where infrastructural development had not been planned or executed.

Figure 2. The hierarchy of roads in Bamenda City
Source: Fieldwork, 2020

Classification of Roads in the city of Bamenda

The roads network distribution of Bamenda city is classified based on their functions and capacity into primary, secondary, tertiary and local streets. For the purpose of this study, the trunk roads that exist in the city were incorporated into primary roads. This classification is an important aspect in the understanding of traffic distribution and trends in the city as seen on table 5.

Table 5. Classification of roads in the city of Bamenda.

Type of roads	Bamenda I	Bamenda II	Bamenda III	Number of roads
Primary	National Road 1	Food market street Sonac street Wum road Muna street	-	5
Secondary	Mile I street	Commercial avenue street Ntarikon street Azire street Mbengwi road	Mile four Nkwen road	6
Tertiary	Governor street Avenir street	Cow street Ghana street	Mbelewa street Council street	31

		Foncha street Below Foncha street Ndamukon street Ayaba street Meta quarter streets Mulang streets Old Town street, New Road Longla street, Che street Tawa street, Vicky street Savannah street Independence street Treasury street Virgin land street	Menteh street	
Local streets		Angwafo street Awanu street Mofor street	Fundzon street	4
Unclassified		Church street Mancho street Ndefu street		3

Source; Field work, 2020

According to table 5, there exists one primary road that connects the city to other regions. Four trunk roads exist in the city, with five secondary roads while there are several collector roads that connect the city. Equally there are local roads and others which are unclassified. The highest density of roads are found in Bamenda II municipality accounted for by the fact that, this municipality is a host to many activities in the city ranging from primary, secondary to tertiary. As such the road network connectivity is fairly good with all parts of the city connected to the city center. Bamenda II and I have low road network distribution with at least four roads in each of the municipality. This is explained by the fact that these municipalities are experiencing the phenomenon of urban sprawl spreading to areas dominated by foot paths or local streets hence a low road network.

Identification of Road Users in Bamenda city

Traffic congestion cannot occur on the roads without the presence of different road users. These road users compete for space on the limited access roads in the city that lead to congestion. These road users were identified with the use of questionnaires and they comprise of pedestrians, motorists, cyclists and street vendors or hawkers. Table 6 shows the categorization of road users in Bamenda city.

Table 6. Identification of road users in Bamenda city

Road users	Occasional users	Regular users	Percent
Pedestrians	26	31	27.4
Street vendors/hawkers	23	25	25
Cyclists	6	0	2.9
Public vehicles	15	24	21.5
Private vehicles	8	10	6.8
Motor bike riders	9	22	16.4

Source; Field work (2020)

Table 6, indicates that the highest road users in Bamenda city are pedestrians and vehicle (taxi and private drivers) with a percentage of 27.4 % each. These two road users occupy the road at each given time of the day on a regular basis. This is followed by street vendors who locate their businesses by the roadside taking up part of the road. Motor bikes riders are equally identified as road users in Bamenda city with 16.4% while cyclists are the least seasonal users identified in Bamenda city with 2.9 % engagement on the roads on part time basis.

Mode of transport and preference in the city of Bamenda

Effective road based public transport is central to economic growth of developing cities. In the city of Bamenda, this is the common available means to access employment, education and public services especially where these destinations are beyond walking. Urban dwellers in the study area are limited in their choice for a preference mode of transportation due to the attribute of the available mode. These attributes were associated to cost, time, convenience and flexibility of the available mode ranging from private cars, public transport, motor bikes, bicycles and walking. These different modes and their preferences were investigated and presented in figure 3 and table 7.

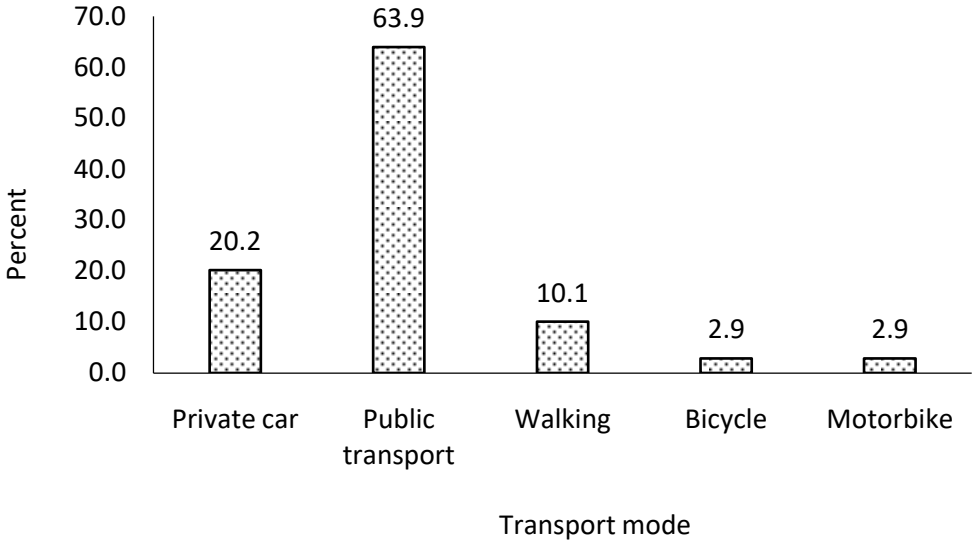


Figure 3. Modes of transport in the city of Bamenda
Source: Fieldwork, (2020)

According to figure 3, public transport account for 63.9% of the preferred mode of transport in the city of Bamenda. Public transport within the city comprise of commercial taxis, motor bikes and buses. These taxis and motor bikes are limited in capacity where a single taxi accommodates a maximum of four passengers per trip and the motor bike limited to two passengers. The increase in the use of public transport with limited capacity and the consequent proliferation of these taxis and motor bikes leads to congestion in the city. The preference in the use of public transport in the city is based on the service availability and low cost as compared to the management of private vehicles. This has created a scenario wherein illegal motor bike parks are created at every major junction in obstruction to sustainable transportation in the city. These parks are threats to pedestrians, moving vehicles and congestion in the city. A World Bank study reviewed similar funding that the most popular mode of transport in African countries is the use of public transport which is made up of minibus taxi (Kayode, 2015). Findings also revealed that private cars account for 20.2% of the preference mode of transport use in the city. This is accounted for by the fact that this mode is flexible and less time consuming. The influx of this mode of transport is experienced in the early hours of the morning when the population leave for work and in the evening as they return. This also explains why congestion peak hours in the city are highest between these two periods. Walking as a mode of transport, accounts for 10.1% of the mode of preference which comprise of short distances within the city that are reachable via walking such as a trip to a cold store. Biking and private motor bikes contribute for 2.9% each for the movement of persons within the city. The choice for the mode of transport also influences congestion and parking patterns in the city. The modes are preferred based on several sustainable transportation factors as analyzed on Table 7.

Table 7. Preferred mode of transportation by the population

Transport mode	Mode of transport preference				Total
	Flexibility	Cheap and affordable	Readily available	Fast and time saving	
Private car	23	0	13	6	42
Public transport	9	67	31	26	133
Walking	2	10	3	6	21
Bicycle	5	0	0	1	6
Motorbike	1	0	5	0	6
Total	40	77	52	39	208
%	19.2	37	25	18.8	100

Source: Fieldwork, 2020

Table 7, indicates that 67% of the population prefer public transport to other modes because it is cheap and affordable. A tariff of 250 FRS is required per drop within the city which is relatively affordable as compared to running a private car. The inadequate number of buses available in this public transport sector enhances the use of taxis. The increase use of taxis for public transportation therefore brings about the incidence of traffic congestion on the narrow urban roads. The least mode of transportation according to table 7 is the use of bicycles and motor bikes with 6% each on the basis of time saving. This is accounted for by the restriction placed on commercial motor bike riders from using a majority of the secondary and tertiary roads such as the commercial Avenue Street, Sonac Street among others limiting them to the use of local streets.

Drivers of congestion on major road axis in Bamenda

Between 1996 and 2008, the population of Bamenda (53,329 in 2005) was far less than what it is today (127456, 2020) which meant less needs for road infrastructure. The present population figure demands greater provision of access roads across the municipality and the inadequate number of these roads result to congestion. Traffic congestion is driven by several factors that act concurrently to create congestion in the urban area. Such factors as identified in the study area include urbanization, population growth, poor or inadequate road network and the increase in car ownership (table 8).

Table 8. Drivers of traffic congestion in Bamenda

Drivers	Frequency	Percent
Urbanization	58	27.9
Population growth	27	13.0
Poor/inadequate road network	115	55.3
Increase in cars	8	3.8
Total	208	100.0

Source: Fieldwork, August 2020

Table 8, presents the causes of traffic congestion in the City of Bamenda. Four prominent drivers were identified and the result attested to the fact that poor or inadequate road network accounts for 55.3% as the main cause to traffic congestion in the city of Bamenda. According to the result, urbanization is the second highest driver to congestion that contributes 27.9%. Closely linked to urban road network and urbanization, is population growth, which from at first sight is viewed as the most obvious reason to congestion in the city. Increase in population contribute 8% as a cause to congestion in the city of Bamenda while increase in car ownership accounts for 3.8%.

Poor road network as a driver to traffic congestion in Bamenda city

The state of the roads in Bamenda city is deplorable and noted for potholes. During the rainy season, the roads are largely a byproduct of abandoned and dilapidated roads whose surfaces are coping with mud and in the dry seasons, the roads are covered with dust that obstruct view slowing down the speed of moving vehicles. A major part of the roads contain potholes along small stretches which is the case of the Sonac Street and Ayaba Street. These potholes on the roads occur just a few months after some maintenance as a result of poor repair works carried out by local construction companies. Plate 4. presents the present state of Sonac Street with potholes and repair works. This is one of the major street that grant access to the commercial Centre of the city serving the population of Nkwen, Bamendankwen and the neighboring sub urban areas of Bambui and Bambili.

Longitude;010^0 09'13" E and Latitude $05^0$54'40"N

Longitude;$010^0$09'21"Eand latitude $05^0$54'40"N

Source; Field work, 2020

Photo B: Nature of Urban Road network at veterinary junction Bamenda

Plate 1 above, Shows the poor surface of roads that enhance traffic congestion in the city. The maintenance are required at each season of the year making it difficult for the roads to benefit from past investments. The poor or inadequate road network in the study area greatly enhances the traffic situation of the city. Plate 1 below show pothole on the roads that hinders free movement in the city of Bamenda.

Photo A; Pothole at City Chemist Bamenda Photo B; Pothole at City Chemist Bamenda

Source; field work (2020)

Plate 4 presents the road network in the city, which is one among many road containing potholes that have depth of about one meter and with a width that cut across the road that impair free traffic flow.

Population growth as a driver to traffic congestion in Bamenda city

It is projected that about 75% of Cameroonians will be living in urban areas in the next 30 years (Njimanted and Mbohjim, 2014) as such if preemptive sustainable transportation actions are not put in place to upgrade the needs for urban mobility, the city of Bamenda will experience congestion that extend to hours as the case of Douala. This population growth has led to an increase in the number of persons who depend on modern transportation modes and has equally changed the settlement density of the city making it difficult for past road infrastructural development to meet the mobility demand of the population and so result to traffic queues on the roads. There is an increasing need for the urban roads to match the increasing number of other social service provisions such as education and health in order to minimize the effect of population growth on congestion in the city. The population of Bamenda was projected based on the assumption that the average growth rate (2.6) from 2005 to 2015 were maintained to 2035 as the low growth rates on the basis that current growth trends are maintained everything being equal. The study made use of the general growth rate of Bamenda city to project the population for the three municipalities as seen on table 9.

Table 9. Projected Population of Bamenda City from 2005 to 2035

Municipality	2005	2010	2015	2020	2025	2030	2035
Bamenda I	28,359	60,405	64,091	67,778	71,465	75,151	78,838

Bamenda II	184,277	392,510	368,554	440,422	464,378	488,334	512,290
Bamenda III	110,253	687,753	729,729	771,704	813,680	855,655	897,631
Total	322889	1,140,668	1,162,374	1,279,904	1,349,523	1,419,140	1,488,59

Source; Projection from 2005 by author.

The projected population of Bamenda was calculated at the interval of five years as from 2005. From table 9, it was observed that Bamenda II has the highest population in the city of Bamenda. From 2005 to 2015, the population increased to 248,611 inhabitants and from 2015 to 2020 it increased by 204,102 inhabitants. This increase in the urban population means an increase in the demand for roads. The city has experienced urban sprawl progressively since 1996, with settlement spreading to the fringes where road developments have not taken place and had not been planned. This increase in the number of persons living in the city implies new deviation of roads to link the periphery to the city Centre. The absence of these roads thereby results to overcrowding on the existing roads in the city and by implication congestion occurs.

Vehicle ownership and its contribution to traffic congestion

The number of cars and motor bikes owned by each household was to further examine their contribution to traffic congestion in the city of Bamenda. Over the years the number of vehicles and motor bikes in the city has been increasing occasioned by greater access to cars and motor bikes, access to credit and the large supply of used vehicles to middle income earners giving rise to greater demand for road space for circulation and parking. Figure 4 shows vehicle ownership per household.

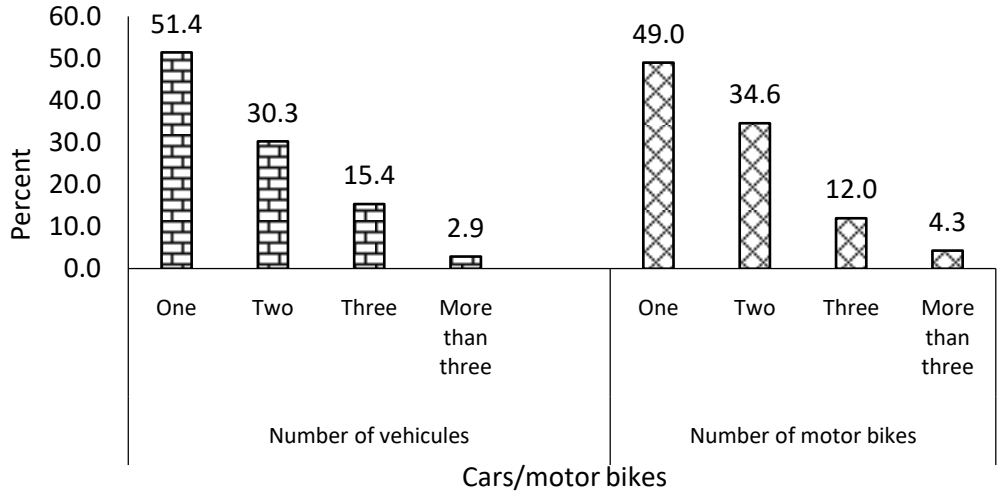
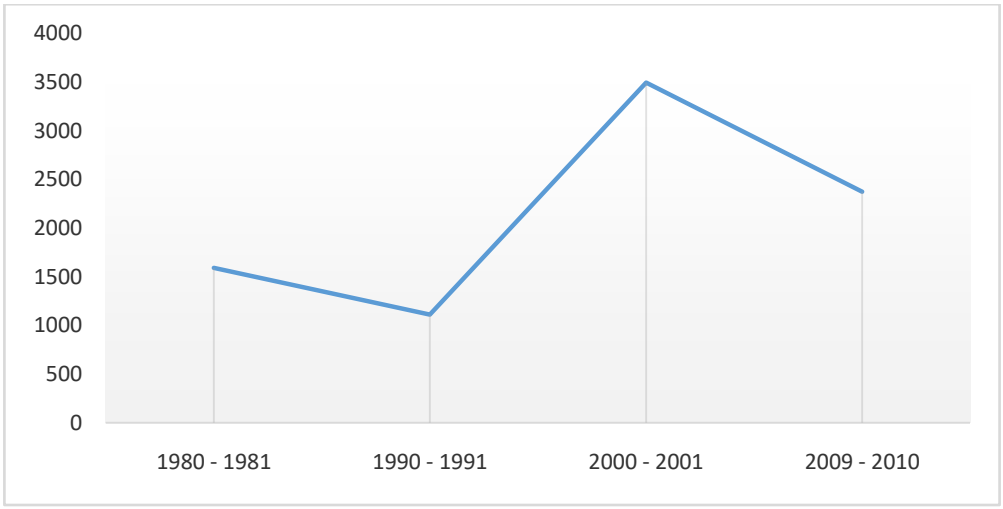


Figure 4. Number of cars and motor bikes in Bamenda
Source: Fieldwork, August 2020

According to figure 4, 51.1% of the population in the city owns a single car or vehicle and 49% of the population own a single motor bike. The number of persons with two cars and motor bikes account for30.3% and 34.6% respectively. Individuals with three or more vehicles were also accounted for by 15.4% and 12.0%, this was attributed to the higher income earners (business persons) who give out the vehicles or motor bikes on either mortgage or hire for commercial

purposes. As population increase in the city of Bamenda, more people shifted from less expensive modes of movement to privately owned cars and motor bikes which further aggravated the traffic condition of the city. Figure 4.5 shows the frequency in the registration of vehicles in Bamenda city.



Vehicles

Figure 5. Matriculation of vehicles in Bamenda city period

Source; Regional Delegation of Transport, Bamenda, 2020

According to figure 5, the periods 1980 to 1990 and 2001 to 2010, saw a recession in the matriculation of vehicles in the city of Bamenda. Cameroon suffered an economic crisis in the 1980s thus people had little to spend on luxury recoding a drop in vehicle registration in the city. The recession experience between 2001 to 2009 is explained by the fact that, the poor or inadequate nature of roads in the city made the use of vehicles unattractive to many. This is also of the fact that several vehicles in the city are registered in other regions such as in Yaoundé and Douala thus giving the drop in the graph of vehicular matriculation in the city. The period between 1991 to 2000 received an increase in the number of vehicles that were found in Bamenda city accounted for by the economic boom experience after the economic crisis of the 1980s.

Urban infrastructures and Traffic congestion

Some urban infrastructures are partly responsible for traffic congestion in the Bamenda city includes; travelling agencies, illegal parks, motor parks, bike parks, regular markets and illegal or irregular markets. These urban infrastructures contribute to traffic queues along the urban roads within the city. Table 10, present some urban infrastructures that contribute to congestion in the study area.

Table 10. Urban infrastructures that contribute to traffic congestion in Bamenda

Infrastructures	**Bamenda I**	**Bamenda II**	**Bamenda III**
Transit points or travelling agencies	Avenir	Moghamo Vatican Symbol	Psalms 23 Nso Boyz

		Peoples express Amour Mezam Mondial express Grand Jeanot Guarantee Express	
Illegal parks		Mbengwi park (HRA) Bali park (HRA) Santa park (CA and Finance junction) Bafoussam park (Finance junction) Nkambe park (Mobil Nkwen)	
Markets		Nkwen market Food market Main market Ntarikon market	
Junction markets	Bamendankwen park and market	Bali park and market Mbengwi park and market Below Foncha market	Mile four park and market Foncha junction market

Source; Field work (2020)

According to table 10, these are four regular well-structured urban markets in the city of Bamenda. These markets include; the Bamenda main market situated within the CBD, Nkwen market, Ntarikon market and food market, all located within Bamenda II Sub Division. While the Bali park market, Mile IV Nkwen park market, Mbengwi park market, and mile 8 Mankon market are the minor markets in the city operating alongside authorized motor parks that serve the urban population to the surrounding sub urban areas. These markets are situated along major road axis in the city and the opening and closing hours of these markets coincide with that of offices and schools. During these periods the demand for road space increases and the limited access roads therefore induce congestion along the roads. Also, there are illegal markets operate within the city such as at Foncha Junction and Below Foncha markets that operate on Wednesdays and Saturdays. These markets lack infrastructure as such they occupy by the roadside which hinders the free flow of vehicle flight and pedestrians. The presence of illegal motor parks in the city at Hospital Round About serving passengers for Bali and Mbengwi, at Finance junction loading for Santa and Bafoussam and at Mobil

Nkwen loading and off-loading passengers from Nkambe and Ndop hinders the free flow of vehicles and pedestrians. Figure 6, represent these infrastructures.

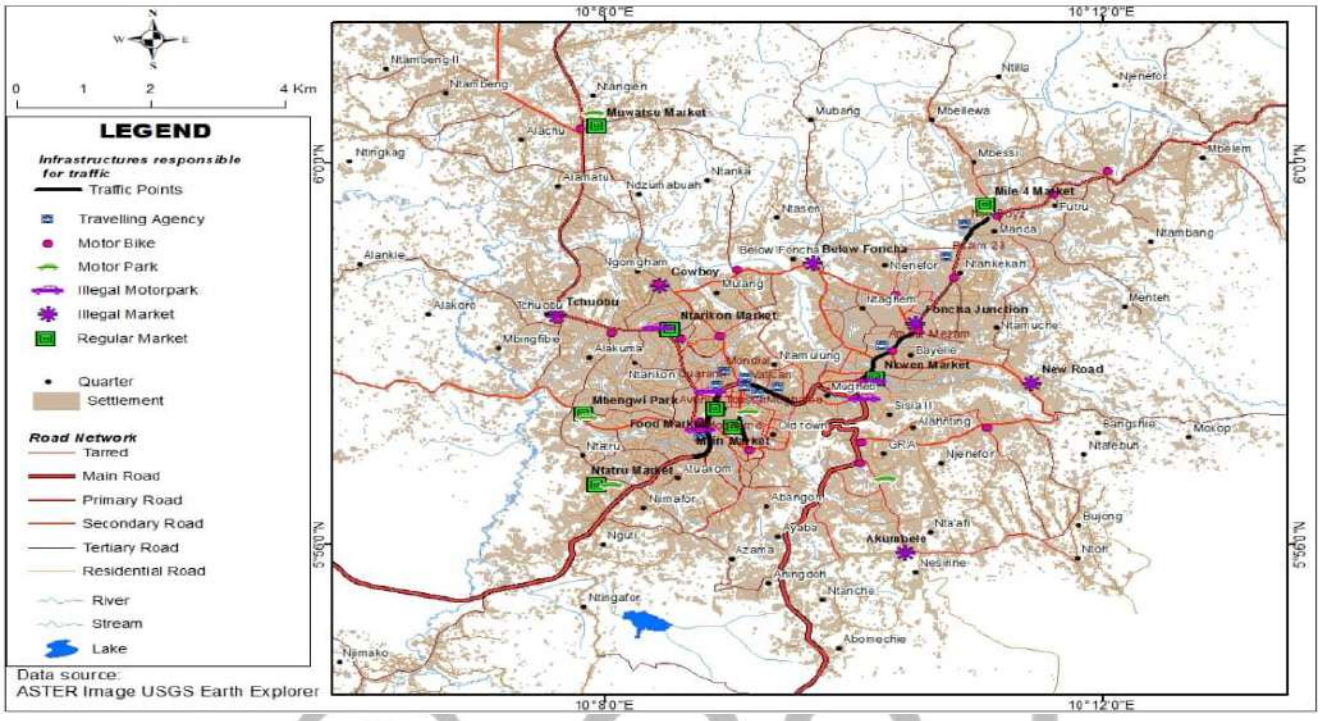


Figure 6. ***Selected urban infrastructures Responsible for Traffic Congestion in Bamenda***
Source: Fieldwork, 2020

Periodic variations in traffic in the City of Bamenda

Traffic count was an important aspect for the study as this enabled the study to determine which corridor in the three municipalities contributes to high traffic congestion at the city Center as per the number of incoming vehicles registered. Table 11, shows the traffic count recorded over three days at different intervals in the three municipalities of the City.

Table 11. *Traffic count in Bamenda city*

Periods	**Bamenda I**	**Percent**	**Bamenda II**	**Percent**	**Bamenda III**	**Percent**
Morning (7am - 8am)	**(vehicles)**	**(%)**	**(vehicles)**	**(%)**	**(vehicles)**	**(%)**
Day I	285	12.7	327	16.9	214	9.9
Day II	481	21.4	240	12.4	280	13
Day III	455	20.3	338	17.5	227	10.6
Midday (12-1pm)						
Day I	280	12.5	228	11.8	230	10.7
Day II	238	10.6	249	12.9	249	11.6
Day III	126	5.6	180	9.3	238	11.1
Evening (5pm -6PM)						
Day I	78	3.4	140	7.2	138	6.4
Day II	168	7.5	96	4.9	339	15.8
Day III	128	5.7	130	6.7	226	10.5
Total count	**2239**	**100.0**	**1928**	**100.0**	**2141**	**100.0**

Source; Field work, 2020

Table 11, illustrates the daily traffic count recorded for Bamenda city. The record indicates that Bamenda I recorded the highest count in the city. This is accounted for by the fact that this municipality harbors the Regional road that connect Bamenda city with other regions in Cameroon. During morning periods, vehicles comprising of buses, mini buses, taxis, Trucks and private cars flaunt into the from other regions thereby recording high traffic flow as compared to Bamenda II and III. The result also indicates that Bamenda III records high traffic flow during midday and evening periods. This is accounted for by the fact that this road axis provides access to Higher Institutions (University of Bamenda, Polytechnic Bambui among others) found at the suburban areas of Bambui and Bambili. The closing hours of these institutions together with the population of Bamenda III municipality therefore increase the number of vehicles entering the city Center leading to a high traffic count during the afternoon and evening periods. This traffic count enabled the study to identify hotspots for traffic congestion and to determine peak hour periods for traffic congestion.

Daily trips in Bamenda city

Crowds and queues signals mobility, prosperity and economic growth up to a limit since movement cannot occur with zero congestion at all times. The rising transportation demand in the city of Bamenda manifest in the number of daily trips undertaken around the city by an individual. To determine the average number of trips, data from the traffic count was generated and the average number of trips made in the city presented on table 11 as per municipality.

Table 12. *Average number of daily trips per sampled individual in Bamenda city*

Periods	Bamenda I	Percent (%)	Bamenda II	Percent (%)	Bamenda III	Percent (%)
Day 1	214	28.7	232	36	194	27.3
Day 2	295	39.6	195	30.4	289	39.5
Day 3	236	31.7	216	33.6	230	33.2
Total	745	100.0	643	100.0	713	100.0

Source; Field work, 2020

According to table 11, Bamenda I municipality recorded the highest average number of trips with 39.6% in the city of Bamenda. This is accounted for by the high inflow of vehicles from other regions of the country using the national road that runs through Bamenda I. Bamenda III recorded the lowest average count of 27.3%. To further determine the number of trips made by an individual in the city per day individual perception was recorded as seen on figure 7.

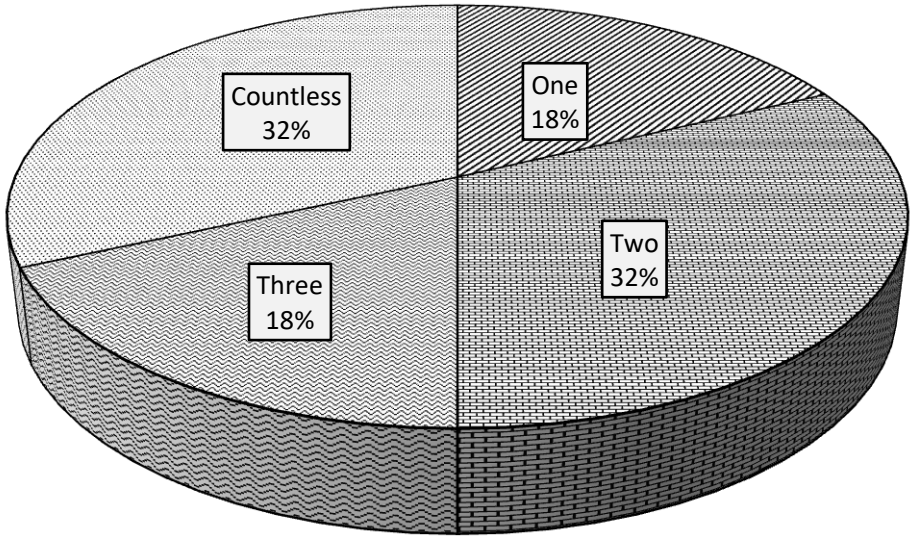


*Figure 7****. Average number of trips made in the city per day based on individual perception***
Source: Fieldwork, 2020

According to figure 4.6, 32% of the populations undergo countless number of trips in the city on a daily basis. This was attributed to commercial vehicles drivers and motor bike riders who pick up and drop passengers in the city as well and Business persons who provide delivery services with the aid of vehicle or motor bikes. Individuals who undergo two trips within the city recorded 32%. This was attributed to workers and students who leave for work in the morning and only return home in the evening. Individuals who undergo three or a single trip had 18% each. Three daily trips was attributed to individuals with private vehicles or motor bikes who

move on specific purpose while a single trip was attributed to those who either move in or out of the municipality. The number of trips per individual had an influence on peak period of traffic congestion in the city.

Peak periods of traffic congestion in Bamenda city

To complement and appreciate the drivers to traffic congestion in the city, it was necessary to identify the peak periods of traffic congestion in the study area. The location of basic service provisions at the city Centre in the study area promotes the occurrance of peak congestion periods as people turn to pursue these services simultaneously are the limited urban space. Figure 8, present the peak congestion periods in Bamenda city.

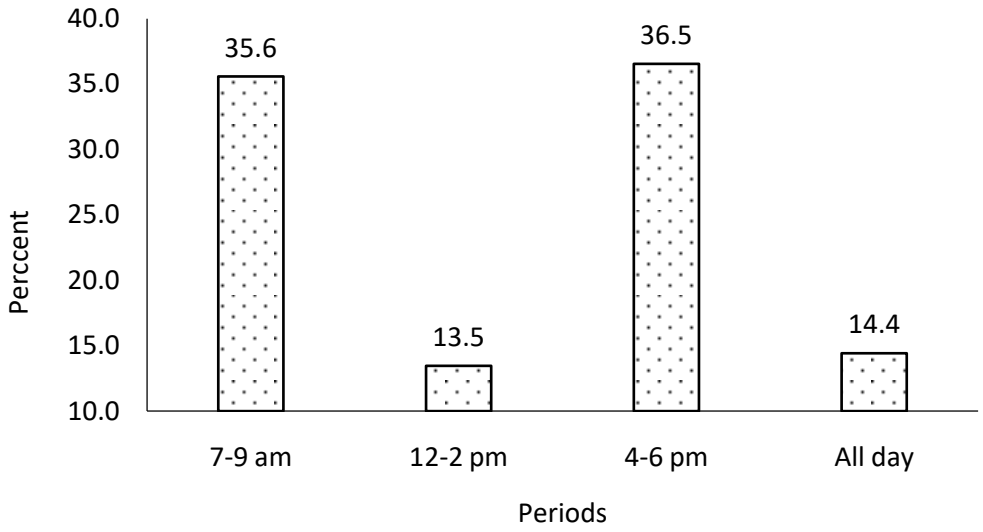


Figure 8. ***Traffic Peak Periods in Bamenda***
Source: Fieldwork, 2020

The dominant peak period for traffic congestion in the city of Bamenda is between 4pm to 6pm (36.5%). This period coincides with the closing time of many urban activities in the city such as offices, schools, daily markets (Bamenda Main Market, Food Market, Nkwen market, Ntarinkon market) and other businesses within the city. The competitive use of the roads at this period by private car owners, commercial vehicles and motor bikes to take the masses to their destinations result to traffic jam and consequently congestion. The peak congestion period in the city of Bamenda is replicated between the period 7am to 9am (35.6%). In the morning, workers and students rush off to work and schools while at the markets, business persons open their doors. The afternoon period between 12 to 2 pm witness less congestion with a response rate of 13.5% as few persons move within the city or return home at this time of the day. A significant percent of 14.4 of the respondents view peak or rush hours in the city to be all day round given that activities and personal schedules vary from one person to another and this makes the roads busy all day long. Plate 5.3 shows peak congestion period in Bamenda city.

Source

Source: field work, 2020

Photo A; Peak period of traffic at mile II Nkwen Bamenda

Photo B; Peak period traffic at city Chemist, Bamenda

Plate 2. Congestion during rush hours at Mile II Nkwen from 7am to 8am.
*Source; Field work, 2020***.**

Spatial Nature of Traffic Congestion

A common feature across all road networks in the study area is the presence of critical congested areas. These congestion hotspot areas are common due to poorly planned road network connectivity or the ineffective implementation of the city's land use plan. These areas have poor or inadequate traffic management systems, which usually occurs when a driver suddenly stops or park poorly that result to massive traffic jam. These hotspot areas were identified as the Hospital Round About junction through Food Market to City Chemist and Sonac Street, Commercial Avenue, Mobil Nkwen through Mile II Junction to Amour Mezam, Foncha junction and Mile IV Nkwen. These critical congestion areas are associated with high commercial activities that bring together many persons into the areas which are characterized by daily markets, travelling agencies, illegal parks and motor bikes parks. Figure 4. 6 show these congested areas in Bamenda city.

Figure 9 shows the major traffic hotspots in the study area. These areas constantly experience congestion on daily basis. The four dominant points in the study area are the Amour Mezam stretch of the road, the Commercial Avenue street, Food Market Street and Sonac streets. These streets are flanked by numerous economic activities and are host to transit points with high vehicular flow such as the Amour Mezam Agency, Moghamo and Vatican Express among others.

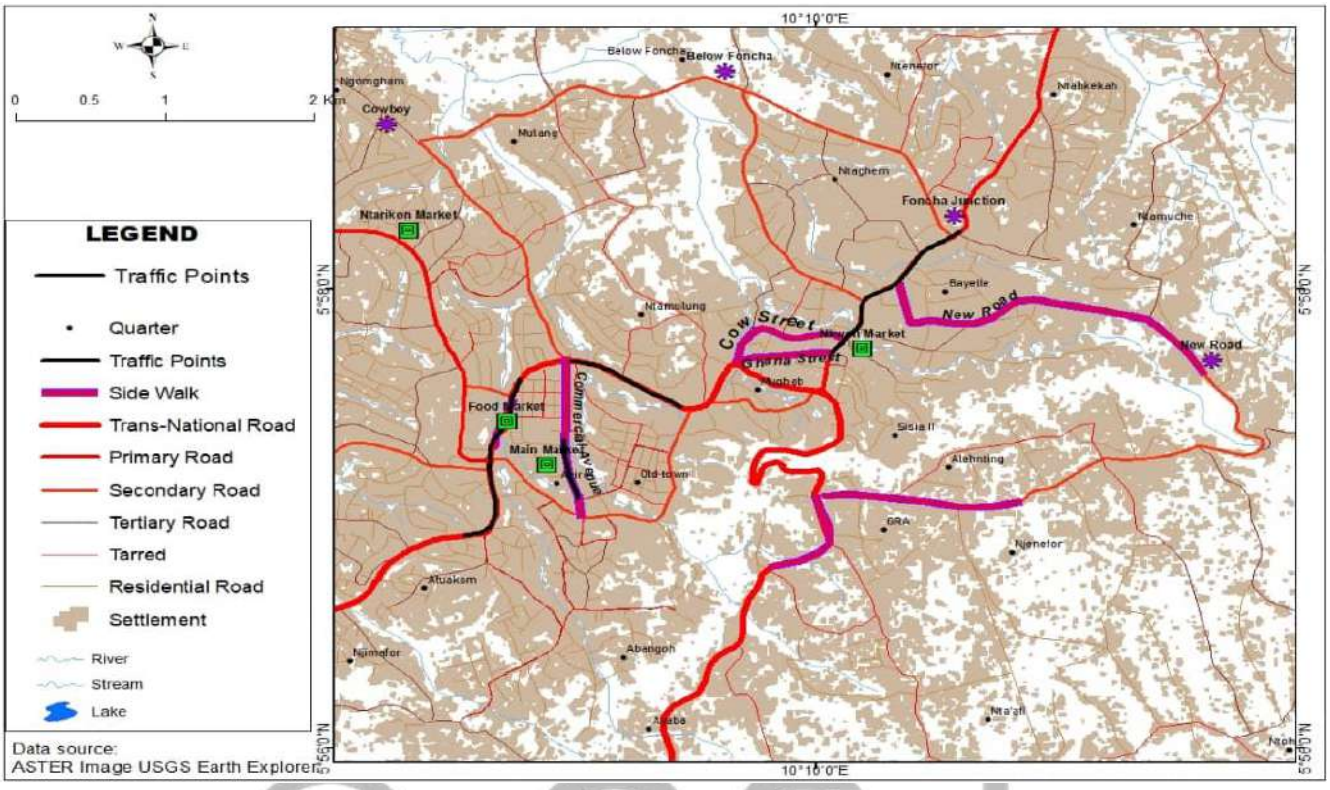


Figure 9. ***Peak Traffic hotspots (stretches) in Bamenda City***
Source: Fieldwork, 2020

Implications of traffic congestion

Traffic congestion is typically seen as a burden to urban dwellers and those in the immediate vicinity. Commuters and other road users perceive congestion in the city at different levels and at each of these levels congestion brings about negative effects to individuals and the economy while just a small proportion of the population benefit positively from the effect of traffic congestion in the city. Table 13, presents the effects of congestion in the city of Bamenda.

Table 13. *Perception and effect of traffic congestion in Bamenda*

Perceptions		
Perceptions	**Frequency**	**Percent**
Waste of time and has financial losses	98	47.1
Period of reflection	3	1.4
Privacy and relaxation	18	8.7
Extra fuel costs	21	10.1
Chaotic personal schedules	68	32.7
Total	208	100.0

Source: Fieldwork, 2020

According to table 13, a high Percent of 47.1 % of the population perceived traffic congestion from the negative perspective as a waste of time and financial loss. 32.7% of the population

viewed congestion as irritant that through their personal schedule in to chaos as due to congestion they either appear late at their work places or business sites. Motorists perceived the negative effect of congestion in terms of additional use of fuel due to congestion while a small proportion of the population of 1.4% and 8.7% perceived congestion as a period of reflection and relaxation respectively.

Negative implications of traffic congestion in Bamenda

In addition to the effects and perception of traffic congestion, congestion also has an implication on the urban dwellers in terms of economic efficiency, social cohesion and environmental degradation. Figure 10, shows the implications of congestion from the three dimension of social cost (financial lost), economic lost (time and fuel consumption) and pollution as a measure to environmental dimension.

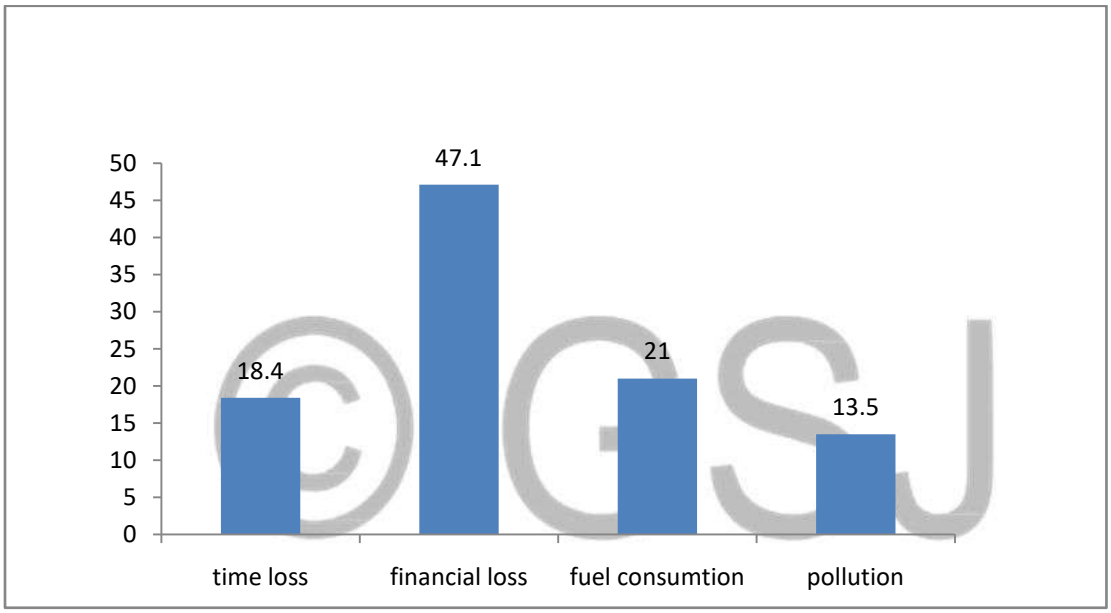


Figure 10. ***Overall Effects of Traffic Congestion***
Source; Field work, 2020

According to figure 10, the effect of traffic congestion in Bamenda City is highly economic. This is shown through financial lost followed by increase in fuel consumption. Talking to Francis Lukong, a taxi driver in Bamenda, he attested to the fact that on days when he is caught in congestion he will experience a drop in his earning of not less than 5,000 FRS and this loss equally amount to additional consumption of fuel. The effect of traffic congestion is also felt in the aspect of time. Yvonne Che a business women in Bamenda ascertain that it is not easy leaving mile II Nkwen to Commercial Avenue a distance she will use ten minutes during free flow whereas when caught in traffic she will spend not less than 30 minutes. This has greatly affected the economy as people do not get to work or business places on time.

Taxi Tariff in Bamenda city

The easiest and most confortable way to get around the city of Bamenda following the restriction of motor bikes access to the city centre is by taxi. In many cases, taxi drivers avoid rides to areas with heavy traffic as this reduces their service productivity and daily profit with additional fuel consumption. The services of commercial taxi drivers is been guided by the official taxi tariff

from the North West Professional Drivers Trade Union (NOWEPRODTU) on a drop in the city. Table 14 shows the taxi fare for each period and destination in the city of Bamenda.

Table 14. *Official Taxi Tariff in Bamenda*

Period and Destination	Taxi fare (frs)
Morning (drop in town,5A.M-10;00P.M)	250
Night (drop in town, 10;00P.M-5A.M)	300
Commercial Avenue to Bambui	400
Commercial Avenue to Bambili	500
Nkwen to Bambui	300

Source; Field work, 2020.

According to the North West Professional Drivers Trade Union (NOWEPRODTU), the official taxi tariff in the city of Bamenda range from 250 FRS to 500 FRS per drop within the city and the surrounding Sub urban neighbourhoods. However, this tariff changes with the occurrance of congestion on the roads and during rush hour periods as taxis take a longer time to reach their destination with additional cost in fuel which is often borne by the passengers.

Average expenditure on daily transport fare

The social effect of traffic congestion is directly reflected in the amount of money spent as transportation fare. When congestion is present, road users face additional costs on the average amount spent on transport fares. Figure 11, was analysed based on the normal daily taxi fare to evaluate the social implications of congestion on the population.

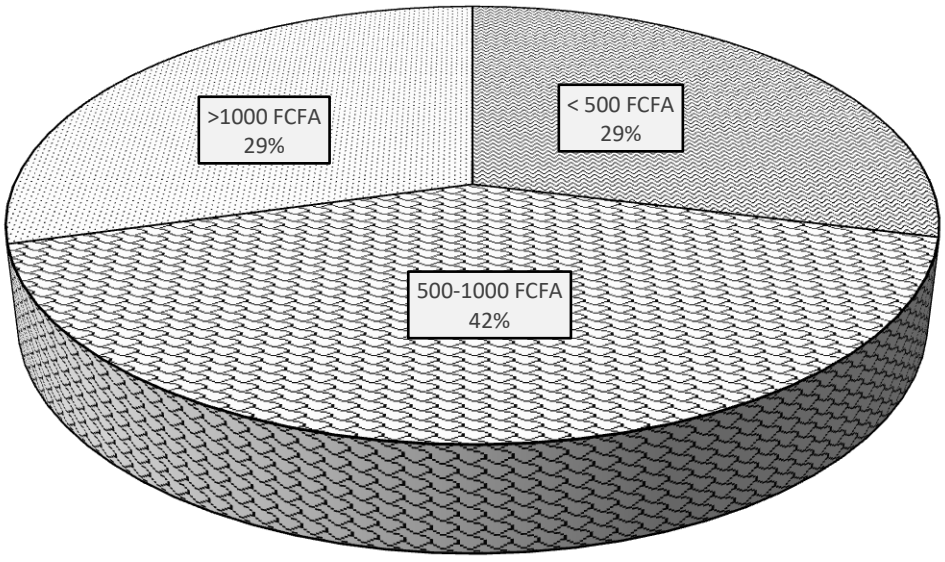


*Figure 11****. Daily expenses for taxi fare during congestion periods***
Source: Fieldwork, 2020

On average, 42% of the population uses 500-1000 FRS on transportation fare during periods of congestion as compared to 250 FRS during free flow period. The population incure financial losses by way of income from the occurrence of congestion. 29% of the population spend above

1000 FRS as transportation fare due to congestion and many are forced to use the services of bike riders that are costly but flexible and time serving to escape seating in a taxi that extend for hours. 29% of the population spend 500 FRS as an additional cost to congestion in the city of Bamenda.

Addressing the nature of urban road network in the city of Bamenda is the major cause to traffic congestion (primary considered hypothesis). Based on the population view, a Chi Square was used to test the relationship that exists between the nature of the road network and its contribution to congestion among other factors. This test was used because it best suits the ordinal variable. The hypothesis was evaluated by comparing the actual value against the critical value found in the chi square distribution by examining the p-value provided by SPSS. The hypothesis was tested using a 95% level of confidence, the value labeled Asymp. Sig (which is the p value of the chi square statistic) was taken to be less than 0.5 so as to determine the statistical relationship between the state of the road network and traffic congestion and to draw a conclusion that the variables are not independent of each other. Table 4.13 shows the Chi Square test for the first hypothesis of the study.

Table 15. Chi-Square test for Road Network and Traffic congestion in Bamenda

	Value	df	Asymp. Sig. (2-sided)
Chi-Square	44.262[a]	12	.000
Likelihood Ratio	52.624	12	.000
Linear-by-Linear Association	.290	1	.590
N of Valid Cases	208		
a. 12 cells (60.0%) have expected count less than 5. The minimum expected count is .29.			

Source: Field work, 2020

This statistical method was used to determine whether there is a statistical significant relationship between the nature of urban road network and traffic congestion in the study area. The chi square enabled the testing of the stated alternative hypothesis that there is a significant relationship between the road network and traffic congestion in the city of Bamenda at a significant level of 0.5. The p-value of .000 (Asymp. Sig.), which is less than 0.05 of the significant level, indicates that there is sufficient evidence to conclude that the two variables (road network and traffic congestion) are not independent of each other and that there is a statistical significant relationship between them in the study area? This confirms the hypothesis that the nature of the urban roads network is the major cause of traffic congestion in the city of Bamenda, further influenced by parking and the use of sidewalks.

Conclusion

Findings revealed that, there is a relationship between the nature of the urban roads and traffic congestion among other factors such as population growth and increase in car ownership. Out of the 562.1 km length of roads in the study area, 475.9km of these roads are poorly constructed and have potholes that directly impact movement and traffic flow. Findings also reveal that these causes are not without an effect on the population and the urban economy. The recurrent

congestion that occur at some traffic hotspots in the city such as the Hospital Round About, Food Market and Mobil Nkwen result to peak hour congestion that was found to be in the evening period between 4pm to 6pm and at a minimal rate between 7am and 9am. The occurrance of congestion in the study area result to an increase in transportation fares from the normal taxi fare of 200 FRS to about 500 FRS per trip. This result attests to the fact that there is need to implement some measures to reduce traffic congestion and its implications in the city of Bamenda.

The purpose of this study is to contribute to the better understanding of planning based approach to transportation issues in terms of traffic congestion, parking and the use of sidewalks that hinders sustainable transportation in the city of Bamenda. This study explores specific interest in planning measures that aim to address congestion in the city of Bamenda.

This finding is in line with that of Fogwe (2020). His work noted that traffic congestion is common place rocking cities in Cameroon where there exist an inverse relationship between the roads density, state of the road and the population travel demands.

The state of the roads is deplorable and is noted for numerous potholes. These potholes on the roads are common just after a few months of maintenance as a result of poor repair works carried out by local construction companies. Fogwe (2020), attested to the fact that pot holes found on the urban roads slow down vehicular flow speed. The state of the roads are a hindrance to free flow of movement in the city, vehicles are stock in the potholes and this replicate in the increased rate of vehicles break down and accidents.

Findings further revealed that other factors to congestion in the city include urbanisation, population growth, increase in car ownership, location of travel agency, illegal motor parks, illegal markets, location of markets, and the increase incidence of bike parks. Raheem *et al,* (2015) in his study in Nigeria revealed some of these causes of congestion seen in the study area. The effects of congestion include; increase in daily expenditure on transport fare from 250 FRS per drop in town to 500 FRS, while taxi drivers daily earnings drop by at least 5000frs with an increase in travel time of about 30 minutes among others. In the same vain, the Nigerian Ministry of Economics Planning and Budget (2013) noted that traffic congestion has negative effects of adding extra financial cost amounting to $829 per person annually in Nigeria. At a significant level of 0, 05, given the p value of .000, the results revealed that there is sufficient evidence to conclude that the nature of the urban roads is the major cause to traffic congestion in the city of Bamenda among other factors.

Recommendations to key Stakeholders

The Government of Cameroon. Cameroon Vision 2035 objective projects the increase in the length of tarred roads, making an increase from the current 10 percent to 32 percent by the end of the vision period. The ambitious nature of the goal pursued reveals that special focus should be laid on the development of infrastructure as an indispensable industrialization catalyst. Thus the study recommends that the Government of Cameroon should provide regional transportation authorities more power and resources to plan, coordinate and implement all transport projects in each region. This will aid in the enforcement of more rational planning for anti-congestion tactics that will work effectively in line with the land use plans of the city.

The Bamenda City Council. Should constantly renovate the road network; maintenance work on the roads should be carried out with emphasis on sustainability; new roads should equally be

constructed to link up newly developed neighborhoods that will help to redistribute the population and reduce overcrowding on the existing roads; employ the use of Intelligent transportation System (ITS) to speed up traffic flow management; include the use of, GPS equipment in cars and trucks, signal lights on the street to inform drivers of the traffic conditions ahead in order to avoid jam, among others; increase the number of buses for public transportation; and carry out sensitization campaigns on the media to educate the population on the need for sustainable transportation free of traffic congestion, creating streets that are safe for all road users.

Road users. Motorists should adopt low driving speed limit on the urban roads in order to ensure a more fluid traffic flow especially during peak periods; avoid parking maneuvering and the use of sidewalks without considerations for pedestrians; and the population should prioritize the use of buses over taxis and motor bikes as this is a great major to reduce congestion.

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