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Road Infrastructural Development and Traffic Patterns in Bamenda - A Cameroonian Medium City

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Abstract

Road mode of transport dominates African and Cameroonian cities but unequally developed to portray sturdy spatio-temporal variation trends. This assessment of the negative development ramifications of traffic congestion along road axis of Bamenda is carried out through a sample survey of road users from September to October 2014. Field observation and sampling on traffic trend variables indicate that technical factors play over infrastructural variables to trigger mobility flow bottlenecks and trends. Statistical treatment of primary and secondary data depicts unequal daily/seasonal variation with distance from city centre being higher in the rainy season and school periods than dry seasons and holidays. Traffic flow and congestion is higher along the NE than NW road axis with significant socio-economic consequences road users such as weakening of income, lateness, emotional and psychological stress, accidents, and material damage as well as pollution. This study opts for a holistic approach to mitigate traffic problems using structural and non-structural measures.

Keywords: Bamenda; Infrastructure; Road; Stakeholders; Traffic congestion; Vehicles.

Introduction

Traffic flow and congestion is a pitfall of the development of the road transport sector in countries stressed by galloping demographic growth, economic, social problems and oversized cities as they connect unequally distributed facilities. The 1980 economic crises that wrecked the economy opened doors for vehicular and pedestrian competition on roads. Bamenda on the northern axis is served by two narrow urban-outlet roads: one winds north-eastwards and the other north-westwards being about 12.8 km linking Bamenda III Sub-Divisions through Nkwen towards Tubah depicts a paradoxical inverse relationship between population growth and infrastructural development. The study area is located between longitude 10º8′29.70″ and 10º7′49.28″E and latitude 5º58′13.77″ and 6º0′19.62″N in the North East and 24 km linking Bamenda II through Ntarinkon towards Bafut, 10º9′42.05″E and 10º15′19.89″E and 5º57′40.60″N and 6º0′17.79″N in the North East (Fig. 1)

The development of transport infrastructure facility is the basic preoccupation of Bamenda urban managers with eased circulation as Cow Street, Ghana Street, Up Station and Savannah Street against areas of stuffed traffic as Commercial Avenue, Food Market to Hospital Roundabout, Ntarinkon, SONAC Street to Veterinary Junction, and MOBIL Nkwen to AMOUR MEZAM EXPRESS negatively hampering urban activities. Tarred road surfaces are degraded with pot holes that slow vehicular flow speed.

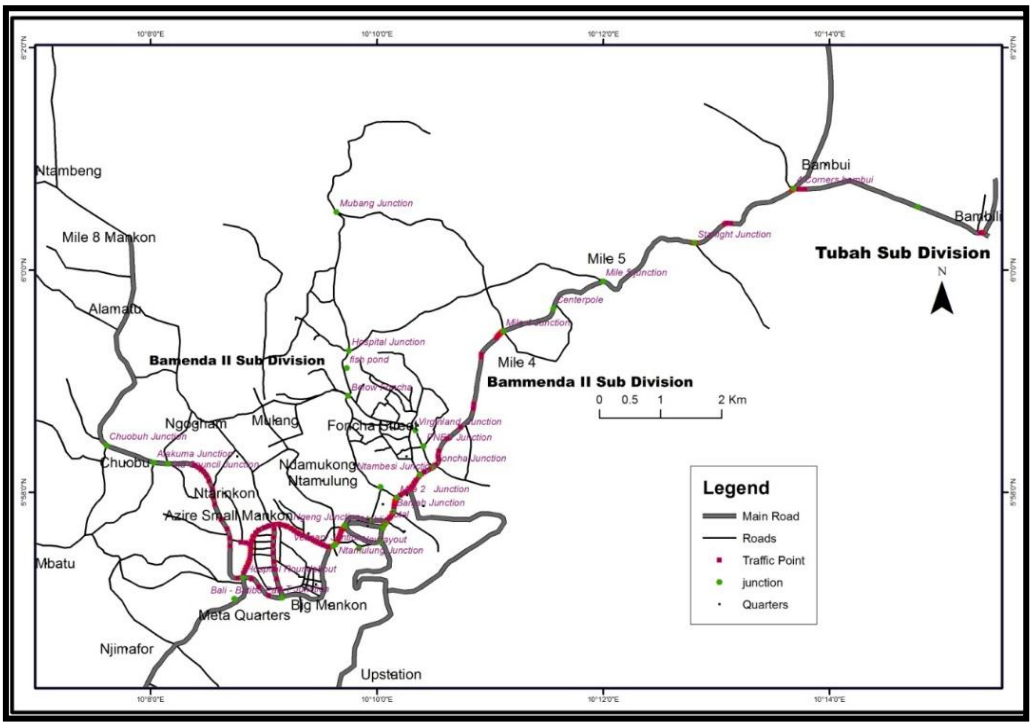


Figure 1: Map of the Northern road axis and traffic congestion points of Bamenda

The Northern outlet of Bamenda are congested with traffic leading to Bafut and Wum (North West) and Bambui and Bambili, Babanki, Mbingo, Njinikom, Ndop, Jakiri, Kumbo, Ndu, Nkambe, Mesaje, Dumbo, Ako and Abongshire (North East). There is slowdown of movement at some periods of the year and hours of the day with negatively effects as established by Badger (2013). The aim of this study is to determine the intensity and regularity traffic flow during the calendar and school seasons as well as identify tangible and intangible losses to the stakeholders along the North East and North West Road Axis of the Bamenda

Methodology

The Study Area

Bamenda has two seasons being an eight months rainy season (1565 to 2654 mm) of moisture laden winds ushering rain water that degrades road surface materials widening surface pot holes. Lamm et al (1990) identified such heavy rains as having a 10 to 15% reduction on traffic flow because of potholes as at AMOUR MEZAM travel agency, MOBIL Nkwen, SONAC Street, Ntarinkonin the wet season or dust in the dry seasons.

The relief of Bamenda is rugged in the south and altitude ranges from 1200 to 1865m (Nyambod, 2000) which imposes excavation for road construction (Neba, 2000)and that accounts for the winding road bends. The population of Bamenda II is 117,600 while Bamenda III is about 150,000 inhabitants who use vehicles towards the North East and North West road axes for their daily commitments, leading to traffic congestion at particular periods and places in patterned ways as Rumani (2014) established with regards to traffic congestion in Delhi as being due to substantial increase in the number of vehicles. Several income generating activities are carried out along the road axis like subsistence and commercial gardening, poultry and pig farming, breweries (GUINNESS), soap factory, markets (Food Market, Nkwen, Bambui, Ntarinkon and Bambili) as well as a plethora of informal sector businesses paving the way for transport agencies, taxis and motor bikes deployed in human mobility leading to traffic congestion. Rodrigue (2009) observed that such urbanization stresses transport systems any city limited in modes like Bamenda with only road and having no mass transport transit system options, Rosen (2013) identified traffic congestion as caused by multiple variables which may include too many cars for the roadway.

Methods and Techniques

The methodology involved the collection and treatment of primary and secondary data for quantitative and qualitative analyses. Primary data collection involved observation and count of flow direction as well as sampling using questionnaires in a randomly stratified method to road users from the 30 September to 5 October (to include holiday and school period).. Direct personal interviews were made with stakeholders of urban traffic such as the Regional Delegation of Transport, Regional Directorate of Roads, Delegation of Public Works as well as the Department of Traffic at the

Bamenda City Council. Direct observation on the field involved daily traffic count on four different periods (twice during the calendar and school seasons) to evaluate traffic flow density variation with time and space.

Presentation of Results and Interpretation

1. Trend Patterns of Traffic Flow in Bamenda

The North East road axis of Bamenda was constructed in 1983 with largeness inversely proportional to distance to the central town being 5.26 to6 as well as 8.53mto exceptionally 12m at Ngeng Junction receiving some 9 urban feeder road links. The North West road axis starts from the Hospital Roundabout at about 24m to Bafut maintaining a uniform width of about 5m throughout with only 2 urban road links.

There is a noticeable variation between the traits of road users between the two axes. Generally this study considered students and drivers of both sexes to be the prime road users most affected on the baes of their daily regularity. Fieldwork examined the road user-traits of the northern road axis and results reveal students and drivers more along the NE road axis. The dominant age group was 30-40 years serving higher institutions of learning along this road such as Bamenda University of Science and Technology, National Polytechnic Bamenda, The Oxford University Polytechnic Bambili campus and The University of Bamenda including numerous secondary, primary and nursery schools of the private and public sectors. These institutions are very much fewer along the NW road axis (Fig. 2). Most drivers on the NW road axis drove self-owned vehicles while those along the NE road axis drove periodically borrowed cars as associate drivers called "mercenaries". Some 25% of drivers resided along the NE direction road axis and only 20% in the NW direction while 75% of students schooled in NE road axis and only 20% in the NW axis

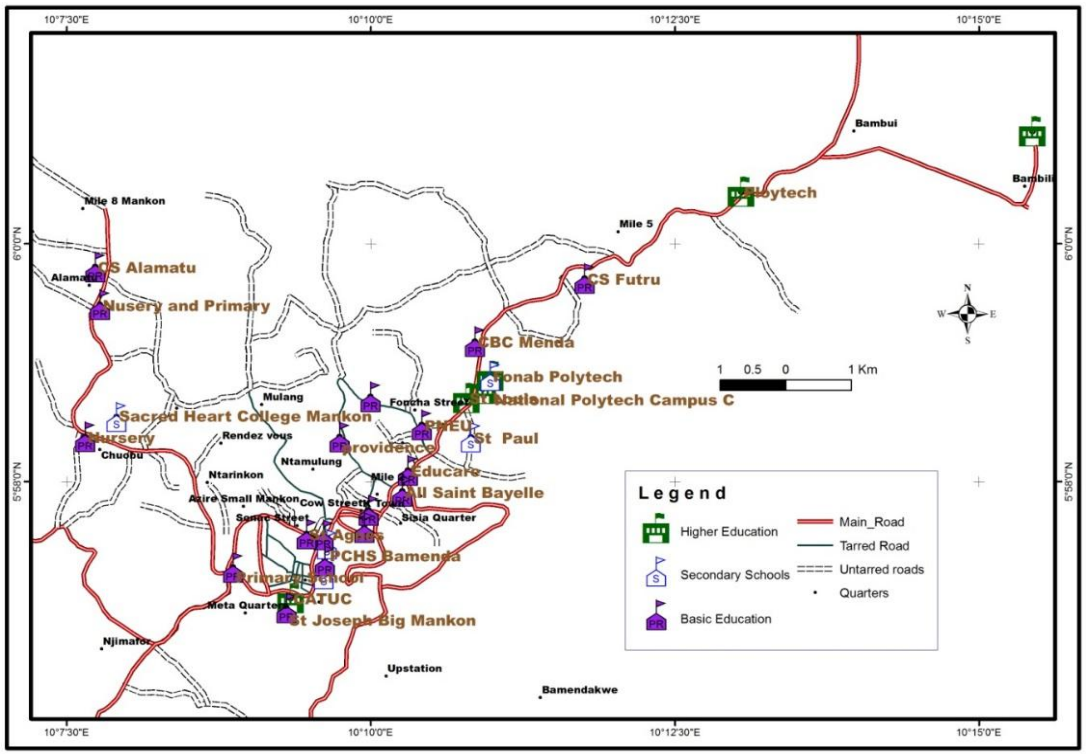


Figure 2: Spatial distribution of educational institutions, North of Bamenda

The vehicles type was taxis and private car with more taxis (being the most used (60%) mode of transportation in Bamenda) than private cars (3.33%). Most students and workers use taxis to and from school and work during rush hours. Many young men now ride of motor bikes exciting an increasing number of students (33.33%) to like its flexibility and greater accessibility into serve the urban road links unnerved areas of the under privileged.

Field work permitted to test the level of consciousness about traffic congestion by students in their pendula movements. Identified negative impacts included lateness for lessons, psychological stress and tiredness in class while drivers cited reduced daily income and greater expenditures on fuel and repairs. The seriousness of this depended on the number of days spent in congestion. These days were higher in week days when students and workers go to school and work offices than weekends. Traffic congestion is higher towards the Nkwen-Bambili road being directly proportional to the number and location of educational institutions, presence of economic activities, road breadth and pothole frequency. The number

of acknowledged traffic congestion days per week were more along the Nkwen - Bambili road (NE) than the Ntarinkon - Bafut road (NE) and so the rush hours (Table 1).

Table 1: Stakeholder declared traffic congestion days per week in Bamenda

Days	Student declaration				Driver declaration			
	Nkwen - Bambili		Ntarinkon - Bafut		Nkwen - Bambili		Ntarinkon - Bafut	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
2	2	6.7	0	0	0	0	0	0
3	4	13.3	2	10	2	6.7	3	15
4	7	23.3	4	20	7	23.3	6	30
5	14	46.7	9	45	12	40	9	45
6	3	10	4	20	8	26.7	2	10
7	0	0	1	5	1	3.3	0	0
Total	30	100	20	100	30	100	20	100

Source: Field work, 2015

Daily traffic congestionwas observed that along the northern road axes of Bamenda at particular periods of the day than others (Table 2)

Table 2: Stakeholder declared traffic congestion daily periods in Bamenda

Periods	Student declaration				Driver declaration			
	Nkwen - Bambili		Ntarinkon - Bafut		Nkwen - Bambili		Ntarinkon - Bafut	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Morning 6-9 am	19	63.3	12	65	18	60	11	55
Afternoon 11am -2pm	11	36.7	7	35	3	10	2	10
Evening 5-9 pm	none		None		9	30	7	35
Total	30	100	20	100	30	100	20	100

Students are stuck in traffic congestion in the morning periods and afternoon period whereas taxi drivers are stuck in congestion in the morning and evening periods since they are transporting students and workers to and from school and work places. These students and workers return home at different times of the day. Some return in the afternoon (students) while others return in the evening (drivers). So there is a reduction in the number of people using the road as compared to the morning period.

Fieldwork also assessed the seasonality in traffic congestion being high during the rainy season and school period. It was lower during the rainy season and holiday period (Table 3).

Table 3: Stakeholder declared traffic congestion seasonality in Bamenda

Season	Student declaration				Driver declaration			
	Nkwen - Bambili road		Ntarinkon - Bafut road		Nkwen - Bambili road		Ntarinkon - Bafut road	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Rainy	13	43.35	6	30	None		None	
Dry	4	13.3	2	10	None		None	
Holiday	11	36.7	11	55	3	10	1	5
School	2	6.7	1	5	27	90	19	95
Total	**30**	**100**	**20**	**100**	**30**	**100**	**20**	**100**

Traffic congestion is higher during the rainy season in the months of August and September and lower in the dry season in the months of October and December. Students experience traffic jams during school period while drivers experience traffic jam during the school and holiday period as well as in the rainy and dry seasons. The traffic congestion is however lower during the holiday period and the dry season but the amount of time wasted in the traffic varies depending on the user and axis involved (Table 4)

Table 3: Stakeholder declared length of time lost in traffic congestion Bamenda

Time lost	Student declaration				Driver declaration			
	Nkwen - Bambili		Ntarinkon - Bafut		Nkwen - Bambili		Ntarinkon - Bafut	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
10 minutes	5	16.7	2	10	2	6.7	1	5
20-30 minutes	17	56.7	12	60	15	50	11	55
30-50 minutes	7	23.3	6	30	11	36.7	8	40
>1 hour	1	3.3	0	0	2	6.7	0	0
Total	30	100	20	100	30	100	20	100

Stakeholders loose more time in traffic congestion along the NE road axis than along the NW road axis because the NE road axis has more bad roads, has more educational institutions than the NW road axis.

2. Spatial Variation of Traffic Congestion Triggers in Bamenda

Though a strongly patio-temporal dynamic factor the mmultitude and frequency of road surface potholes is a leading congestion trigger. Fieldwork forced vehicular speed to remain below 10 km/hr. Field work in 2015 permitted account of 1,123 potholes along the northern road with a high frequency between Mile 2 to Mile 4 along the NE road axis and at Ntarinkon opposite the Credit Union Building in the NW road axes. All drivers were unanimous that these potholes were head-on points for traffic congestion being the ones on the steering wheels and feel the obligation to slow down else risk their vehicles (Fig. 2)

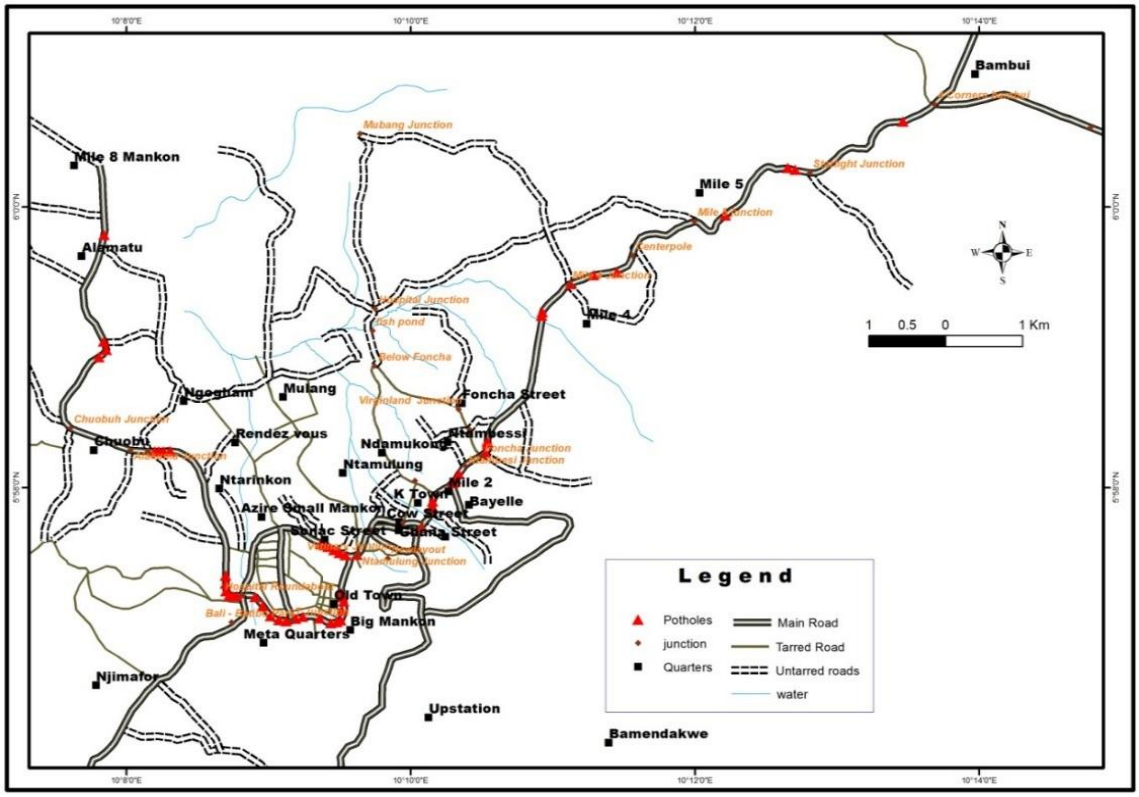


Figure 3: Distribution of pothole clusters along the northern road axis of Bamenda

Continuous accumulation of this rain water leads to erosion, leading to larger potholes as seen at Mile 2, Mile 4, Ntarinkon and AMOUR MEZAM EXPRESS before the road was maintained. This accounts for why traffic congestion is always higher at these spots than at other spots along these road axes since drivers move at reduced speed in order to avoid mechanical damage to their cars. According to Kenfack, (2014), 4 Corners Bambui to Bambili has the smallest size of the road (5.26 m) followed by Foncha Junction to Mile 3 bridge (5.50m), MOBIL to Foncha Junction (6.05 m) and Mile 4 Junction to 4 Corners Bambui (8.53 m). While along the NW road axis, the width of the road is fairly uniform (5m). Traffic congestion is therefore higher in the NE road axis than along the NW road axis. These road axes have so many bends and junctions which contribute to the traffic congestion problem.

The roads along the northern axis of Bamenda do not have parking lots and pedestrian lanes. So the tendency is that drivers park their vehicles along the road sides while pedestrians walk on the road. The parking of vehicles reduces the width of the road which is first of all small. These violate Article 113 of regulation N^0 04/01-UEAC-089-CM-06 of the Road Safety Code which states that vehicles must be parked completely out of the road and definitely not on pedestrian path. Pedestrian parking is instead encouraged along the Nkwen-Bambili and Ntarinkon-Bafut roads.

3. Uneven Traffic Flow Patterns and Congestion in Bamenda

Traffic congestion is unequally distributed in the calendar and school seasons as well as distance to the city centre along the NE and NW road axes of the Bamenda determined by four significant sample point counts with two along the NE at AMOUR MEZAM EXPRESS and Bambui Toll Gate and two others along the North West at Ntarinkon and Mile 8 Mankon representing increasing distance and assuming decreasing traffic congestion from the city centre in each case.

3.1. Traffic Flow and Congestion Trends along the NE Road Axes of Bamenda

Along the NE road axes, traffic counts were done during the rainy season in the months of August and September and during the dry season in the months of October and December.

During the rainy season traffic count was conducted on 5 August 2014 for all types of vehicles coming in and going out of the Nkwen sample point (Fig. 3).

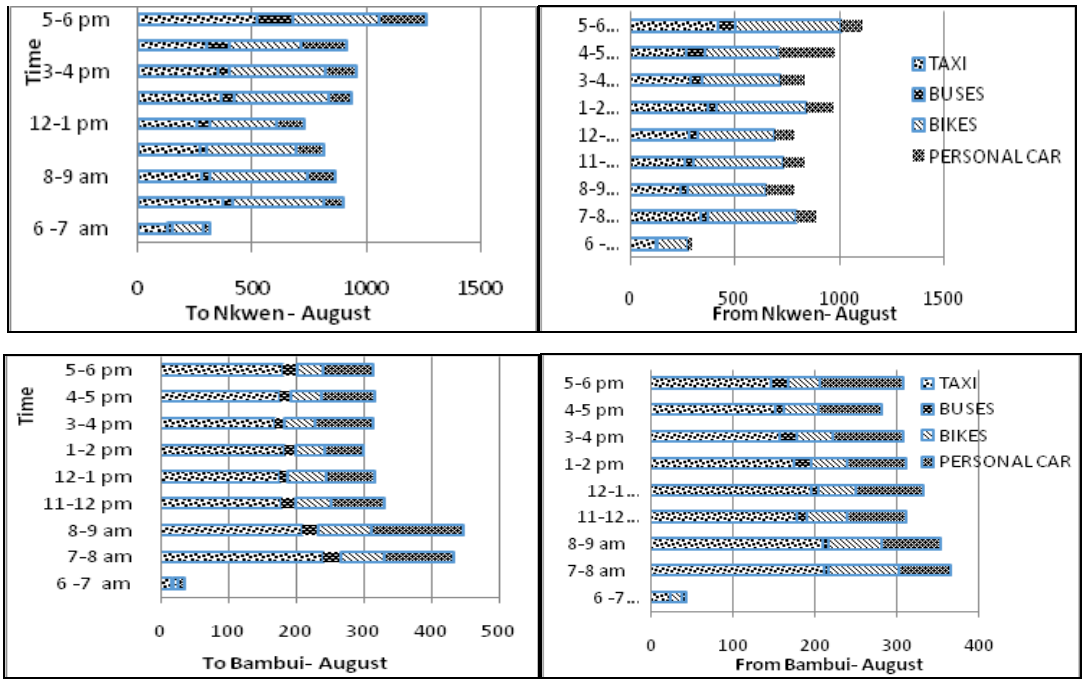


Figure 3: Traffic flow trend patterns along the NE road axis of Bamenda in August 2014

Traffic flow count at these two sample points show unequal flow being higher at some periods of the day than at others because monthly rainfall is high (400mm) and roads are wet and potholes are filled with water. The foggy atmosphere reduces driving visibility thereby slowing down the speed of vehicles

Another traffic count was done on 9 September 2014 at the same Bambui and Nkwen sample points to determine the seasonal variation (Fig. 4)

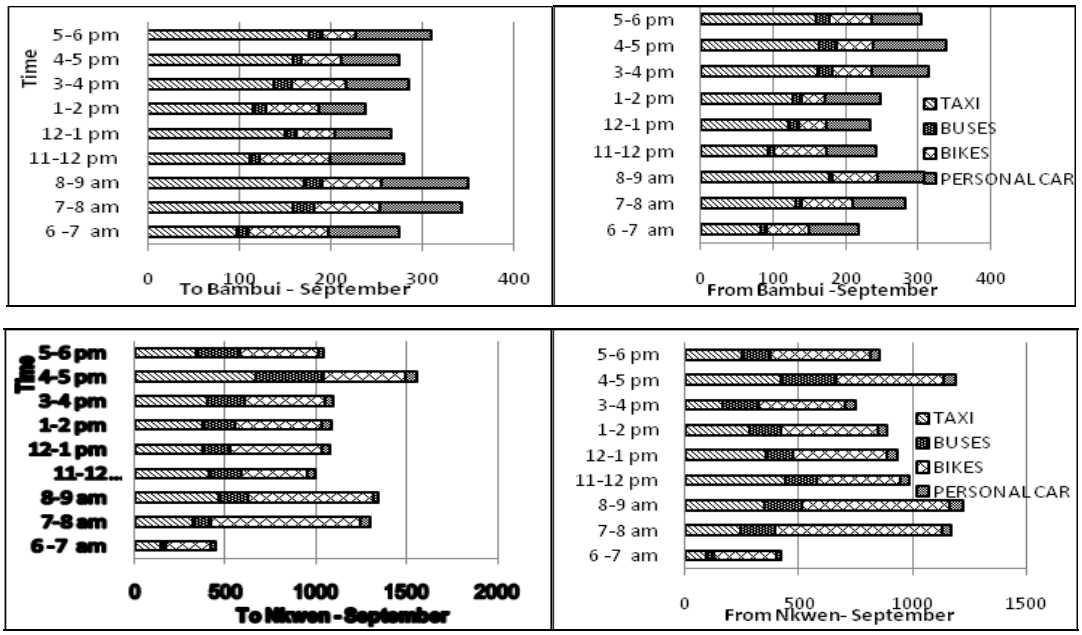
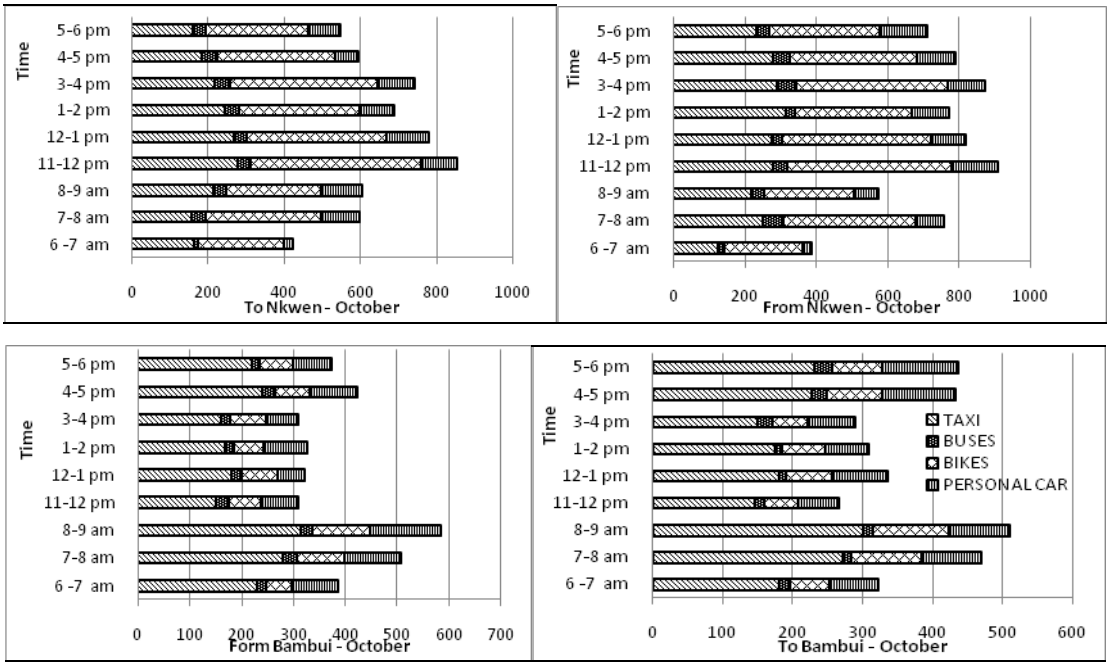


Figure4: Traffic flow trend patterns along the NE road axis of Bamenda in September 2014

At the Nkwen flow sample point, there was equally a daily variation in traffic congestion being generally higher in September when rainfall is higher and more intensive than August. Traffic flow is higher at Nkwen (closer to the city centre) than at Bambui and higher in September(especially mornings and evenings being students' to and from school movement periods) because it was a school period and lower in the month of August because it was a holiday period.

The dry season traffic flow was done in October and December at Nkwen and Bambui sample points. These counts showed unequal distribution of traffic congestion as some sample points had higher traffic at some particular periods of the day. To further show this seasonal variation in traffic congestion, a traffic count was conducted on 9 December 2014 at the same sample points (Fig. 5).



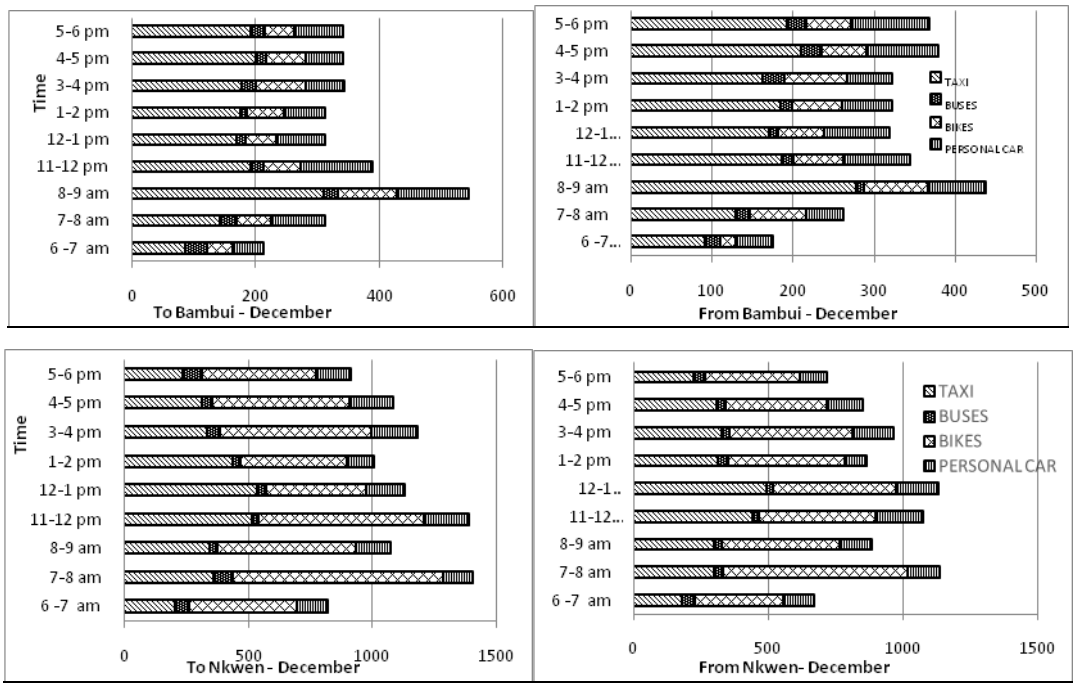


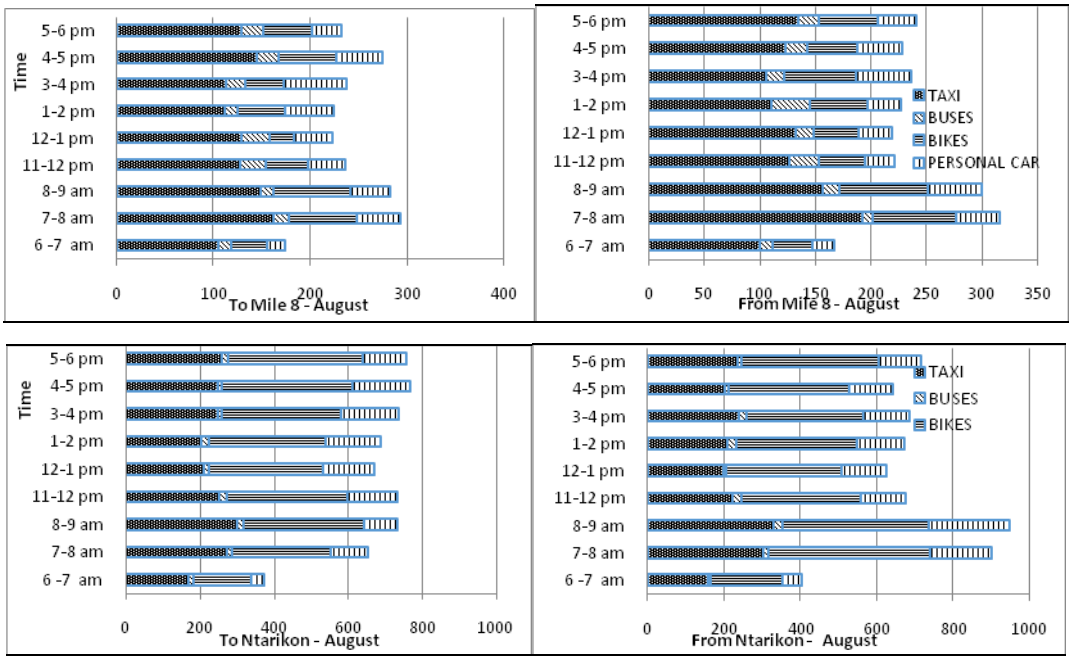
Figure 5: Traffic flow trends along the NE road axis of Bamenda in the dry season

Seasonal variation showed that traffic flows higher in October and lower in December (deep dry season when temperatures are very high (30.1ºC) so that the rate of evaporation is high drying up the potholes of their water.

3.2. Traffic Flow and Congestion Trends along the NW Road Axes of Bamenda

Traffic counts along the NW road axes were also done during the rainy season in the months of August and September and during the dry season in the months of October and December.

Rainy season traffic counts were done at Ntarinkon and Mile 8 on 5 August 2014 (Fig. 6)



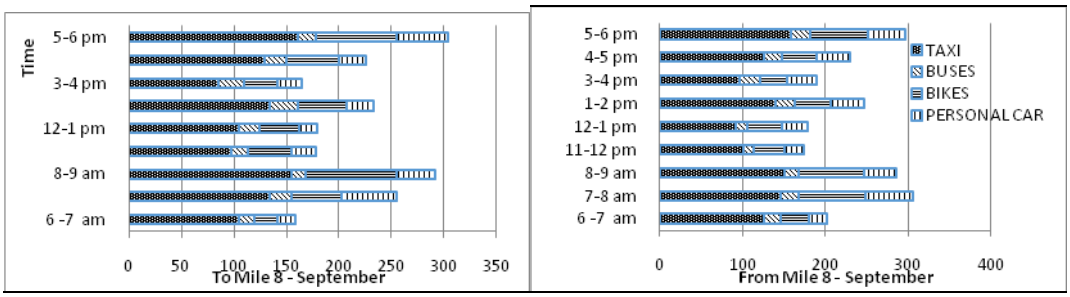


Figure 6: Traffic flow trends along the NW road axis of Bamenda in the rainy season

Traffic flow shows an unequal distribution being higher in Ntarinkonmarred with numerous potholes and is closer to the city centre than at Mile 8. Traffic flow count was conducted again on 9 September 2014 at these same sample points to test the impact of school season revealing traffic flow being higher at some periods of the day (Fig. 7)

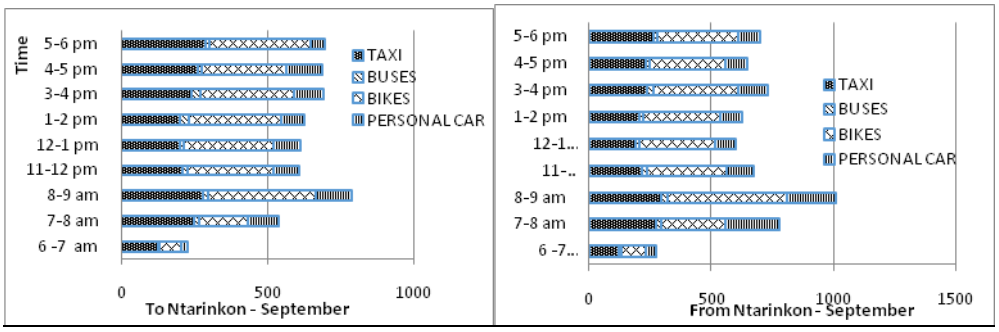


Figure 7: Flow along the Ntarinkon - Bafut road axis in the rainy season

Traffic flow was higher in September because rainfall was higher (449mm) than in August (400mm). Traffic flow was generally at Ntarinkon than at Mile 8 since Ntarinkon is closer to the city centre. Traffic counts were also done along the NW road axis in the dry season months of October and December at Ntarinkon and Mile 8 sample points which showed unequal distribution of flow within the day (Fig. 8)

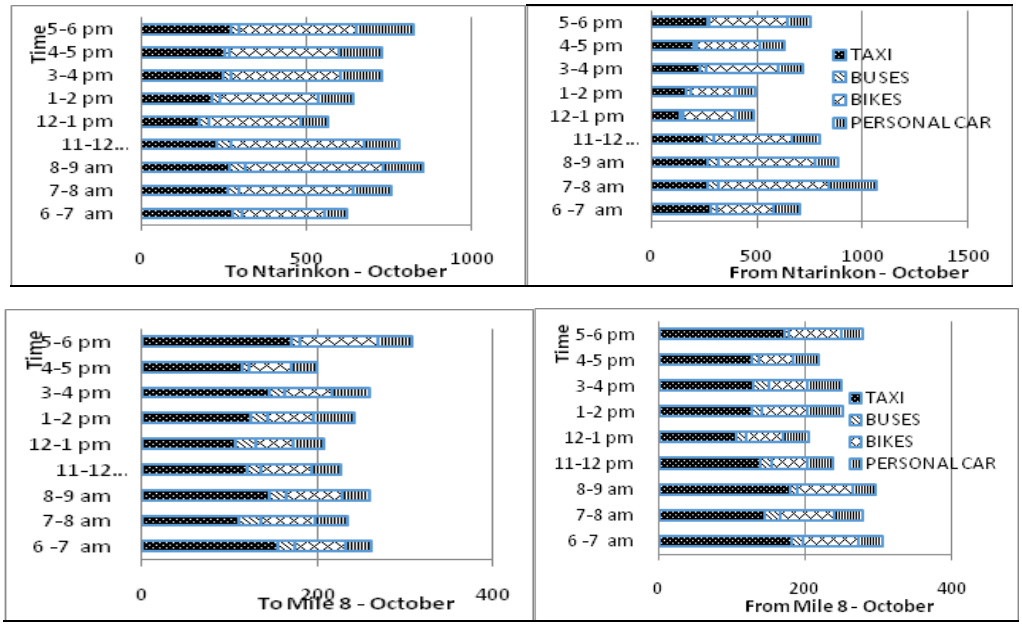


Figure 8: Traffic flow trends along the NW road axis of Bamenda in the dry season.

Traffic flow was generally higher at the Ntarinkon it is nearer to the city centre while Mile 8 is farther. Traffic flow count was again conducted on 9 December 2014 at these same sample points and again showed variations of daily traffic patterns (Fig. 9)

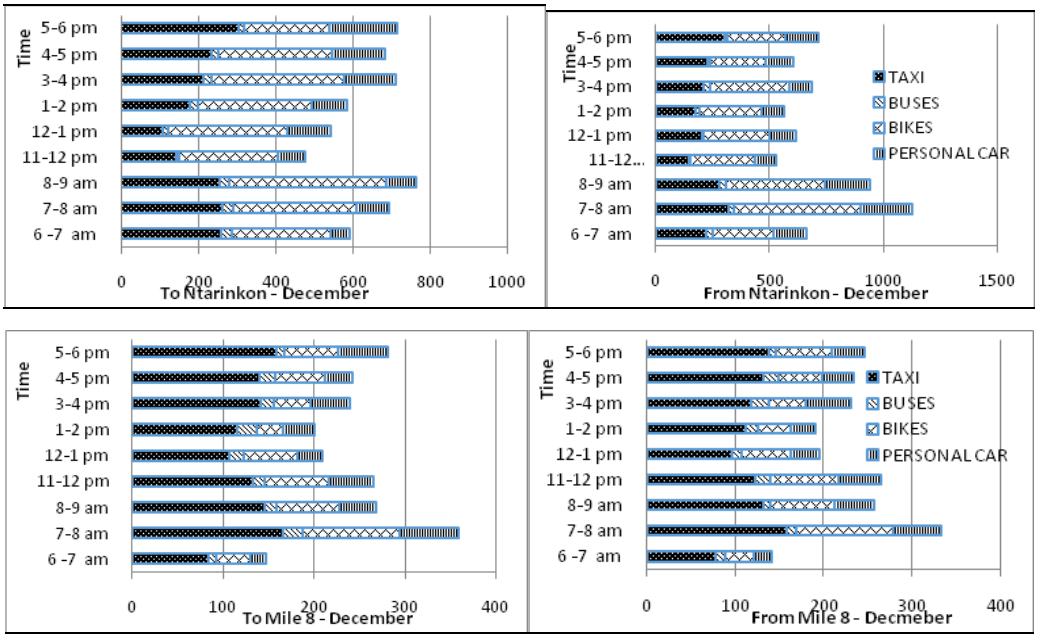


Figure9: Traffic flow trends along the NW road axis of Bamenda in the dry season

Traffic flow is greater in the NE road axis than in the NW road axis. The NE road axis has many educational institutions and is marred with bad roads unlike the NW road axis.

4.Tangible and Intangible Impact of the Traffic Flow Pattern and Congestion

The traffic flow trends and congestion inflicts tangible and intangible losses in terms of time wastage and losses in fuel and accidents on the drivers and students as the prime stakeholders of the sampled road axes in Bamenda. Drivers as the permanent daily stakeholders in this traffic challenge face negative ramifications in terms of daily income, time and money spent in the garage.

To students traffic congestion creates tiredness class, lateness and psychological stress. A large number of road users involved in traffic accidents along the NE and NW road axes recover from their injuries, but some of them never recover fully and suffer from some kind of permanent disability (Table 4).

Table 4: Recent accidents recorded along the Northern road axes of Bamenda

Location	Date	Time period	Vehicles	Fatalities	
				Human	Material tangibles
Mile 9(Bambili - Ndop road)	23/02/2013	6.00 p.m.	Trucks vs. motorbike	1 dead (17years) 1 wounded	damage of motorbike
Mile 9 (Bambili -Ndop road)	02/03/2013	5.40 p.m.	Private cars	wounded (36 years)	damage on both vehicles
Hospital roundabout	10/03/2013	7.00 a.m.	Trucks vs. taxi	1 dead (25 years)	damage on taxi than truck
Mile 4 Junction Nkwen	15/03/2014	6 a.m.	Truck vs. private car	1 wounded(40 years)	damage on car
Ntarinkon market	15/04/2012	9.35 a.m.	Taxi vs. bus	dead (36years)	damage on bus
Mile 9-Bambili road	22/05/2012	4.30 p.m.	Taxi vs. truck	4 wounded(27,34,37,30 years)	damage on taxi
Bambili	26/05/2014	10.00 a.m.	Taxi on store	None	damage on store
Four corners Bambui	31/05/2013	9 a. m.	Truck vs. private car	None	damage on private car
Mile 9 (Bambui - Bambili road)	03/06/2012	7.45 p.m.	Taxi vs. pedestrian	1 dead(55years)	little damage on taxi
Mile 8 Mankon	09/06/2013	3.30p.m.	Taxi vs. motorbike	1 dead (41 years)	damage on motorbike than taxi
Mile 7 (National Polytechnic)	17/06/2012	5 p.m.	Taxi vs. motorbike	4 wounded (62,26,50,52 years)	little damage on both taxi and bike
Ntarinkon Council Junction	03/07/2014	8.00 a.m.	Taxi vs. taxi	None	damage on both vehicles
Mile 7 National Polytechnic	28/07/2012	8 a.m.	Taxi vs. pedestrian	1 dead	little damage on taxi
Mile 3 (Nkwen GUINNESS Depot)	06/08/2013	6.00 p.m.	Taxi vs. pedestrian	1 wounded (16 years)	None

Source: Adapted from Regional Delegation of Transport for the North West and Fieldwork

Motor vehicles contribute to air pollution from their exhaust pipes such as nitrogen oxide, carbon monoxide, hydrocarbon and lead puts the urban dwellers at the risk of respiratory diseases, asthma and chronic lung diseases in violation of Article 81 of the Regulation N°04/01-UEAC-089-CM-06 of the revised road safety code of January 2003 which states that all vehicles should not emit smoke which could disrupt traffic circulation or cause harm to the population or road users. Such health problems include sleep deprivation, cognitive impairment and high blood pressure. Noise pollution from traffic activities contravenes Article 83 of Regulation N°04/01-UEAC-089-CM-06 of the revised Road Safety Code of January 2003 which states that all vehicles must not produce sounds that may be a nuisance to the road users or residents.

Conclusion

The development of the road in the NE and NW road axis of Bamenda left it with potholes and small size being the main cause of traffic congestion which add to on-street parking, poor state of vehicles, too many vehicles and vehicle breakdown to create an unequal distribution of traffic flow along the NE and NW road axes. Traffic congestion is greater along the NE road axis than along the NW road axis with negative pitfalls as time wastage, tiredness, absent or lateness to appointments and psychological stress apart of fall in daily income

Traffic lights should be provided at major road junctions along the NE and NW road axes to regulate large volumes of traffic especially at peak periods. The roads of the NE and NW road axes should be regularly maintained especially the filling of potholes. Where there are large concentrations of pedestrians, complete separation of vehicles should be encouraged to reduce pedestrian-vehicular conflicts along the road. This could be achieved by creating pedestrian paths. Off- street parking facilities should be provided.The width of the road should be expanded and if possible the construction of a double lane will be better to reduce traffic congestion along these roads.

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Biography

Zephania Nji Fogwe holds a Bachelor of Arts, Maitrise, Diplome d'Etudes Approfondi, Doctorat de 3e Cycle in Geography from University of Yaounde 1. At the University of Buea he obtained a Ph.D in Geography with interest in Development and Environmental Assessment. He has lectured in pure and applied physical geographies being his focus in research and publications in books and journals. This Associate Professor formerly serving at the Office of Academic Affairs of The University of Bamenda deputises at the Laboratory of Environment, Hazards and Sustainable Development of the Doctoral Unit in Geography, History and Heritage, Faculty of Arts, University of Douala where he had served as Vice Dean. He is also an editorial board member of many national and international journals, a consultant, and member to scientific bodies of common interest. He is the current and pioneer Chair of the Department of Geography and Planning, Faculty of Arts at the University of Bamenda.