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IDENTIFYING MAJOR URBAN ROAD TRAFFIC ACCIDENT BLACK-SPOTS (RTABSs): A SUB-CITY BASED ANALYSIS OF EVIDENCES FROM THE CITY OF ADDIS ABABA, ETHIOPIA

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ABSTRACT

Despite its adverse socio-economic impact, a study on identification of road traffic accident black-spots (RTABSs) in Addis Ababa is either negligible or only a general attempt made for the city as a whole (National Road Safety Coordination Office, [NRSCO], 2005) without considering the specific experiences of each sub-city. The main aim of this study was, therefore, to identify the major accident black spots in each sub-city of Addis Ababa separately. For this purpose, secondary data obtained from Addis Ababa traffic police office was employed. The findings of the study revealed that there were 125 major accident black-spots in Addis Ababa as a whole. The distribution by sub-city shows10, 11, 24, 10, 21, 10, 20, 6, 4 and 9 RTABSs in Kirkos, Bole, Arada , Yeka, Lideta, Nifas-Silk/Lafto, Addis-Ketema, Akaki, Kolfe and Gullele sub-cities respectively. This has implication on the need for sustainable transport development planning. The RTABSs identified in each sub-city need to be focused while planning. Therefore, concerned bodies should encourage further investigation of specific causes for designing and implementing appropriate road safety control strategies in order to significantly reduce the incidence of road crashes in the city. This can be done by planning sustainable ways of designing transport system such as road networks that should accommodate the ever increasing number of vehicles followed by frequent inspection of vehicles themselves.

Keywords: Road Traffic, Accident Black-spot, socioeconomic, Impacts, Sub-city, Addis Ababa

BACKGROUND OF THE PROBLEM

Theoretical explanations that road traffic accidents (RTAs) constitute major health, economic, and developmental challenges of developing countries, especially those in Africa (Chen, 2009; World Health Organization, [WHO] , 2009; United Nations Economic Commission for Africa, [UNECA] , 2009), holds true as it is evidenced in many countries. In 1999, for instance, 750-880,000 people died prematurely in road traffic crashes of which, some 85% of these occurred in developing countries (Downing, Jacobs, Aeron-Thomas & Sharples, 2000)) and in 2002, for example, of the estimated 1.2 million people killed in road traffic crashes (Peden, Scurfield, Sleet, Mohan, Jyder, Jarawan, & Mathers, 2004; WHO, 2009; UNECA, 2009), 90% occurred in low and middle income countries of which Africa had faced the highest fatality rate (28.3 per 100,000 population), which is substantially higher than developed world, such as those in North America (i.e.12.1 to 16.2 per 100,000 population) (Peden et al., 2004). In economic terms, the cost of road crash injuries is also estimated at roughly 1% of gross national product in low-income countries, 1.5% in middle income countries and 2% in high-income countries (WHO, 2004). This shows that RTAs are not limited to developing nations but are also universal phenomena. In other words, the implication it has on sustainable transport development in a nation or a city is immense. As current cities of the world have been experiencing high level of motorization and threatened by the lack of sustainable transport development (Kennedy et al, 2005), serious attention must be given to the issues of urban transport.

The important issue here is that ever increasing trend and spatial pattern of road accidents emerge following the ever increasing demands for fast movements that demand faster means of transport. This is because the need to move from place to place along with its own luggage in making a living is a human character. Such a movement of human beings and goods across a unit of geographical space for day to day activities by any means (foot, animal and/or vehicles is known as 'Traffic' (Goodall, 1987; Mayhew, 1997). This has led to gradual shift of transportation from on-foot to animals and then to vehicle; and even from slower vehicle of the first generation to the fastest vehicles of the 21stc generation. And such improvements in means of transport have been accompanied with Traffic congestion and in consequence with accidents. The problems of road safety may, therefore, perhaps remain unresolved despite efforts made to reduce through appropriate road designing methods and legal enactment. Consequently, RTAs are claiming the lives of millions and caused destruction of property leading to what is known as social and economic crisis (Peden et al, 2004). This implies that the impact it has on human, physical and financial capital, is huge posing challenges to national development efforts. In fact, this requires planning for sustainable transport system in general and sustainable urban transport development in particular. A sustainable transport development planning requires the effort of all concerned bodies including transport authority and the community itself (Kennedy et al, 2005).

The social, economic and political impacts of road accidents are widespread all over the world. The loss of lives, damage to property and the sorrow it leaves in human mind are profound though the degree varies from nation to nation, developing nations being the hardest hit (Peden et al, 2004). RTAs are found to be among the top leading causes of deaths and injuries of various levels (Tesema, Abraham & Grosan, 2005). An estimated 1.2 million people die in road traffic accidents each year while about 50 million are being injured and about 85% are in developing countries (WHO, 2004; WHO 2009, UNECA 2009). Odero, Garner and Zwi (1997) also attempted to review the differences between sexes and ages in developing countries, showing 80% of road causalities occurred to men. On the other hand, urbanization accompanied by high

population (Guyu, 2011) and vehicle growth is usually accompanied by high urban congestion and increases in the occurrence of road traffic crashes. Accordingly, nearly ½ a million people die and up to 15 million people are injured in urban road accidents in developing countries each year and this is estimated to have a direct economic cost of 1% to 2% of worldwide gross domestic product (Peden et al, 2004). Moreover, in 1999, for instance, of the total 750-880,000 people died prematurely in road traffic crashes, between 35% and 70 % of all crashes occur in urban areas and urban road networks contribute to a significant proportion of countries' national road traffic crash problem (Downing et al, 2000). These and other estimates have indicated that traffic accident as a whole will become the third major killer next to HIV/AIDS and TB (Peden et al, 2004).

The situation of RTAs is most severe in Sub-Saharan Africa where the lives of millions are lost and significant amount of property is damaged. For example, more than 85% of these casualties occur in low and middle in-come countries (UNECA, 2009). This has imposed a huge economic burden on developing economies that may amount to1%-2% of GNP in most countries (ibid).

In Ethiopia, the situation has been worsened as the number of vehicles has increased and consequently due to increased traffic flow and conflicts between vehicles and pedestrians. Despite government efforts in the road development, road crashes remain to be one of the critical problems of the road transport sector in Ethiopia (UNECA, 2009). Every year many lives are lost and much property is destroyed due to road traffic accidents in the country. The country has experienced average annual road accidents of 8115 over the past 11 years (Central Statistical Agency, [CSA], 2000/01-2010/11) compared to over 8000 deaths annually in Turkey (Murat, 2009). In financial terms, Ethiopia, one of the poorest countries in the world, looses at least 400 million Birr each year due to road accidents which was 12 million Ethiopian Birr per year on average, 15 years ago and was the third killing vector (Fanueal, 2006). Currently, the financial estimation of property damage (excluding human deaths and injuries), is more than 15 million Ethiopian birr annually on average (CSA, 2000/01-2010/11). According to UNECA (2009), the rate of traffic accident death in 2007/08 was 95 per 10,000 motor vehicles which put the country on the extreme high side of the international road safety scene. Moreover, in the same year, the police report revealed 15,086 accidents which caused the losses of 2,161 lives and over 82 million Ethiopian birr, equivalent to US$7.3 million estimated cost of property damage (US$1 =11.34 Ethiopian Birr). And, up to 2005/06, traffic accidents and fatalities increased at 17 % and 10 % per year respectively although there is a decreasing decline in these respect. There were 2.84 road accident fatalities per 100,000 populations in the same year (UNECA, 2009).

Urban areas are the most hit by car crashes due to ever increasing numbers of population and vehicles and the resulting shortage of road facilities and congestion and need to plan in a sustainable manner (Kennedy et al, 2005). The city of Addis Ababa is the capital of Ethiopia where the majority of road accidents are highly concentrated in. For instance, of the total 46,897 passenger vehicles in Ethiopia, more than 56.1% is found in Addis Ababa (Addis Ababa City Government, [AACG], 2010) while of the total road crashed of 9,301 in Ethiopia during 2007/08 period, 2,071were in Addis Ababa.

According to the police reports, motor vehicle traffic accidents in Addis Ababa during the year 2000 – 2005 are about 44,000 and are relatively less compared to more than 50,000 crashes during the period between 1985 and 1997, and an average 3000 crashes are reported to the police each year (Fanueal, 2006) although data reliability may be questioned. For example, in

2010/11, out of 15884 total RTAs (including property damage) occurred in the country, 7882 had occurred in Addis Ababa (CSA, 2012) and the trend decreased from 10543 in 2005/6 to 8523 in 2009 (AAVG, 2010). But one can observe it to be low performance compared to the technical and knowledge developments in traffic police control systems. That is, despite possible efforts of traffic police of the city, road traffic accidents have remained one of the most threatening challenges of the city. Each year, therefore, there were 300 people killed and 1500 slight and serious injuries in Addis Ababa (Fanuael, 2006). Therefore, understanding of RTABSs of the city helps us understand the severity of road accidents that would call for serious policy measures to be formulated and implemented as previous such policy measures couldn't have brought the necessary changes. Thus, it is very essential to begin with the identification, analysis and discussion of the RTABSs of the city, specifically by *sub-city (broader administrative division/unit in Ethiopia, and hence in the city of Addis Ababa greater than 'kebele' in the hierarchy)* before going to analyzing the trend, temporal and spatial patterns and causes and consequences of RTAs in Addis Ababa.

Generally, Addis Ababa, as a capital city of the country, is characterized by the largest share of road traffic flow, congestion and accidents. The causes are diverse and dynamic, and are both spatially and temporally significant (See Birhanu, 2000; Bitew, 2002; Fanuea, 2006; Tewolde, 2007 and others). These can be identified as human behavioral related and non-human behavior related causes. While factors related to drivers, passengers and pedestrian behaviors are human related causes, those factors related to weather conditions, road network situations and vehicle technical problems can be grouped under non-human behavior related causes of road crashes. According to Birhanu (2000), pedestrian are the most victims of road car accidents. For example, 56 % of the fatalities during the period 1987/8-1996/7 were pedestrians in Ethiopia which is higher than the corresponding average for African countries (40%) and the average for some developed countries (20%) in the period (ibid). In contrast, the pedestrian fatalities in Addis Ababa were much higher, 88 % of all fatalities in 1987/8-1993/4 (Birhanu, 2000).

Attempts have been made to identify RTABSs in Addis Ababa as a whole in 2005 by Addis Ababa Traffic Police Bureau and Federal Road Transport Authority (Fanuel, 2006). However, the attempt was comprehensive one which compared the hazardous sites of road crashes for the city as a whole. This definitely overlooks the spatial distribution of the severity of road crashed among the 10 sub-cities of Addis Ababa. Thus, according to the black-spot map 0f 2005, RTABSs are highly concentrated in the central parts of Addis Ababa, generally in parts of Kirkos, Addis Ketema, Arada, Yeka, Lideta, Gullele and Nifas-Silk/Lafto sub-cities. This ignores the importance of road crashes those sub-cities located relatively on the outer skirts of the city. This study considers those gaps by dealing with RTABSs of each sub-city.

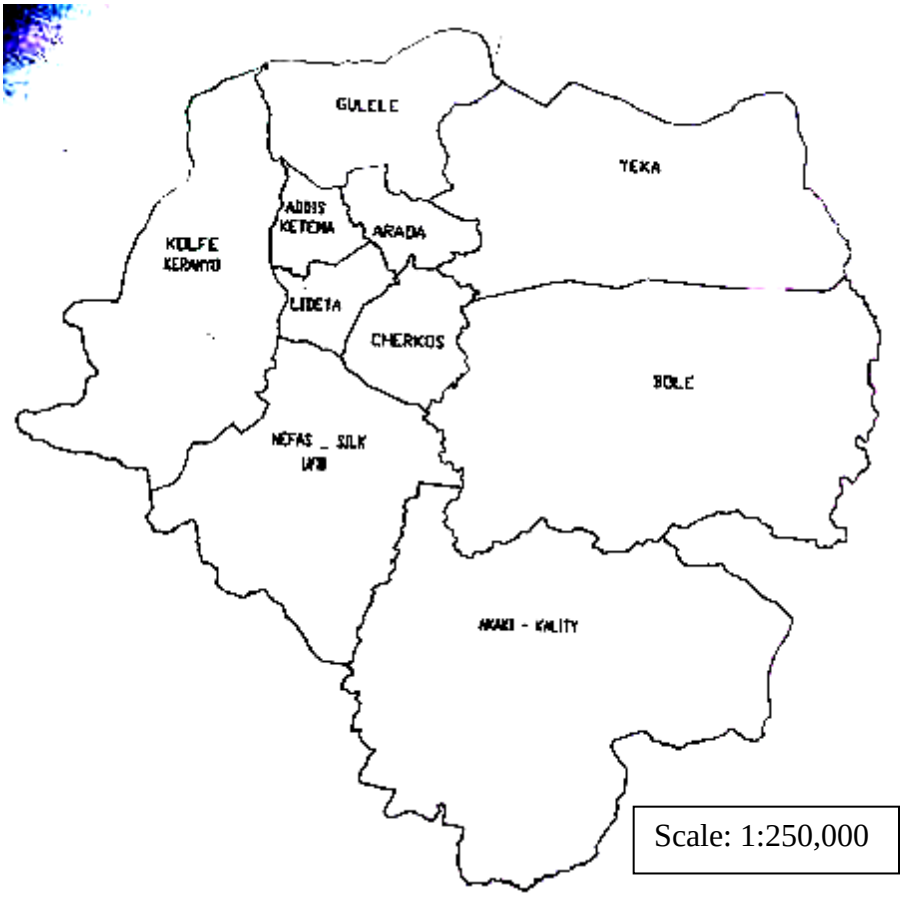
In Ethiopia, the loss of lives, damage to property and the sorrow it leaves in human mind, due to road accidents are profound. Such road safety problem is most pronounced in urban areas like Addis Ababa. For example, Hassen, Godesso, Abebe and Girma (2011) attempted to identify significant factors for risky behaviors of drivers in Mekele town found that significant number of the study subjects (66.6%) had risky driving behaviors. Of this, more than 28.6% had less knowledge about basic traffic signs, 51.7% had negative attitude towards risky driving behaviors; 42.3% had a habit of using mobile phone while driving vehicle and 9.7% had experience of driving after drinking alcohol (Hassen et al, 20011). In the country in general and in Addis Ababa in particular, a study on road traffic accidents, is not new task. Researchers and scholars have conducted a number of studies on road accidents in the country and in urban areas sufficiently (see Bitew, 2002; Tessema et al, 2005;

Fanueal, 2006; Tewolde, 2007;Persson, 2008; UNECA, 2009; Hassen et al, 2011; and others). However, none of these were devoted to identify hazardous accident sites (road traffic accident black-spots-RTABSs) especially at sub-city level except an attempt made by the National Road Safety Coordination office (NRSCO, 2005) in collaboration with Addis Ababa traffic police office for the city as a whole as cited in Fanueal (2006). For example, while Bitew (2002) studied the causes, temporal and spatial variations and consequences of taxi traffic accident, Tessema et al (2005) focused on developing adaptive regression trees to build a decision support system to handle road traffic accident analysis. Fanuel (2006) on his part tried to identify major causes of traffic crashes, concluding that there is growing problems of road accidents, and forwarded traffic simulation model for network selection. And while Tewolde (2007) tries to identify variable that most cause road accidents, UNECA (2009) analyzes the trends, causes and characteristics of accidents. As could be seen from the above examples, almost all of them are concentrated on assessing usual causes, consequences and spatial and temporal characteristics as well as application of some models. Such studies including RTABSs identified by national road safety coordination office in 2005, haven't dealt with the experiences of each sub-city in road accident situation. But the identification of RTABSs for each sub-city is one of the crucial steps in road traffic accident control planning and management for countermeasure. Therefore, the current study aims at investigating the major RTABSs for each sub-city based available data obtained from Addis Ababa traffic police office so as to suggest the right policy recommendations as a remedy for the road safety problem. This may provide at least baseline information about the current situation of traffic accident in Addis Ababa that may enable concerned bodies to re-examine the overall system of urban transportation networks and traffic flow. Therefore, the basic problem is an identification of those RTABSs in each sub-city of Addis Ababa. And ultimately to recommend appropriate policy options.

The City of Addis Ababa

Addis Ababa is capital city of Ethiopia which has an area of 540km^2 (54000ha) and average elevation of 2500m above mean sea level. It is located almost in the central part of the country. It is also the seat of the African Union and the United Nations Economic commission for Africa. Moreover, it can be considered as a gateway for diplomats and tourists. According to AACG (2010), the population of the city is nearly 3million. The municipal administration is sub-divided into 10 sub-cities and 99 'kebeles' the lowest administrative levels below the sub-city but larger than a village. The following figure provides the map the city.

Map of Addis Ababa City Administration, 2010



Source: Adapted from Addis Ababa City Government, 2010

SOURCES OF DATA AND METHODS

Addis Ababa is a capital city of Ethiopia which is administratively divided in to 10 sub-cities, and each sub-city is in turn divided into lower level administrative units known as '*kebele' (the lowest administrative unit in Ethiopia including both urban and rural greater than village)*. The astronomical location of the city is $9^0$02'00"N and $38^0$42'00"E. As it lies in the central part of the country, in addition to serving as a capital, there is a higher concentration of human and vehicle populations leading to road traffic congestions and crashes. Therefore, the data employed to conduct this study was obtained from Addis Ababa traffic police office.

Because of data limitation, the identification of RTABSs was based mainly on traffic accident records of 2005/06. This year is preferred due to fully available data from traffic police office of the city by sub-city. In other words, during the remaining recent years, data couldn't be found for all sub-cities for the same year. Due to this reason, data for the year were gathered on all forms of road car accidents (deaths, slight injuries, serious injuries and property damage) in each sub-city at each accident site. Moreover, although this particular study of RTABSs is generally based on the data acquired during 2005/2006 i.e. September 2005 – June 2006, for some sub-cities (Kirkos, Bole and Addis-ketema) to which data are available, the analysis is

based on two years' data (2004 -2006). The number of RTABSs in each sub-city doesn't imply the total number of accident that show the rank orders. Rather the respective numbers of RTABSs were determined separately for each sub-city considering only the top ten ranks of the frequency of accident at each hazardous site in each sub-city.

After the data were secured, the next step was to determine the most hazardous accident locations/sites (i.e. RTABSs) based on the frequency of road traffic crashes at each site in each sub-city (Sayer, 1994). In this regard, many researchers employed reliable traffic data to determined RTABSs in their respective countries and their urban areas (Geurts & Wets, 2003; Getu, 2007). As Getu (2007) cited different sources, accident black spot identification varies from country to country. For example, black-spots in Norway is defined as any place with a maximum length of 100 meters where at least four injury accidents are reported during a four year period (Rune & Vaa, 2005) In the UK, it has only five injury accidents in three years, while in Bangladesh it is having more than 10 injury accidents in a year (Geurts & Wets, 2003). In most developed countries, black-spots are defined as the locations where there are 12 accidents in 3 years per 0.3 kilometers (Guo & Kong, 2003)-i.e. 4 accidents per year. In Czech Republic, junctions or 250 m-long road sections, where at least 3 road accidents with injuries occurred within 1 year or at least 3 road accidents with injuries of the same type occurred within 3 years or at least 5 road accidents of the same type occurred within 1 year, are considered as black-spots (Jitka, 2000). Getu (2007), therefore, utilized a three years accident data (2003 – 2006) and determined 9 black-spots in roads between Addis Ababa and Shashemene. This implies that despite such variations and even mathematical models available for determining RTABSs (Geurts & Wets, 2003), the intensity of road traffic accidents in terms of severity and frequency can be employed. Moreover, Mustakim and Fujita (2011) forward methods of determining black-spots using Accident Point Weightage (APW). However, in this study, the frequencies of occurrences of road crashes were used to determine RTABSs by identifying the rank orders of each RTABS in each sub-city. Thus, the intensity of accident is weighted in terms of the frequency accident data, which has been employed by many writers (Jitka, 2000; Guo & Kong, 2003; Geurts & Wets, 2003).

Accordingly, based on the rank orders in the frequency of accidents, the author determined the accident black-spots of each sub-city. In most sub-cities, the first 10 hazardous sites in the rank order were determined to be the most hazardous black-spots although in others where the intensity of accidents is relatively lower, RTABSs were determined accordingly. However, as a general principle, in this study the first 10 hazardous sites are taken as accident black-spots. In this regard, the positivist approach, rather than subjectivist, that underpins the use of quantitative or numerical methods of data analysis (Creswel, 2003, 2009), is employed.

RESULTS

Road Traffic Accidents Black-Spots and Their Distribution by Sub-City

The aim of this study was to clearly identify the location of major RTABSs in each Sub-city by ranking the total number of RTAs of each Sub-city rather than for Addis Ababa as a whole. Table 1 shows the distribution of traffic accidents, its rank order and the number of RTABSs as identified through current study.

Table1: Total Number of RTAs, Rank orders and RTABSs by Sub-city (2005/06)

Sub-city	Total RTAs	%	Rank	No. of RTABSs
Kirkos	2948	26.77	1	10
Bole	1750	15.89	2	11
Arada	1209	11.00	3	24
Yeka	1104	10.02	4	10
Lideta	1064	9.66	5	21
Nifas-Silk/Lafto	810	7.35	6	10
Addis-ketema	797	7.23	7	20
Akaki	615	5.58	8	6
Kolfe	439	3.99	9	4
Gullel	277	2.50	10	9
Total	11014	100	-	125

Source: Computed from Data obtained from AATPO (2005/06) by the Author, 2012

Obviously the frequency of road car crashes in Addis Ababa varies from one sub-city to the other. This variation in the frequency and intensity of road accidents has led to the need for identification of RTABSs for taking appropriate policy measures at relevant accident locations by considering each sub-city. Table1 shows the distribution of number of respective accidents and black-spots in each sub-city. Accordingly, Kirkos (26.77%), Bole (15.89%) and Arada (11%) sub-cities were the three leading sub-cities in the frequency of RTAs being the 1st, 2nd and the 3rd for the year specified. Yeka (10%), Lideta (9.66%), Nifas-Silk/Lafto (7.35%) and Addis Ketema (7.23%) sub-cities followed with 4th, 5th, 6th and 7th ranks respectively. On the other hand, Akaki (5.58%), Kolfe (3.99%) and Gollele (2.5%) sub-cities, with rank orders of 8th, 9th and 10th respectively were found to be the last with regard to the frequency of road accidents. Therefore, the following sections are devoted to present the distribution of RTABSs in each of the sub-cities in Addis Ababa.

Major Accident Black-spots in Kirkos Sub-city

As mentioned earlier, a two years data were employed to determine the total number of RTABSs in Kirkos sub-city (i.e. 2004 – 2006). As a result, the first top ten hazardous accident sites in Kirkos sub-city were determined as shown in Table2 along with their rank orders. Accordingly there are 10 RTABSs during the year. Overall, Kirkos sub-city is the most accident prone area in Addis Ababa because of its central location and high congestion. Although there are other secondary sites of RTABSs in the sub-city, those identified above are extremely exposed to traffic accidents. According to Table2, Olompia (14.42%) is the leading accident prone area followed by Kasanchis (13.67%), Wollo-sefer (11.93%), Mexico-square (10.97%) and Teshale-garage (10.87%) representing the first top five hazardous sites in the sub-city. The second top five (Meskel-square (8.08%), Bambis (7.81%), Urael (7.70%), Lagahar (7.63%), Stadium (6.95%) respectively are still very essential black-spots that need special policy attention in the sub-city.

Table2: Major Road Traffic Accident Black-spots in Kirkos Sub-city (Jan. 2004 -Jan.2006)

Major ABSs	Tot. Road Traffic Accidents		%	Rank
	No.	Ave.		
Olompia	423	211.5	14.42	1
Kasanchis	401	200.5	13.67	2
Wollo-sefer	350	175	11.93	3
Mexico-square	321	160.5	10.94	4
Teshale-garage	319	159.5	10.87	5
Meskel-square	237	118.5	8.08	6
Bambis	229	114.5	7.81	7
Urael	226	113.0	7.70	8
Lagahar	224	112.0	7.63	9
Stadium	204	102.0	6.95	10
Total	2934	1467	100.0	-

Source: Computed Data obtained from AATPO (2004 -2006) by the Author, 2012

Major Traffic Accident Black-spots in Bole Sub-city

Bole Sub-city was the second with regard to the total number of road crashes it experienced during the year when data were recorded (see Talbe1).

Table3: Major Road Traffic Accident Black-spots in Boles Sub-city(Jan,2004-Jan,2006)

Major ABSs	Road Traffic Accidents		% of Total	Rank
	Tot	Ave.		
Raguel-zuria	406	203.0	15.48	1
22-mazoria-Lem-hotel-Megenagna	392	196.0	14.95	2
Bole M/alem-Atlas-Raguel	272	136.0	10.37	3
Megenagna-Imperial-Grji	262	131.0	10.0	4
Gurdshola-CMC-Meri	207	103.5	7.90	5
Imperial-Ras Hotel-Tele M/alem	197	98.5	7.51	6
Ras Hospital-Ring road-Bole Mikael	187	93.5	7.13	7
Zerfeshewa-school-Gurd-shola	182	91.0	6.94	8
Gerji-Yere	177	88.5	6.75	9
22-mazoria-Awuraris hotel-Bole school	177	177.0	6.75	9
Japan embassy-Ruwanda-Karamara Bridge	163	81.5	6.22	10
Total	2622	1311	100	-

Source: AATPO (Jan, 2004-Jan, 2006), Computed by the Author, 2012

Of course, like Kirkos sub-city, the minimum number of accidents set to determine major black-spots was based on two years data- i.e. data obtained for the period of January, 2004 – June, 2006. For this period, there was 11 such accident locations lying between the 1st and 10th ranks identified based on the data mentioned. Table3 depicts those RTABSs along with the total number of RTAs, annual average and rank orders in the sub-city. Two RTABSs are ranked as 9 because both experienced equal number and hence percent of accidents during the period specified. The minimum number in the sub-city is 81.5 on average around Japan Embassy-Rwanda-Karamara Bridge and the maximum average (203 accidents) being around Raguel area respectively (See Table3). Thus, the first top-five RTABSs in the sub-city were Raguel-zuria, 22-mazoria-Lem-hotel-Megenagna, Bole M/alem-Atlas-Raguel, Megenagna-Imperial-Grji and Gurdshola-CMC-Meri accounting for 15.48%, 14.95, 10.37%, 10.37%, 10% and 7.9% respectively. It doesn't mean that the remaining six are not important accident sites. The remaining black-spots as seen from Table3 are also important locations that need serious police attention too. Generally, these 11 black-spots are the major RTABSs of the sub-city that need serious policy attention which concerned bodies work with more emphasis.

Major Traffic Accident Black-spots in Arada Sub-city

One year data obtained from Addis Ababa traffic police office (July, 2005 - June, 2006) were employed in identifying the major RTABSs in Arada sub-city.

Table4: Major Road Traffic Accident Black-spots in Arada Sub-city (2005 -2006)

Major RTABSs	Total Accident		Rank
	No.	%	
Around Arat Kilo Square	27	9.82	1
Around Arat Kilo Palace	20	7.27	2
Minilik Square-Municipality	17	6.18	3
Around Abune Petros Square	15	5.35	4
Piasa Cinima Empire	15	5.35	4
Around Tewodros Square	14	5.09	5
Main Piasa	14	5.09	5
Kidist Mariam Church	14	5.09	5
Around Semen Hotel	14	5.09	5
Ras Mekonen Bridge	11	4.00	6
Around Sidist Kilo Lion's Park	11	4.00	6
Piasa Atkilit Tera	11	4.00	6
Around Amist Kilo	11	4.00	6
Cherchir Godana	10	3.54	7
Somalia Tera	10	3.54	7
Tourist Hotel (Arat Kilo)	8	2.81	7
Sebara Babur	8	2.81	8
Ginfile Bridge	8	2.81	8
Main Post Ofiice	7	2.54	9
Down way to Sheraton Addis	7	2.54	9
Afincho Ber	7	2.54	9
Around Fikire Hotel (Arat kilo)	6	2.18	10
Abakoran Sefer	6	2.18	10
Around Kelifa Building	6	2.18	10
Total	275	100	

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

According to Table4, by setting the minimum number of accidents to determine the major RTABSs at 6-i.e. the 10^{th} rank, a total of 24 RTABSs were found in the sub-city. The table shows those RTABSs along with the total number of road accidents and their ranks. Accordingly, the around Arat Kilo Square (9.82%), around Arat Kilo Palace (7.27%), Minilik Square-Municipality (6.18%), around Abune Petros Square (5.35%), Piasa Cinima Empire (5.35%), around Tewodros Square (5.09%), Main Piasa (5.09%), Kidist Mariam Church (5.09%) and around Semen Hotel (5.09%) respectively form the first

five top-ten black-spots in the sub-city. Whereas, Ras Mekonen Bridge (4%), Around Sidist Kilo Lion's Park (4%), Piasa Atkilit Tera (4%), Around Amist Kilo (4%), Cherchir Godana (3.54%), Somalia Tera (3.54%), Tourist Hotel (Arat Kilo) (2.81%), Sebara Babur (2.81%), Ginfile Bridge (2.81%), Main Post Office (2.54%), Down way to Sheraton Addis (2.54%), Afincho Ber (2.54%), Around Fikire Hotel (Arat kilo) (2.18%), Abakoran Sefer (2.18%) and Around Kelifa Building (2.18%) respectively belongs to the next five accident black-spots (i.e. 6^{th} to 10^{th} ranks). The majority of RTABSs are found in this second category.

Major Traffic Accident Black-spots in Yeka Sub-city

RTABSs were also identified for Yeka sub-city based on the data obtained for the year 2005 – 2006. The result showed that there were 11 RTABSs in the sub-city. This is presented on Table5 as follows.

Table5: Major Road Traffic Accident Black-spots in Yeka Sub-city (2005 - 2006)

Major ABSs	Total Accident		Rank
	No.	%	
Around Yeka Mobile	61	17.13	1
Wondirad School	53	14.89	2
Megenagna Cross Road	49	13.77	3
Around Lady Pastry	45	12.64	4
Around of Zerihun Building	43	12.07	5
Et-fruit	42	11.79	6
Zerfeshebel Scchool	14	3.94	7
Yeka Primary School	14	3.94	7
Jin Bank	13	3.65	8
Mission Pharmacy	12	3.37	9
Shola	10	2.81	10
Total	356	100.00	

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

The findings as presented on Table5 revealed that 11 RTABSs in Yeka sub-city, the around Yeka Mobile (17.13%), Wondirad School (14.89%), Megenagna Cross Road (13.77%), Around of Zerihun Building (12.64%) and Around Lady Pastry (12.07%) being respectively constituted the first five top accident black-spots in the sub-city. Therefore, one can conclude that the area around Yeka mobile was the leading hazardous site with 17.13% of total TRAs followed by Wondirad School (14.89%) and Megenagna cross road (13.77%) while the lowest was Shola area with RTAs accounting for 2.81% in the specified year. Here one should note that the minimum number found to delineate the 10^{th} RTABS experienced a total of 10 accidents while the maximum 61. This numbers are very smaller than Kirkos and Bole sub-cities but more than Arada sub-city.

Major Traffic Accident Black-spots in Lideta Sub-city

This sub-city is the fifth in terms of total road accidents and has 21 RTABSs as identified during the year specified. Table6 shows the list of those black-spots together with their total accident and rank orders according to the frequencies of RTAs.

In Lideta sub-city, there were 21 RTABSs during the year. Taking the 10th rank, the minimum number of RTAs set was 9 while the highest was 44. Accordingly, the areas around Tor-hailoch (12.25%), Tekle-haimanot square (11.14%), Tikur-Anbesa hospital (9.19%), Mexico Tegbare-id (7.52%) and Mexico Square (7.24%) made up the first top-five RTABSs in the sub-city and were the leading hazardous sites.

Table6: Major Road Traffic Accident Black-spots in Lideta Sub-city (July, 2005 -June, 2006)

Major ABSs	Total Accident		Rank
	No.	%	
Around Tor-hailoch	44	12.25	1
Tekle-haimanot Square	40	11.14	2
Tikur-Anbesa Hospital	33	9.19	3
Mexico Tegbare-id	27	7.52	4
Mexico Square	26	7.24	5
Goma Kuteba	19	5.29	6
Sanga Tera	19	5.29	6
Lideta Church	13	3.62	7
Amstegna Police Tabiya	13	3.62	7
Wabe Shebele Hotel	13	3.62	7
Di Africa Hotel	13	3.62	7
Philips Building	12	3.34	8
Brebere Berenda	12	3.34	8
National Theatre	10	2.79	9
Geja Sefer	10	2.79	9
Balcha Hospital	10	2.79	9
Awash Wein-brewery Factory	9	2.51	10
Emigration	9	2.51	10
Sarbet Square	9	2.51	10
Coka-cola	9	2.51	10
Cigarette Factory	9	2.51	10
Total	359	100	-

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

Whereas, relatively the less exposed areas to such accidents were the areas that constituted the nest top accident black-spots ranked as 1st to 10th. These include the areas around Goma Kuteba (5.29%), Sanga Tera (5.29%), Lideta Church (3.62%),

Amstegna Police Tabiya (3.62%), Wabe Shebele Hotel (3.62%), Di Africa Hotel (3.62%), Philips Building (3.34%), Brebere Berenda (3.34%), National Theatre (2.79%), Geja Sefer (2.79%), Balcha Hospital (2.79%), Awash Wein-brewery Factory (2.51%), Emigration (2.51%), Sarbet Square (2.51%), Coka-cola (2.51%) and Cigarette Factory (2.51%) respectively making up the RTABSs ranking from 1st to 10th. This shows that Cigarette factory, Coca cola, Sar-bet Square, Emigration, and Awsh-wein-tej factory, each accounting for 2.51% of total RTAs over the year, are relatively less exposure to RTAs in the sub-city.

Major Traffic Accident Black-spots in Nifas-Silk/Lafto Sub-city

This sub-city is the six in terms of total RTAs and has 10 RTABSs as identified during the year specified. Table7 shows the list of RTABSs together with their total accident and rank orders in accordance with the intensity of the frequencies. With regard to the minimum number set at 10th rank order, i.e. 2 accidents around Mekanisa Alkohol factory and the highest number of accidents found at 1st rank order i.e. only 13 accidents around Hana-Mariam were the lowest compared to others. Of the 10 RTABSs identified, areas around Hana-Mariam (18.31%), Goffa-Gebreal (16.91%), Sar-bet (14.08%), Mekanissa school(12.67%) and Sarbet-Mekanisa (9.85%) were the leading five hazardous sites followed by Rink-road-Kebele 15/16 (8.46%), Adey Ababa (7.04%), Goffa Kamp (5.64%), Around Saris (4.23%) and Mekansa alcohol Factory (2.81%) respectively constitute the second top-five hazardous locations in the sub-city.

Table7: Major Road Traffic Accident Black-spots in Lideta Sub-city (July, 2005 -June, 2006)

Major ABSs	Total Accident		Rank
	No.	%	
Hana Mariam	13	18.31	1
Goffa Gebreal	12	16.91	2
Around Sar-bet	10	14.08	3
Mekanisa School	9	12.67	4
Sarbet-Mekanisa	7	9.85	5
Rink-road-Kebele 15/16	6	8.46	6
Adey Ababa	5	7.04	7
Goffa Kamp	4	5.64	8
Around Saris	3	4.23	9
Mekansa alcohol Factory	2	2.81	10
Total	71	100.0	-

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

Although the number of RTAs occurred were few relative to other sub-cities, the remaining hazardous sites are still important ones at the sub-city level and seek policy attention.

Major Traffic Accident Black-spots in Addis-Ketema Sub-city

This sub-city is the seventh in terms of total number RTAs and had 20 RTABSs as identified during the year specified. This was computed from the data obtained over the two years period (Jul., 2004 – Jun., 2006). Table8 shows the list of those RTABSs together with their total accident and rank orders in the intensity of the frequencies.

Table8: Major RTA Black-spots in Addis-Ketema Sub-city (Jul, 2004 -Jun, 2006)

Major ABSs	No. of Accident		%	Rank
	No.	Ave		
Around Bus station	134	67	12.57	1
Mesalemiya	106	53	9.95	2
Gijam Berenda	91	45.5	8.54	3
Sebategna Mebrat	91	45.5	8.54	3
Cinima Ras	76	38	7.35	4
Monalesh Tera	76	38	7.35	4
Near Square	56	28	5.25	5
Near Amanuel	56	28	5.25	5
Tekle-hayimanot	56	28	5.25	5
Near Amde	42	21	3.84	6
Kuwas meda	32	16	3.01	7
Post office	32	16	3.01	7
Adarash	32	16	3.01	7
Addid-ketema	29	14.5	2.62	8
Haile-giorgis Bridge	29	14.5	2.62	8
Kesel-tera to Chid Tera	27	13.5	2.52	9
Sefere Selam	27	13.5	2.52	9
Near Tana Tera	27	13.5	2.52	9
Chew Berenda	23	11.5	2.14	10
Arategna Police Station	23	11.5	2.14	10
Total	1065	532.5	100.	-

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

The minimum number set at the 10th rank was 11.5 on average around Arategna police station in this sub-city contributing to 2.14%, while the maximum number at the 1st rank constituted about 67 accidents i.e. 12.57%, around the Bus-station in the sub-city, of the total accidents in the black-spots. In between these were Mesalemiya (9.95%), Gijam Berenda (8.54%), Sebategna Mebrat (8.54%), Cinima Ras (7.35%), Monalesh Tera (7.35%), Near Square (5.25%), Near Amanuel (5.25%) and Tekle-hayimanot (5.25%) respectively which constituted the 2nd to the 5th rank in their frequency. Whereas, the areas near Made (%), Kuwas meda (%), Post office (%), Adarash (%), Addid-ketema (%), Haile-giorgis Bridge (%), Kesel-tera-to-Chid Tera (%), Sefere Selam (%), Near Tana Tera (%) and Chew Berenda (%) respectively constituted the remaining rank order of 6th to 9th.

Major Traffic Accident Black-spots in Akaki Sub-city

This sub-city is the eight in terms of total number RTAs and has 6 RTABSs as identified during the year specified. This was computed from the data obtained over one year (Jul., 2005 – Jun., 2006). Table9 shows the list of those RTABSs together with their total accident and rank orders in the intensity of the frequencies.

Table9: Major Road Traffic Accident Black-spots in Akaki Sub-city (Jul, 2005 -Jun, 2006)

Major ABSs	Total Accident		Rank
	No.	%	
Saris Abo	11	26.83	1
Cheralia Bscute Factory	8	19.52	2
Around Akaki Bridge	7	17.08	3
Near Gebriel	6	14.63	4
Akaki Health Station	5	12.19	5
Alem (World) Bank	4	9.75	6
Total	41	100	-

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

Akaki sub-city seems the least in its exposure to RTAs during the year specified. While the general principle to determine RTABSs in each sub-city in this study was selection of such black-spots up to the 10^{th} rank, in Akaki it was up to the 6^{th} rank because of negligible nature of accidents above the 6^{th} rank, all about 1 accident or zero. The 1^{st} rank was found to be 11and the last was set at 4. However, as there is a need for identification of RTABSs for each sub-city in Addis Ababa, relatively hazardous sites were chosen as indicated in Table9.

Major Traffic Accident Black-spots in Kolfe Sub-city

Kolfe sub-city is the ninth in terms of total number of RTAs and has 10 RTABSs as identified during the year specified. This was computed from the data obtained over one year (Jul., 2005 – Jun., 2006). Like Akaki sub-city, because of negligible number of accidents recorded, the accident sites above 5^{th} rank order were ignored. Table10 shows the list of those RTABSs together with their total accidents and rank orders in the intensity of occurrences. Kolfe sub-city was less exposure to RTAs during the year. This is why the RTABSs were determined taking maximum of 5^{th} rank order despite while the general guideline to determine RTABSs in each sub-city was selection of such black-spots up to the 10^{th} rank.

Table10: Major Road Traffic Accident Black-spots in Kolfe Sub-city (2005 -2006)

Major ABSs	Total Accident		Rank
	No.	%	
Zenebe-work Ring road	10	21.75	1
Ayer Tena	8	17.40	2
Repi Soap Factory	5	10.87	3
Atana Tera Bridge	4	8.69	4
Kara Kore	4	8.69	4
Holand Embasy	3	6.52	5
Near Natran Company	3	6.52	5
Koshi Sefer	3	6.52	5
Woira Sefer	3	6.52	5
Kolfe Keraniyo	3	6.52	5
Total	46	100.00	-

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

It is also one of the sub-cities in which low frequency of RTAs occurred. In general, within the sub-city, the area around Zenebe-work Ring road was the leading in RTAs with 21.75% followed by Ayer-Tena (17.4%), Repi soap factory (10.87%), Atana-Tera (8.69%) and Kara-Kore (8.69%). Each of the remaining black-spots (Holand Embasy, Near Natran Company, Koshi Sefer, Woira Sefer and Kolfe Keraniyo) as indicated on Table10 made up 6.52% and also need policy attention.

Major Traffic Accident Black-spots in Gullele Sub-city

Gullele sub-city is the tenth in terms of total number RTAs and has 6 RTABSs as identified during the year specified. This was computed from the data obtained over one year (Jul., 2005 – Jun., 2006). Because of negligible number of accidents recorded, the accident sites above 3th rank were ignored. Table11 shows the list of those RTABSs together with their total accident and rank orders in the intensity of the frequencies.

Table11: Major Road Traffic Accident Black-spots in Gullele Sub-city (Jul, 2005 -Jun, 2006)

Major ABSs	No of Accident		Rank
	No.	%	
Near Addisu Gebeya	4	23.53	1
Entoto Mariam Church	3	17.65	2
Alem Tsehay Brigde	3	17.65	2
Mene-Shiromeda	3	17.65	2
Medihanialem Church	2	11.76	3
Near Rufael	2	11.76	3
Total	17	100.00	-

Source: AATPO (July, 2005-June, 2006), Computed by the Author, 2012

Gullele sub-city is also the other one which was less exposure to RTAs during the year. This is why the RTABSs were determined taking maximum of 3th rank despite the general guideline to determine RTABSs in each sub-city was selection at the 10th rank. Anyways, the RTABSs identified need to be solved through some kind of policy intervention. The major RTABSs, according to Table11, include Near Addisu Gebeya (23.53%), Entoto Mariam Church (17.65%), Alem Tsehay Brigde (17.65%), Mene-Shiromeda (17.65%), Medihanialem Church (11.76%) and Near Rufael (11.76%) respectively.

As Peden et al (2004) and others stated, in recent years, there is an increasing problems of cities associated with road transport developments as a result of which RTAs have become their nightmares. Both economic and social consequences have been profoundly prevailing in cities of the world. The fact that RTAs seriously affect human life and economic development of a country as a whole and urban area of that country specifically has attracted scholars all over the world. This article, too, is written to show major specific accident spots in the city of Addis Ababa in order to contribute the findings from Addis Ababa, capital city of Ethiopia. The findings of the study are, therefore, their own contribution to sustainable urban transport development planning in the city.

In fact, sustainable urban transport planning requires identification of problems, specifically RTABSs, and suggestion of remedial solutions. Accordingly, the findings of study has clearly shown the major RTABSs in Addis Ababa that need serious planning, designing, implementation and management of road safety programmes in the city. In this regard, there is a debate on what types of urban form (as defined by land-use and transportation systems) are more sustainable as there is doubt whether certain urban forms are efficient in terms of automobile usage than others and whether current urban forms are sustainable in long run (Kennedy et al, 2005). Thus, to go through to lead urban centers toward a sustainable transport redevelopment, Kennedy recommends first to establishing performance measures that can then be used define sustainability objectives. This can be done by establishing sustainable transport indicators. Accordingly, Kennedy et al (2005) listed the central attributes of sustainable transportation performance measure as accessibility, health and safety, cost effectiveness, impacts on competitiveness and generation of wealth, consumption of natural capital and production of pollutants at local and global scale. Of these, the health and safety issues are the major concerns of this article for which planning should be made. The identification of hazardous accident locations, therefore, provides an insight to local sustainable transport planners especially focusing on those black-spot sites in the city.

CONCLUSION

The result of the study revealed RTABSs to be the feature of all sub-cities although there are differences in the concentration of accidents among them. In terms of total number of road crashes, some sub-cities that are located in the central parts of the city (such as Kirkos, Arada, Addiss-ketema, etc) exhibited larger number compared to others. This fact of variation in the actual number of accidents has no direct connections with the aim of identifying RTABSs in this study as it aims to indentify black-spots in each sub-city, not for Addis Ababa as a whole. The study identified the hazardous accident locations (black-spots) for each sub-city which solved the problem of identifying for Addis Ababa as a whole and generalizing for all sub-cities (as done by National Road Safety Coordination office, NRSCO, 2005) as one geographical units ignoring the spatial variations. The identification of black-spots in Addis Ababa by NRSCO (2005) had generally masked the specific situation of each sub-city especially those sub-cities which are not centrally located and those which seemingly less exposure to road

accidents. However, these sub-cities, although experience relatively smaller number of accidents, have locations where road accidents occur more frequently than even those having largest numbers.

The findings of the study revealed that Kirkos, Bole, Arada, Yeka and Lideta sub-cities were the leading five in terms of the total number of road accidents while the second five were Nifas-Silk/Lafto, Addis-ketema, Akaki, Kolfe and Gullele sub-cities. Therefore, while the highest accident concentrations were located in Kirkos sub-city, the least was in Gullele sub-city. This rank order doesn't have connection with the nature of RTABSs identification as stated earlier. The assessment of RTABSs revealed that there were 125 hazardous black-spots in all sub-cities of Addis Ababa as identified by current study. It doesn't mean that these are the only ones rather they are the major ones. The distribution by sub-city shows that there were 10 ABSs in Kirkos, 11 in Bole, 24 in Arada, 10 in Yeka, 21 in Lideta, 10 in Nifas-Silk/Lafto, 20 in Addis-ketema, 6 in Akaki, 4 in Kolfe and 9 in Gullele sub-cities. However, if the minimum number of RTAs set to determine black-spots in the last three sub-cities (Akaki, Kolfe and Gullele) were employed to all sub-cities; several hundred black-spots would have been identified. In contrast, if the minimum number of RTAs used in the first three sub-cities (Kirkos, Bole and Arada) were equally considered, most of the black-spots identified in the subsequent sub-cities would have been ignored, which would have been similar with the identification of black-spots by the NRSCO (2005). The findings from the data in this study took the first 10 hazardous sites for each sub-city. The overall implication of the findings is that there is no lack of planning transport system in a sustainable manner in the city. This calls for the need for reminding transport authority to revise the city master plan and the road network as a whole mainly on those RTABSs identified. Thus, in each sub-city at each black-spot, there should be critical study of the causes/factors contributing to the incidence of RTAs. Such studies should be followed by the development and improvement of Road Infrastructures, improving traffic management system and law enforcement, traffic education for pedestrian and students, driver training and testing, and continuous inspection of vehicles perhaps monthly and special training programmes to drivers regularly. In general, appropriate traffic control system should be designed and implemented at each RTABS in each sub-city if the incidence of accident is to be reduced significantly in the city.

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