BLACK POINT ANALYSIS OF TRAFFIC ACCIDENTS: 2015
ERZURUM CITY CASE

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Abstract- Determining the points where traffic accidents frequently happen is one of the parameters that is used for urban transportation planning process. The points where accidents frequently happen are called the “black points” of urban transportation. These points can be identified by Geographic Information System (GIS), which is a technology widely accepted by researchers who study on physical planning. In this study, Erzurum’s “black points” are identified by using the official accident reports for 2015. With this data, the city’s urban transportation policies and decisions are evaluated by using GIS. The findings of this study will provide the necessary data for local governments to decrease traffic accidents.

Keywords- Erzurum, Transportation Planning, GIS, Density Analysis, Traffic Accidents

I. INTRODUCTION

Today, the rapid increase in the accumulation of population in urban areas and hence increasing number of motor vehicles result in transportation network systems that cover large areas of urban spaces. For transportation, travel time became more important than distance. In this sense, urban transportation planning is an important phenomenon to focus on in order to create healthy cities in sustainable environments (Karakaş et al. 2009). When the environmental impacts of traffic is analyzed, noise and air pollution are in the most important place. The noise that occurs because of the use of motor vehicles is mostly derived by the vehicles’ engines, exhaust pipes, and suspension (Güvenal and Cabuk, 2005; Özden and Canarslan, 2005; Kocaman and Elbeyli, 2011). The increase of transportation demand resulted in an increase on number of vehicles, as a result of this, the number of traffic accidents increased as well. The main factors that cause traffic accidents can be listed as human factor, road, vehicle, and environmental conditions (Kabakuş et al. 2012). Traffic accidents are one of the most important problems of our country, as it the case all around the World. According to several studies, traffic accidents cause social and economic loss more than natural disasters (Yılmaz et al. 2007). According to Saphiloğlu and Şahin (2010), 40-60% of traffic accidents in our country occur in urban and rural road intersections. In addition, the results of international researches show that the traffic accidents occur in the intersections comprises 50% of urban and 30% of intercity accidents (Kuciemba and Cirillo, 1992). In Turkey, accidents are analyzed through traffic accident detection reports. Accident detection reports are kept by the officials right after the accident. In these reports, a collision diagram that shows how that accident happened is drawn as well as some other information such as the location where the accident happened and the number of vehicles involved in the accident is written (Yılmaz et al. 2007). In compliance with the information obtained from the accident reports, in order to identify the locations where accidents frequently occur, if three or more accidents occur in one location for the same reason, this location is called “black point”. According to Homburger and Kell (1981), one location can be called a “black point, if four or more accidents occur in one year in that location.

In this study, the locations of the “black points” are identified by examining the traffic accident report of Erzurum for 2015. Additionally, the weather and road conditions along with the vehicles involved in accidents are analyzed. Finally, recommendations for decreasing the number of accidents in Erzurum are presented

II. DETAILS EXPERIMENTAL

2.1. Materials and Procedures

Erzurum is located in the northeastern part of Turkey at an elevation of 1850 meters and 39.57 N, 41.10. The city has a surface area of 25,066 km², being the 4th largest city and covering 3.2% of the country’s whole area. Erzurum Plain’s bowl-shaped area covers 825 km². Erzurum is also surrounded by several high mountain series (see Figure 1). According to 2011 Census, Erzurum Province had a population of 780,000 (TUİK, 2009).

GIS has been used in recent years to analyze traffic accidents (Karasaşin and Terzi, 2003; Velavan, 2006; Yılmaz et al., 2007; Kabakuş et al., 2012). In order to analyze the spatial features of traffic accidents (date and time of accident, road information, weather conditions, number and type of vehicles involved in accident, number of death and injured), it is possible to identify the hazardous
locations (black points) by transferring data to GIS and matching the spatial features.

Figure 1. The Location of Erzurum

In this study, 563 traffic accident detection reports of Erzurum for 2015 have been analyzed. In these 563 accidents, 4 people died and 559 are injured. These reports are issued by the Governorship of Erzurum, City Police Department, and Traffic Registration and Inspection Department. The data gathered from the accident reports are transferred to ArcGIS 10.1 software and the black points are identified, which allowed us to perform statistical and spatial analysis.

III. RESULTS AND DISCUSSION

Erzurum is located on the intersection of highways that connect the surrounding cities through Erzincan-Kars, Bingöl-Artvin and Ardahan highways. The ease of access to eastern cities of Turkey from Erzurum and being a regional attraction point moves Erzurum to a higher level in terms of trade. Currently, it is still the case for Erzurum and highway transportation has an important part on this success. Inner-city transport network of Erzurum consists of three major axes that are listed below (Figure 2):

- North Freeway and 50. Yıl Avenue,
- Cemal Gürsel and Cumhuriyet Avenue in central city, and
- South Freeway, which is located between the University and Karskapı (Anonim, 2016)

The data gathered from the accident reports for 2015 made it possible to identify the reasons of accidents by using GIS software. Figure 3 spatially shows the accidents happened within the city limits of Erzurum in 2015. In order to identify the locations where accidents frequently happen, point coordinate base was created in accordance with the National Coordinate System (ED-1950-UTM-Zone-37N) and then ArcGIS software’s “Spatial Analyst Tools/ Density /Point Density” module was used.

Figure 3. Traffic Accident Locations (2015)

Density maps show the level of density in one point, in other words shows the concentration levels. Two methods can be used to calculate density: simple and kernel. In both methods, circular or detection areas are used to calculate density (Anonim, 2014).

Based on the analysis performed, accidents happened in 2015 are analyzed in three metrics as first degree, second degree, and third degree accident density locations. According to the density of traffic accident analysis (Figure 4);

Figure 4. Traffic accident density analysis (2015)

The results show that Erzincan-Erzurum Highway (E80), University Intersection has the highest accident density (Figure 5). Forum Erzurum Shopping Center has the second highest accident density. This point is one of the heavily used areas with high traffic volumes, where Yavuz Sultan Selim Avenue and Erzurum Yenişehir Road intersects (Figure 6).
CONCLUSIONS

Traffic is one of the important problems of Turkey and this can be seen by considering the number of traffic accidents and deaths and injuries as a result of these accidents. Moving far from the central city and having longer and increased number of commutes are other reasons for traffic accidents. In modern day cities, road can be considered as a scarce source and this scarcity makes it more precious. Especially in developed areas, it is almost impossible to add more roads. In developed city centers, where the demand for access is higher, it requires huge amounts of resources to construct new roads. Number of vehicles on roads is increasing every day and to solve this problem, most commonly used method is to increase the capacity of the road system. Every road added creates its own demand and does not actually solve the traffic problems, conversely increases the traffic volume. As a result, greenhouse gas emission, noise and air pollution, and number of traffic accidents increase (Kocaman and Elbeyli, 2011).

As shown on the maps above, traffic accidents are most frequently happen on intersections. In general, University Intersection as the backbone of city traffic, and Erzurum Forum Shopping Center are the two locations where higher numbers of accidents happen. For an healthy and sustainable transport system for Downtown Erzurum, transportation behavior needs to change towards public transit systems and other alternative modes, such as walking. In order to do that, sidewalks should be improved and better paved for better and safe access. Additionally, the challenges of disabled persons should be addressed.

In conclusion, urban transportation has several dimensions that involve different disciplines and these features should be considered in transportation planning process in order to give a sustainable direction to the future of the city. Therefore, all sectors and stakeholders should be included and coordinated both during and after the planning processes.

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