

Investigation of Traffic Accidents in The City Center of Sanliurfa by Using GIS

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ARTICLE INFO

RESEARCH ARTICLE

Received:

Reviewed:

Accepted:

Keywords:

Sanliurfa,
 Accident,
 Accident Analysis.

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ABSTRACT

The loss of life and material caused by traffic accidents all over the world are important problems. Research and studies conducted for the solution of the problem affecting the society reveal the results of urban planning, increasing and improving the divided roads, the use of traffic signals, improving the awareness level of drivers, pedestrians, and passengers in traffic, and increasing the safety equipment of the vehicles. In recent years, the black spots of traffic accidents have been determined by interpreting the spatial analysis of the accidents with the use of GIS. Thus, it was possible to take preventive measures by identifying the points where accidents were concentrated.

In this study, accident blackspots were determined using hot spot analysis of traffic accidents that occurred in 2019 in Eyyubiye, Haliliye, and Karakopru districts of Sanliurfa city center, and it was aimed to develop solutions to reduce accidents. In this direction, traffic accident reports for the year 2019 of Eyyubiye, Haliliye and Karakopru districts, which are the central districts of the city of Sanliurfa, were obtained from the General Directorate of Security to be used in the study. According to the findings obtained in the study, 1626 traffic accidents occurred at the study site in 2019. While most of these accidents occurred in October, the most common day was Thursday. The time zone between 16:00 and 17:59 during the day is the period with the highest accident density. Looking at the accident blackspots; Abide Junction, D-400 (east-west), E-99 (north-south) highways, and Bamyasuyu and Bahcelievler neighborhoods were seen as the areas where the black spots of the accident were concentrated. As a result of the study, it is understood that traffic accidents are concentrated in certain regions and a certain period. To reduce traffic accidents in Eyyubiye, Haliliye and Karakopru districts, which are the central districts of the city of Sanliurfa, measures should be taken to reduce accidents at these time intervals. However, increasing the traffic signaling systems on the roads in the regions where accidents are determined to be intense, maintenance and widening of the roads are very important in reducing the number of accident black spots.

ÖZ

Anahtar Kelimeler:

Şanlıurfa,
Kaza,
Kaza Analizi.

Tüm dünyada meydana gelen trafik kazaları sonucunda oluşan can ve maddi kayıp önemli bir sorundur. Toplumı etkileyen sorunun çözümü için yapılan araştırma ve çalışmalar, şehrsel planlamanın yapılması, bölünmüş yolların artırılması ve iyileştirilmesi, trafik sinyalizasyonların kullanımı, trafikte yer alan sürücü, yaya ve yolcularının bilinç seviyelerinin eğitimle geliştirilmesi ile araçların güvenlik donanımlarının artırılması sonucunu ortaya koymaktadır. Son yıllarda, CBS kullanımı ile kazaların mekânsal analizleri yorumlanarak trafik kazalarının kara noktaları belirlenmiştir. Böylece kazaların yoğunlaştığı noktalar belirlenerek önleyici tedbirler alınması mümkün olmuştur. Bu çalışmada Şanlıurfa şehrinin merkez ilçeleri olan Eyyübiye, Haliliye ve Karaköprü ilçelerinde 2019 yılında meydana gelen trafik kazalarının CBS yardımıyla hot spot analizi kullanılarak kaza kara noktaları tespit edilmiş, kazaların azaltılması için çözüm yolları geliştirmek amaçlanmıştır. Bu doğrultuda Emniyet Genel Müdürlüğü'nden, çalışmada kullanılmak üzere Şanlıurfa şehrinin merkez ilçeleri olan Eyyübiye, Haliliye ve Karaköprü ilçelerine ait 2019 yılı trafik kaza tutanakları elde edilmiştir. Çalışmada elde edilen bulgulara göre çalışma sahasında 2019 yılında 1626 trafik kazası meydana gelmiştir. Bu kazalar en çok Ekim ayında gerçekleşirken, en çok gerçekleştiği gün ise perşembe olmuştur. Gün içerisinde 16:00- 17:59 saat dilimi kaza yoğunluğunun en fazla olduğu zaman aralığıdır. Kaza kara noktalarına bakıldığında; Abide Kavşağı, D-400 (doğu-batı), E-99 (kuzey-güney) karayolları ile Bamyasuyu ve Bahçelievler mahallesi kaza kara noktalarının yoğunlaştığı sahalar olarak görülmüştür. Çalışma sonucunda trafik kazalarının belirli bölgelerde ve belirli bir zaman aralığında yoğunlaştığı anlaşılmaktadır. Şanlıurfa şehrinin merkez ilçeleri olan Eyyübiye, Haliliye ve Karaköprü ilçelerinde meydana gelen trafik kazalarını azaltmak için belirlenen bu zaman aralıklarında kazaları azaltacak önlemlerin alınması gerekmektedir. Bununla birlikte kazaların yoğunlaştığı belirlenen bölgelerdeki yollar üzerindeki trafik sinyalizasyon sistemlerinin artırılması, yolların bakımı ve genişletilmesi, kaza kara noktalarının sayısını azaltmada çok önemlidir.

1. Introduction

Due to the increase in the population over the years in Turkey, the traffic density has also increased. In this context, especially in cities with high population density, the increasing traffic problem and loss of time due to the variety and number of vehicles providing transportation have become one of the most important problems. The reflection of the information and technological developments that have developed in recent years on the transportation process and the development of the welfare level have also been effective in the increase in the number of individual vehicles. According to the March 2021 Turkish Statistical Institute (TUIK) [1] report, the number of Motor Land Vehicles registered to traffic in Turkey was announced as 24,454,396 at the end of March. 54.4% of these vehicles were automobiles, 16.3% van, 14.5% motorcycles, 8.1% tractors, 3.5% trucks, 2.0% minibuses. Busses constitute 0.9% and special purpose vehicles constitute 0.3%. The length of the highway under the responsibility of the General Directorate of Highways is 95279 km as of 01.01.2021 and 26646 km of it consists of divided roads. When we look at the data, due to the high number of vehicles and the length of the highway in Turkey, the most popular transportation choice is the highway. Consequently, the use of the highway made it inevitable to increase the traffic density [2] to the highway traffic law, all incidents that result in injury, loss of life, material and moral damage caused by one or more vehicles in traffic are called traffic accidents. The fact that most of the transportation movements are provided by the highway [3] and the traffic density causes the high number of traffic accidents occurring on the highway.

Due to the high number of traffic accidents, public damages, material damages, injuries, and loss of life are constantly in the memory of the society and the situation reaches extremely worrying results [4]. Accident victims are injured both financially and physically, and the economy of the country is also seriously damaged. Approximately 1 million people die each year in the world, and between 20 and 30 million people are injured [5]. Therefore, it has become a necessity to carry out research and studies to reduce accidents.

Improvement studies on 28 black points determined as a result of the studies carried out by the General Directorate of Highways in the Turkish highways network are continuing [6]. However, black spots obtained due to the results of urban accidents are not shown in the road network because they are within the duties and powers of different units. For this reason, there are deficiencies in transferring the potential accident zones and black spots found as a result of accident studies in urban roads to digital and map environments. Analyzing traffic accident studies across the country, creating a general database that includes urban roads, and analyzing solutions will make an important contribution to the reduction of traffic accidents [7]. Attention is paid to traffic engineering and road planning to solve problems in road networks that are complex to develop. In this context, the lower number of accidents compared to other countries can be shown as traffic success in developed countries [8].

As a result of the increasing technological developments in recent years, the increase in advanced software and programs provides analysis opportunities to eliminate many problems. In this context, Geographical Information Systems (GIS), which enables the application of various analyzes and examine the results, has been used in many service activities. With the geographical information systems, accident areas can be determined in detail and solutions can be produced for taking measures by analyzing the results. For example, Thieman implemented his project for the city of Cheyenne, where he determined black spots using the Geographical Information System (GIS) using accident data [9]. The point to note here is that all accident-related data are as detailed as possible and convenient for interpretation in geographic information systems [10]. Furthermore, as a result of the recent technological advances, the use of software such as GIS plays a role in city planning and the fiction of development aspects. These developments also affect the form and direction of city transportation [11].

Spatial analyzes made with the increasing use of GIS in Turkey have been used in accident analysis in recent years and applications of many disciplines have taken place in the literature. In this context, accident analysis of three districts in Urfa province was conducted to contribute to the literature numerically. In this study, using geographical information systems (GIS) where advanced spatial analyzes can be made and accident data in Eyyubiye, Haliliye, and Karaköprü districts of Sanliurfa central districts, the black spots where traffic accidents occur were determined. With the accident analysis and evaluation of the results, it is aimed to reduce the number of accidents and determine the direction of transportation.

2. Material and Method

Our field of study is the city of Sanliurfa, located in the Middle Firat of the Southeastern Anatolia Region (Map 1). Since the city of Sanliurfa is at the intersection of east-west and north-south roads, there is a constant traffic of vehicles. In the city of Sanliurfa, which is on the transit route of both cars and large tonnage vehicles, it is inevitable to experience traffic jams especially in recent years, and due to this density of vehicles, many accidents with fatalities and injuries occur.

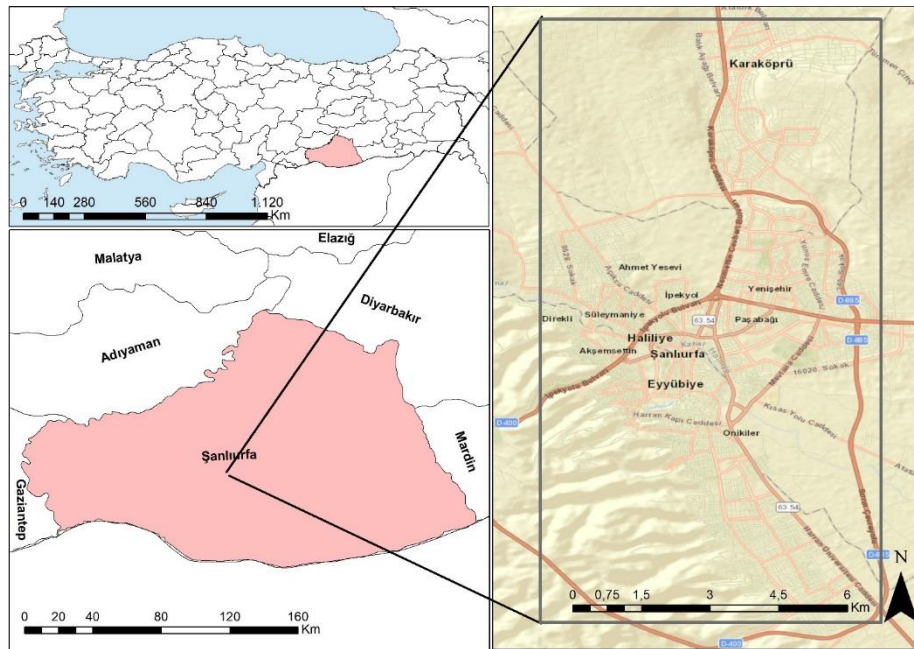


Figure 1. Study Area Location Map

Geographical Information Systems can classify and interpret data with many analyzes made on accidents, as in every field, thanks to its existing analyzes. Many different methods are used for accident analysis. Hot spot analysis is the most used of these methods and gives the most accurate results. In the hot spot analysis, Getis Ord uses G^* statistics. Getis Ord G^* can detect areas where spatial clustering is high and low. In our study, spatial clustering and densities of accident points were determined with hot spot analysis. If the G^* value obtained as a result of the calculations in Getis Ord G^* is positive and the z value is greater than the z_{α} value, it is accepted that the higher values are aggregated or if the G^* value

is negative and the z value is smaller than the za value, the lower values are aggregated [12]. The Getis Ord G^* calculation is as follows:

$$G = \frac{\sum_{i=1}^n \sum_{j=1}^n w_{i,j} \cdot x_i \cdot x_j}{\sum_{i=1}^n \sum_{j=1}^n x_i \cdot x_j}$$

D: Neighborhood distance

W: Weight matrix

i and j attribute information of its objects

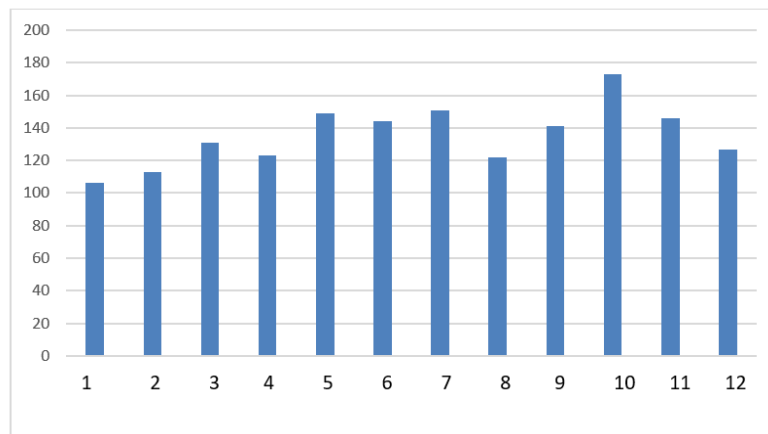
N: It is expressed as the number of objects in the layer.

In the study, the data of fatal and injured traffic accidents taken from the General Directorate of Security Traffic Branch Directorate of 2019 were used. As of 2019, 1626 accidents have occurred in the city of Sanliurfa. In these accidents, the attribute information of the month, day, hour, the result of the accident (fatal or injured), etc. information is included. Interpreting and evaluating this information is very important in analyzing accidents.

3. Findings

When the monthly distribution of the accident data for 2019 in Eyyubiye, Haliliye and Karakopru districts, which are the central districts of Sanliurfa, is examined, the highest number of accidents occurred in October with 173. After October, July is the second month with the highest number of accidents with 150 accidents. It is then ranked with 148 accidents in May and 146 accidents in November. The month in which the least accident occurred is January with 106 accidents. As can be seen, the accidents mostly occurred in the summer and autumn months. The reason for the high rate of traffic accidents in this period was evaluated as the effect of the drivers being overwhelmed by the hot weather and not obeying the traffic rules.

Table 1: Distribution of the accidents that occurred in Sanliurfa in 2019 by months

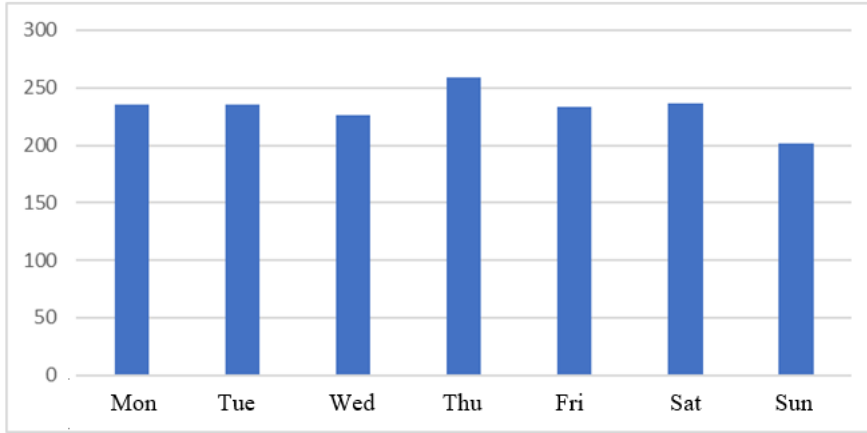


Source: General Directorate of Security Traffic Inspection Branch, 2019.

When we look at the days of traffic accidents, it was seen that the most accidents occurred on Thursday with 259 accidents. Then Saturday with 236 accidents and Monday and Tuesday with 235 accidents each. The day with the lowest number of accidents was on Sunday, with 202 accidents. When we look at the total accident data, it is seen that more

accidents occur on weekdays compared to weekend days. This situation can be interpreted as the traffic is more intense due to the higher number of employees on weekdays.

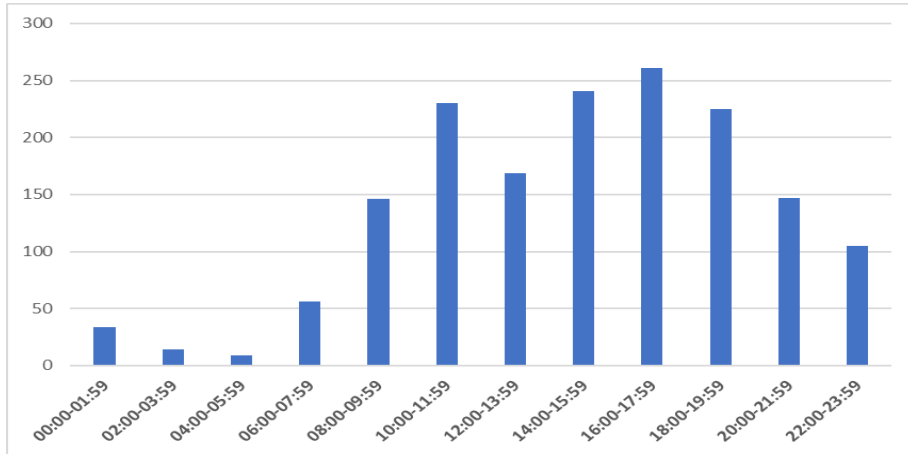
Table 2: Distribution of the accidents that occurred in Sanliurfa in 2019 by days



Source: General Directorate of Security Traffic Inspection Branch, 2019.

Examining the distribution of traffic accidents according to time zones during the day, it was seen that the highest number of accidents occurred between 16:00 and 17:59 with 261 accidents. After this time zone, it occurred in the 14:00-15:59 time zone with a maximum of 241 accidents. The time zone with the least accidents is 04: 00-05: 59 with 9 accidents. When accident data are analyzed, it is observed that traffic accidents in the districts mostly occur in the afternoon. It is seen that the reason for being in this time zone is the effect of the intensity that occurs at the end of work.

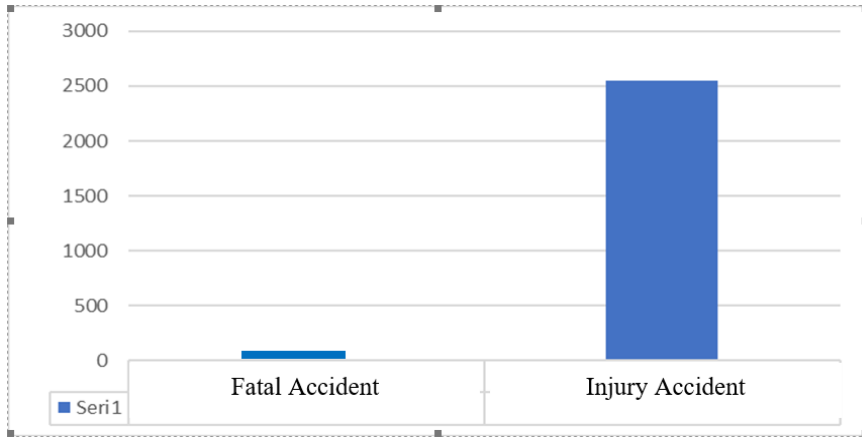
Table 3: Distribution of the accidents that occurred in Sanliurfa in 2019 by periods during the day



Source: General Directorate of Security Traffic Inspection Branch, 2019.

According to traffic accident data, 1616 accidents were injured in 1626 accidents that occurred, resulting in material damage, and 2551 were injured in the accidents that occurred. In 10 accidents, 10 people died in addition to material damage (Table 4).

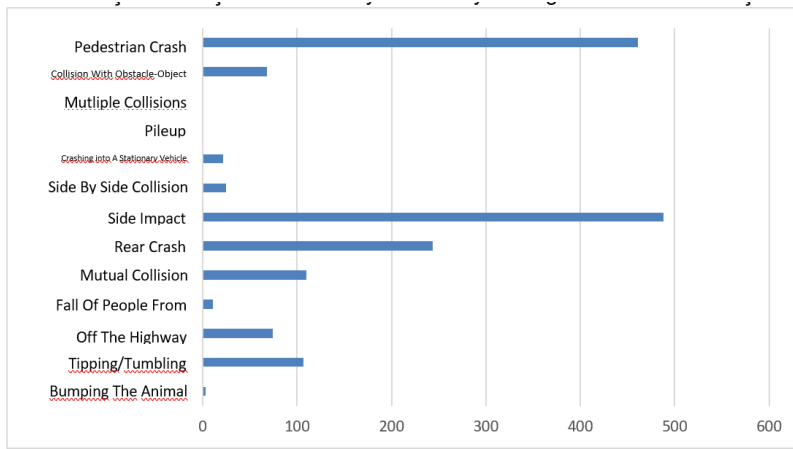
Table 4: Distribution of Sanliurfa City according to the results of the accidents that occurred in 2019



Source: General Directorate of Security Traffic Inspection Branch, 2019.

When the accidents are analyzed according to their occurrence types, it is seen that there are accident types in 13 categories. The highest of these is the side impact. Subsequently, pedestrian collision, rear-end collision, mutual collision, roll-over / overturn, run out of the road, collision with obstacle-object, collision with an obstacle-object, collision with a stationary vehicle, human fall from the vehicle, animal collision, and chain accident-multiple collisions (Table 5).

Table 5: Formation type of the city of Sanliurfa accidents in 2019



Source: General Directorate of Security Traffic Inspection Branch, 2019.

Looking at Map 2, it is seen that the accidents are concentrated on the main roads. Especially at the Abide junction, where the east-west and north-south roads intersect, it is seen that the accidents are very intense. Apart from this, it is seen that the accidents are concentrated at small and large intersections. This, in particular, has a direct link with the number of vehicles and traffic density. It is observed that the accident density from the intersections towards the periphery has decreased. The accidents appear to be concentrated linearly on the D-400 (1) highway (east-west), and E-99 (2) (north-south). Apart from this, it is seen that there are Bamyasuyu (3) and Bahcelievler (4) neighborhoods, which are the areas

where the human circulation is the most intense. The high number of accidents in these areas is due to driver and pedestrian carelessness, violation of traffic rules, and excessive human circulation.

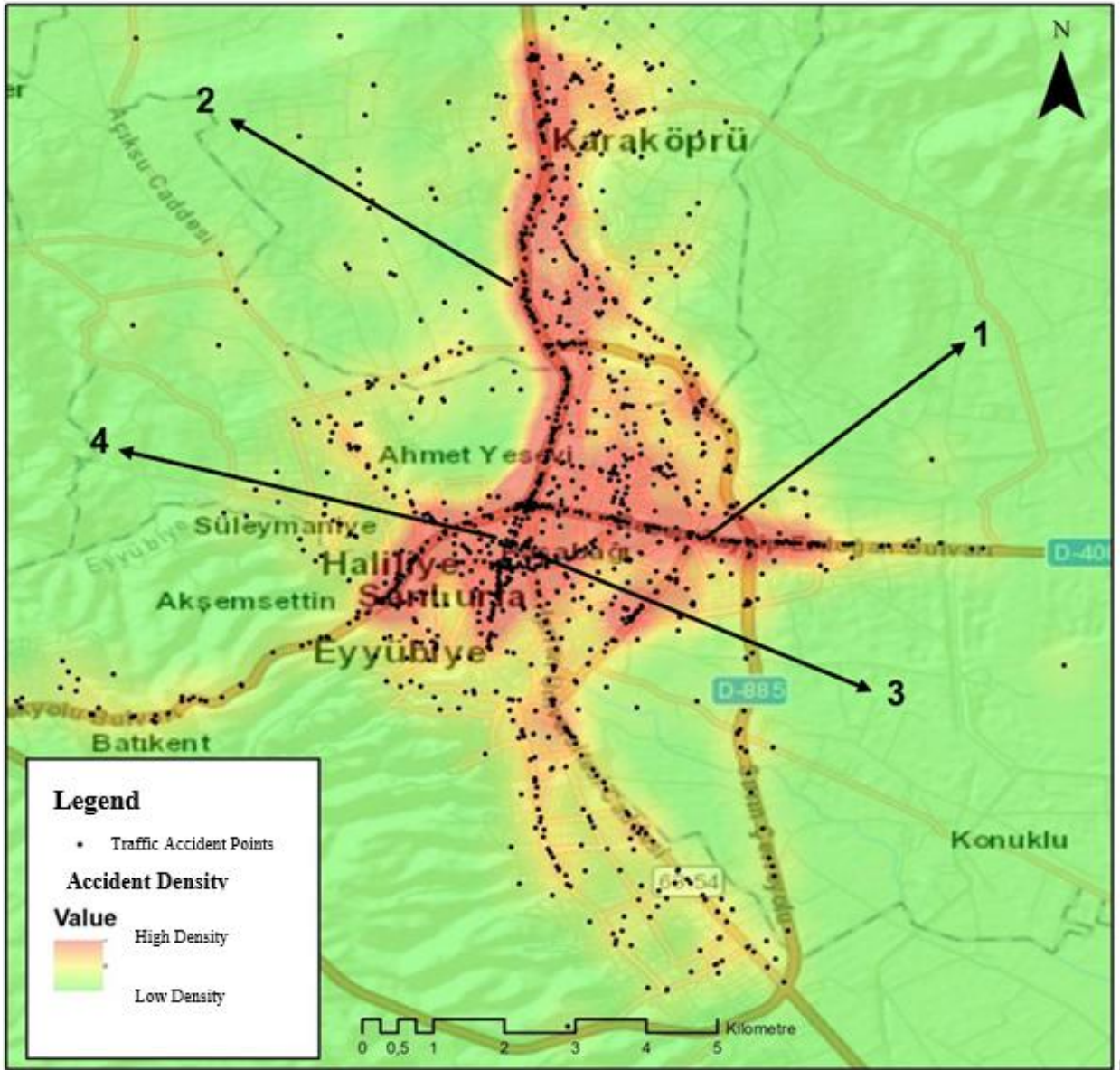


Figure 2. Traffic accident density map that occurred in the city of Sanlurfa in 2019.

4. Results

As a result of the increase in the number of vehicles in traffic due to the increase in population density, the number of traffic accidents has increased both in the world and in Turkey. It has been observed that the number of traffic accidents that occurred has increased quantitatively, according to the data of fatal and injured traffic accidents received from the General Directorate of Security Traffic Branch Directorate of 2019. Even if it is difficult to prevent the occurrence of

traffic accidents, it is aimed to reduce the intensity of traffic accidents as a result of the studies and researches and to reduce the number of accidents to the lowest possible number by raising the awareness of the drivers.

A large number of black spots were determined by hot spot analysis in the study area also concentrated on the roads on the intersections, narrow avenues, and streets. Consequently, taking into account the data and as a result of the interviews with the authorities, driver errors are observed in most traffic accidents. Accordingly, it is seen that drivers' carelessness, rule violations, and excessive speed accidents occur. According to the accident data that occurred in the districts in the study area, vehicles such as automobiles and motorcycles were mainly involved in the accident. When we look at the data in 2019, it is seen that the most accidents occurred in 16: 00-17:59 time zones. Traffic accidents are seen due to the increase in traffic density due to the end of working hours of public and private institution employees. Apart from that, the most intense accidents occurred between 14: 00-15:59 on weekdays. The reason for this can be seen as the departure time of the schools in provincial and district centers after 14:00. The increase in the density of student services causes traffic and accidents to occur. Deformed divided roads and two-way roads in the work area increase the accident rate. In this context, repairing the deformed parts and performing the necessary asphalt works will contribute to the reduction of accidents. Moreover, it is necessary to build sets that will prevent pedestrians from using the vehicle road on the road routes where heavy traffic occurs. Thus, stopping or slowing down of the traffic will be prevented and pedestrian crashes will be prevented. This situation makes it obligatory to construct underpasses or overpasses depending on the building suitability in areas where pedestrians should not use the road. In addition, it should not be forgotten that there should be ramps or elevators in places with underpasses or overpasses for our disabled citizens. During rush hour traffic control points should be established, roundabouts should be enlarged if possible or blind spots should be reduced by placing mirrors. Likewise, the roads that need to be measured can be determined and traffic accidents due to excessive speed can be prevented. Preventing grazing of animals by installing wire fences at points close to highways will prevent loss of life or property in a possible traffic accident. Since giving traffic education lessons starting from the primary education level will increase traffic awareness in students, it will contribute to the reduction of driver errors in the future. On the other hand, depending on the advancing technology, the use of devices such as drones will allow traffic teams to intervene quickly and prevent loss of time.

Competing Interest / Conflict of Interest

The authors declare that they no conflict of interest. None of the authors have competing interests in the manuscript.

Funding

There is no financial support and commercial support.

Acknowledgements

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