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Determination of Flood Plains through GIS (Geographical Information Systems): The Sample of Silivri District

Fatih Aydin*, Osman Çepni, Betül Ilhan

Karabuk University, Faculty of Letters, Karabuk, Turkey

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Abstract: Silivri, a district within the borders of Istanbul, is an open area against the natural disasters such as earthquake and flood. The district is located on the second and the third seismic belts. In consequence of the flood which occurred in 2009, many dwellings were damaged and this flood disaster caused many losses of lives. The housings, within the floodplains, increased between the years of 1980-1990. In this process, there is almost no free space between Highway D-100 and the Sea of Marmara. Concordantly, Silivri was imprisoned within this narrow space in this period. When we look at the 2000s, we see dense housings in the floodplains of Boğluca Stream. In this period, the first of the two big flood disasters has happened in consequence of overflowing of Tuzla and Boğluca streams in 2007. The second one has happened in 2009 and caused financial losses as well as losses of lives. In this study, the risk analysis of the occurring overflows and the risk of changing into natural disasters of these overflows taken place in the district will be investigated while the risk analysis belonging to the overflows occurring in the district is carried out by benefiting from the methods and the techniques of Geographical Information Systems (GIS). In the scope of the study, the aim is to determine the extents of the overflow risks and the areas-at-risk in the district, to identify the places which may be affected most by an overflow within those areas that are under the risk and correspondingly, to reveal which measures might be taken against these disasters. In accordance with this study, the maps regarding overflow risks are formed by benefiting from physical maps, slope, aspect, and the principle of superposition. As a result of the examinations that has been made, it is determined that Tuzla and Boğluca streams have affected the housings in the area between the Sea of Marmara and Highway D-100 in consequence of the sudden overflows. These streams have to be reformed and closed for zoning of the areas which are not suitable for settlement. In this context, it is necessary to do the required planning.

Keywords: Overflow, streams, Geographical information systems, Silivri

Introduction

As the return of living in an age, in which technological improvements are accelerating, increasing industrial activities are causing breaking down of the ecological balance and destroying of the natural resources swiftly. As a result of this, the natural events are reaching up to the extent of calamities and making way for financial and emotional damages. The disrupted ecological balance has a tendency to renew itself and establish the balance again. While the nature wants to renew herself, it gives damage to human and the activities that he/she has made. As a result of this, the events, called natural disasters, are taking place. The natural disaster which is called overflow is also one of them.

The difference between flood and overflow is as follows;

The most common reason of flood is the severe and lasting rainfall. Floods may take place as a result of intense flows occurring in consequence of snowmelt or the blockage of drainage channels. In case of an overflow, the current amount of water in a stream/river bed is rapidly increased by the amount of rain when it is too much for the basin or by the melting of snowpack and giving damages to the livings, terrains, goods and properties around the bed. The event of overflow is taking place after the long-lasting, extreme and severe rainfalls especially in the fields that are impermeable and have very much slope. Furthermore, within the basins, in which snowfall is intense, the melting of snowpack causes overflows in consequence of sudden temperature increases and affects the flow rates of the overflows too. The most dangerous overflows take place when the two factors occur simultaneously and the water covers the two sides of the bed at the same time. Another factor which

Corresponding: E-Mail: fatihaydin@karabuk.edu.tr; Tel: +90370 433 82 94; Fax: +90370 43382 64

affects the occurring of overflows is the dominant rainfall regimes (Turkish State Meteorological Service [TSMS], 2017).

It is not possible to express the overflow calamities as depended just on the meteorological settings. Especially in the countries in which economic development activities are going on densely such as Turkey, urbanization comes along by the variety of industries and sectors. This urbanization activity is increasing the density and variety of people's activities living in different parts of the stream basins on a large scale. This situation breaks down the hydrologic balance in the whole basin and consequently, the natural disasters, which cause vast amount of losses of lives and finance, are experienced. With the settlements growing within the stream basins, such as the opened new roads, and established new facilities, the structure of the terrain is changing. The soils are used more densely with ineligible agricultural methods. The forests and pastures are destroyed. Under all these conditions, the overflow calamities are taken place to larger and more frequent extent (Özcan, Musaoğlu & Şeker, 2009).

When we examine the rainfall data in our country during the recent years, we see an irregular distribution. It is determined that there is a great increase in the loss of lives and finance caused by overflows today. The most fundamental reason of this is growing population density, irregular housing and urbanization.

Under the natural conditions, stream beds cannot cause overflows in the extreme. But the streams, of which beds are narrowed by human intervention and which has been taken into the channels, lead to more overflows. The main reasons of overflows are constriction of stream beds, inclusion into channels and the complete destruction of their flow areas from place to place by minimizing these flow areas for shanties and other using purposes in consequence of incorrect zoning practices and wrong using of terrains (Karakuyu, 2002).

Day by day, we see that human population is growing. Extremely increasing urbanization in the recent years causes both climate abnormalities and the increasing number and effects of overflows. Besides, with the effect of urbanization and housing, the rate of rainfalls got mixed into the soil is decreasing as a natural consequence of urbanization. This situation causes the decreasing of runoffs and ground water levels. Correspondingly, by the reason of bringing overflows together, runoffs cause loss of lives and finance to a great extent (Karakuyu, 2002).

As the day goes on, the numbers of people that are affected by the stream overflows are increasing. Intense field usages in the overflow areas cause the increase of the overflow damages. Across the globe, 80 million people are affected by overflows every year and the financial damages over 11 million dollars are taking place annually. By 1970s, the number of overflows was 50. It reached up 100 by 1990s and in the recent years, overflow calamities occur in most parts of the world by exceeding these records (Ozsahin, 2013).

It is not possible to express the overflow calamities as depended just on the meteorological settings. Especially in the countries in which economic development activities are going on densely such as Turkey, urbanization come along by the variety of industry and sector. This urbanization activity is increasing the activity and density variety of humans which lives in different parts of the stream basins on a large scale. This situation breaks down the hydrologic balance in the whole basin and consequently, the natural disasters, which cause vast amount of loss of lives and finance, are experienced. With the settlements growing within the stream basins, the opened new roads, and established new facilities, the structure of terrain is changing. The soils are used more densely with ineligible agricultural methods. The forests and pastures are destroyed. Under all these conditions, the overflow calamities are taken place to larger and more frequent extent (Özcan, Musaoğlu & Şeker, 2009).

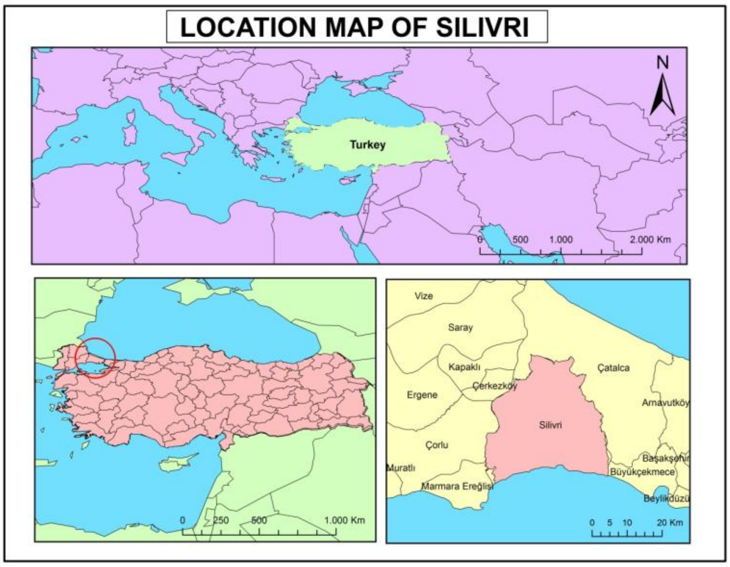
The event of flood and overflow is seen most in spring, summer and winter months in Turkey. %52 of the events of flood and overflow is in the Black Sea Region and the Mediterranean Region and the Marmara Region are following it. The events of flood, which occur in our coastal regions mostly, are effective in the areas in which natural balance is spoiled by human intervention with the excessive precipitation. Therefore, while many natural factors are becoming effective in the occurrence of flood, many human factors also play a crucial role in the transformation of flood into the calamity level (Özcan, 2006).

Silivri, a district within the borders of Istanbul, is an open area against the natural disasters such as earthquake and flood. The district is located on the second and the third seismic belts. In consequence of the flood occurred in 2009, many dwellings were damaged and this flood disaster has caused many losses of lives. In this study, we are looking for the answers of these questions:

1) What is the size of the risk regarding an overflow in Silivri district?
2) Which areas in the district are under the risk? Which places will be affected by these risk areas?
3) How many people would have been affected by the risk regarding an overflow?
4) What are the things to do and the measures to take in this respect?

The Place, the Limits and the Main Geographical Features of the Domain

The purport of the district is a harbour town located in the coast of the Sea of Marmara. According to the terrestrial coordinates, it is located between 41° 4 48.5688'' north latitudes and 28° 16'5.844'' east longitudes.



Map 1. The Location Map of Silivri District

It is known that its name was Selimbria in the ancient ages. Due to having a natural harbour and being on the crossroads of the important trade routes, it still keeps its significance. In the east part of the area, in which the present city is expanding through, there is Byzantine (Istanbul) and Perintos (Ereğli district of the Marmara region). In the place between these areas, the city was established on a steep hill which has 60 meters' height. In the ancient ages, Thrace, in which Selimbria was established, was surrounded by the Black Sea from the east, the Sea of Marmara and the Aegean Sea from the south, Nestos(Maritza) river from the west and the Danube river from the north (Doğan, 2009).

Silivri is located in Istanbul which has precious and extraordinary values within the body of itself. This situation makes Silivri a scene in which many dramatic events has happened throughout the history. Silivri is surrounded by the Sea of Marmara from the south, Büyükçekmece district from the east, Çatalca and Çerkezkoy districts from the north, Çorlu and Ereğli districts of the Marmara region from the west. It is involved in the approved master plan of Istanbul Metropolitan Area with the scale of 1/50.000. Although it is within the provincial borders of Istanbul, Silivri is involved in the area of ''Thrace Sub-Zone'' in terms of its physical, social and economic structure.

The purport of Silivri terrain consists of ridges and wavy planes divided by the streams which have 100-200 height in average. The lengths of those streams are around 15-25 kilometres and they flow into the Sea of Marmara in parallel with each other. The terrain of Silivri is square measure is 860 square kilometres, slightly rises starting from the coasts in the south towards the north. The height of the highest hill is not above 260 meters. Within the borders of Istanbul, Silivri's geographical location is the area between the northern parts of the Sea of Marmara and Marmara Ereğli district. Therefore, it is always settled in the history and its name remained the same. Silivri and it is around usually have an unspecific and low topography and the district can be examined as two different sections.

1) *The Area between Ereğli District of Marmara and Canta Neighbourhood*:The characteristic of this area is that it consists of a ridge which reaches out to Canta Neighbourhood located in the

southern part of Muratlı-Çorlu line. This ridge, reaching out to the sea parallelly, stops the wind coming from northeast to a certain extent.

2) *The Area between Canta Neighbourhood and Büyükçekmece*: The characteristic of this area is to have lower fields. In this case, the effect of the winds coming from mostly northeast is felt. Generally, this area is a moderately sloping land but it also has a perpendicular and globular lined topography from place to place.

The eastern part of Silivri starts from sea border and suddenly reaches up to 90-100 meters' height and at this height, a plain comes into existence. As for its western part, it reaches up to 40-50 meters' height in the London Asphalt (Highway E-5) by rising down from the sea, gradually. While the slope is generally between %5 and %10 in this area, in the direction of Silivri, Kavaklı and Selimpasa, there is a plain of which the slope is %5 (Akkaya, 2011).

In the region, the characteristics belonging to the climate of Thrace are seen, according to the classification of W. Köppen, the climate of Southern Thrace is characterized by the standard of the group of hot-mild-rainy climates. The characteristic of this climate type is being dry and hot in summers, chilly and rainy in winters. It is possible to have more information regarding the details of the region's climate by benefiting from the data of Tekirdag, Çorlu and Florya Meteorology stations that are in the same direction with Silivri on the coast of the Sea of Marmara.

The groundwaters in Silivri Region are generally in the alluvial fields and they have one meter depth. They create marshes on the surface from place to place. As for the area that consists of sand and sandstone, they pose a danger for bases of the buildings because of having 7-8 meters' depth. Around Celaliye, this depth is between 1-4 meters in accordance with the topographical conditions.

It is possible to run across cultivated plants in most part of Silivri region because of the presence of flatlands and having soil with good quality. Agricultural production consists of apple, pear, peach, sour cherry, quince, plum, apricot, fig, hazelnut, wild apricot, cherry, almond and white mulberry in the fields of vineyards and orchards. As for the fields in which dry farming is done, wheat, sunflower, corn, oat and onion are produced. The forests are located in the middle and northern parts of the district. In these forests, slim-bodied trees and shrubberies are in existence from place to place (Akkaya, 2011).

Silivri district is located in Highway D-100 and TEM(European Transit Highway) which are some of the important centre lines of Turkey. These roads are on the passing of the Bosporus. Thus, these roads link Silivri with both other settlements of Thrace and Istanbul metropolis. Also, some parts of Northern Marmara Highway, which is projected as a link road for the third Bosporus Bridge, is passing from Silivri. In addition to this, it is designed to make a highway project for passing from the Bosporus of Çanakkale starting from Silivri which a topic is starting to be important on the agenda. Kınalı Intersection, located in the western part of Silivri, is an important junction point which is a distributing point on the direction of Istanbul-Thrace and a meeting point on the opposite direction (Turan, 2013). According to data related to the year of 2016 from TUIK (Turkish Statistical Institute), 170.523 people, 92.892 men and 77.631 women, is living in Silivri district which has 86.881 hectares (TUIK, 2016).

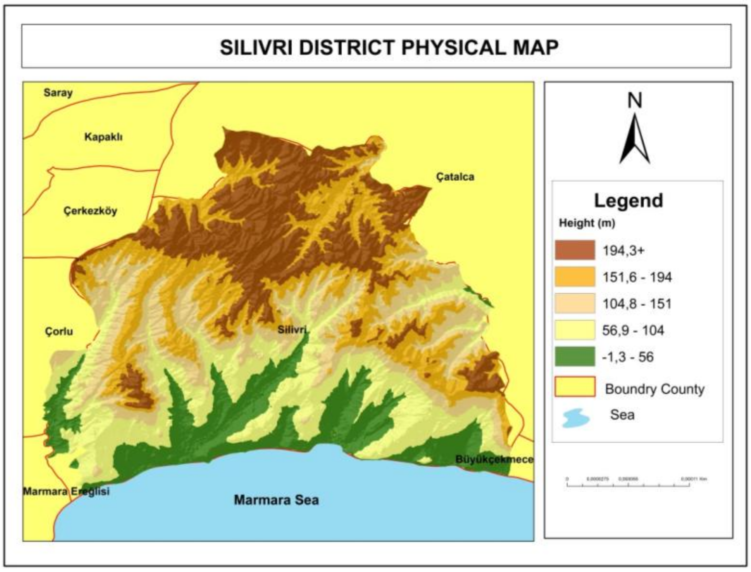
Method

Geographical Information Systems is one of the indispensable resources when we try to determine the risk zones in terms of natural disasters. It is to have exact and up-to-date information by making analyses through GIS. Via this system, it is possible to take some precautions for the problem by making disaster risk analyses and evaluating the cost of damage after the disaster.

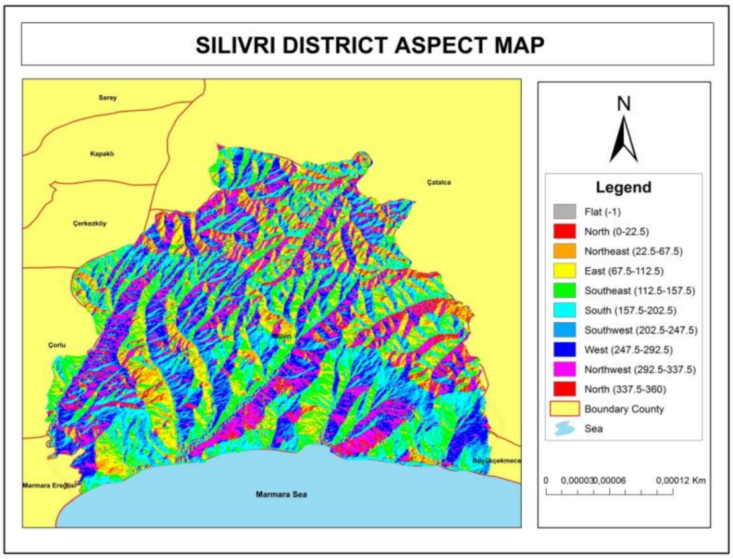
To reveal the reasons of resultant overflows in the area clearly and the risk potential of the area concerning an overflow, not only the physical-geographical factors of the working site have been examined but also the overflow analysis has been made and the maps in different scales have been grounded on by the methods of Geographical Information Systems within the scope of the study. The used materials within the scope of the study are composed of present digital data and software.

Findings

The coast zone of Silivri includes Tuzla Stream, Boğluca Stream, Kavaklar Stream, Kocadere and other smaller streams that have seasonal flows in this region. The surface drainage basins are divided by low ridges from each other. Usually, in the terrain showing stratified alternations, clayey, marly, fine grained sandy oligo-mioceneterrestrials sediments are encountered. It is not possible to run across any topographical escarpments and roughnesses. The basic geomorphological units are composed of some ridges which average elevations are between 80-100 meters, some sides, of which the slope rates are between 2°-15°, and a wide valley zone, of which the slope rates are between 0°-2°. The coast zone consists of low and high coast types. The low coasts are in the shape of the beaches located on the brinks of the streams flowing into the Sea of Marmara. High coasts include the cliffs of extents of the ridges that divide the basins from each other.

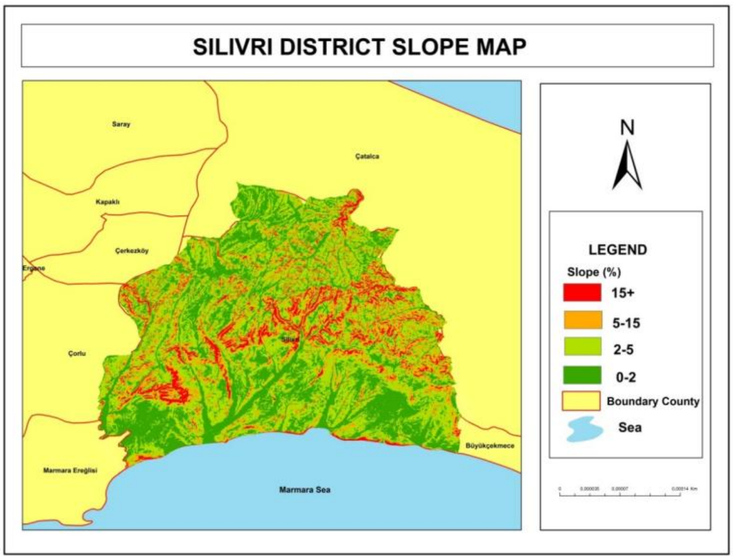


Map 2. The Physical Map of Silivri District



Map 3. TheAspectMap of Silivri District

It is not possible to encounter significant escarpments in the slope rates of stream basins in which the Silivri coast zone is located. The inclines of slope are around 2°-15° and they are usually symmetrical. The signification of the high slope rates such as 0°-2°, 2°-5°, 5°-15° and 15°, which has a place in the slope classification of flood and overflow, is pointed out and the implementation of this is made by using the GIS technologies. Slope rate of the terrain is just one of the important reasons that form a basis for floods and overflows. Displaying straight or close to straight values of the slope characteristics is causes pounding of water. Because of this, the geomorphological units which have 0°-2° slopes are suitable stages for pounding of water. These places usually correspond to valley bottoms and flood plains.



Map 4. Slope Map of the Silivri District

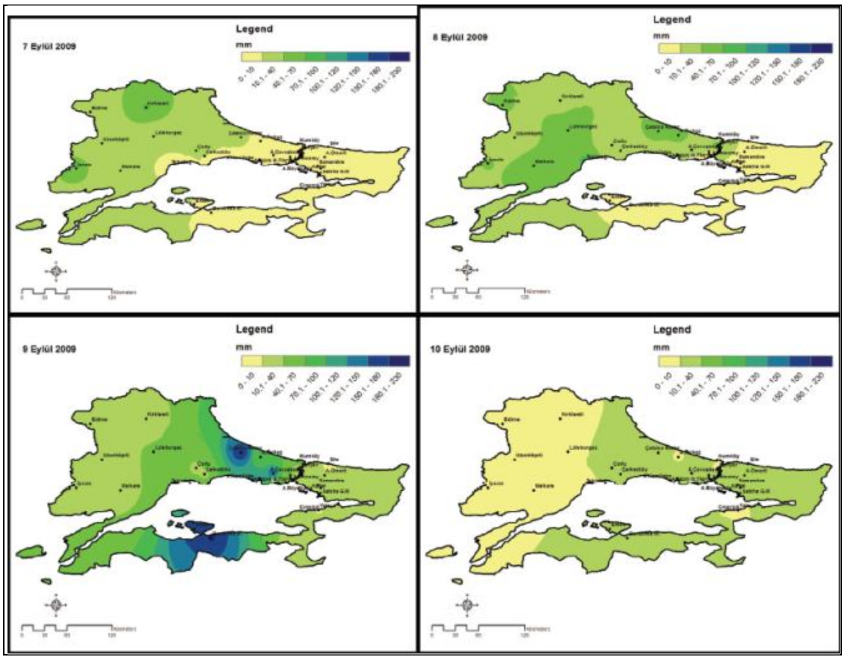
The fields having more than 2° slope rates generate the areas in which water flow is relatively easy, having energy by the force of gravity is possible and flood disasters are seen. As to the fields having 2°-5° and 5°-15° slope rates, they cause seriously devastating and erosive damages. Within the Silivri basin, the slope rates are above 15° only in Tuzla Stream. Apart from this area, the slope rates are between 11°-13° in other areas at maximum.

Table 1. Silivri is located within the coastal zone of large Selimpasa stream watersheds incline to flooding and flood analysis(Turoğlu, 2010 has been compiled from)

BasinName	Slope 0-2°		Slope 2-5°		Slope 5-15°		Slope > 15		Total watershed area(m^2)
	Area (m^2)	Rate	Area (m^2)	Rate	Area (m^2)	Rate	Area (m^2)	Rate	
Tuzla	19170000	46%	16972200	41%	5752800	14%	1800	0,00%	41896800
Boğluca	25083000	63%	13071600	33%	1654200	4%	0	Max. slope11°	39808800
Kocadere	13846500	53%	9799200	38%	2478600	10%	0	Max. slope13°	26124300
Kavaklar	11925000	84%	1898100	13%	360000	3%	0	Max. slope11°	14183100

The severe rainfalls, having influence on the Silivri coast zone, has turned the floods and overflows into the calamities. Frontal rains, which are seen in the form of downpour, are dominant throughout Thrace. Daily rainfall observations of the climate stations of Çatalca, Istanbul Ataturk Airport and Tekirdağ are made by the reason of being closed to Silivri-Selimpasa coast zone. It is seen that these rainfalls, which cause floods and rainfalls, has started on the day of 7 September 2009 and kept going on the day of 8 September 2009. The amount of rainfall regarding on the day of 8 April 2009 is remarkable. When the average amount of rainfall in September is taken into consideration, it is seen that the amount of rainfall on 8 April 2009 is two times more than the average for many years in Tekirdağ(Turoğlu, 2010).

Tuzla Stream and Boğluca Stream are important tributaries which have weak flows. Some of these drainage channels show some flow characteristics in parallel with the precipitation and temperature conditions throughout the year. The areas having weak flows are valley bottoms which have the characteristics of wetted areas. These areas are being used for road constructions and other buildings especially over the last few years. Under the name of environmental planning, to fill the stream beds up, to decrease the capacity of water-carrying, and to change the slope characteristics have negatively affected the natural drainage conditions. The surface drainage on the weak slopes usually have the rainwash characteristic over the course of rainfalls. This surface drainage, having rainwash characteristic, goes down the vide valley bottom by rolling up. As to the linear flow on the slopes, it occurs in the quadies that are not so deep.



Map 5. Marmara region 7-10 September 2009 distribution of total daily precipitation (Kömüşçü, Çelik&Ceylan, 2011).

The water, rolling up in the valley bottom, expands firstly into stream bed and then, in parallel with the increase in the amount of water, into the whole valley bottom by overflowing. After that, it flows into the Sea of Marmara. By the reason of having weak slope rates, the water expands throughout the whole valley bottom. The materials of earth and bedrock consist of fine-grained elements and this decreases the loss rate regarding the quantity of water, considerably. Being flat or nearly flat causes ponding of water in the valley bottom. The pond remains on earth for a long time because of having a flat structure (Turoğlu, 2010). The geographical factors, which controls the runoff, are collected under the two titles as showed in the table below;

Table 2. The geographical factors that affect the runoff(Turoğlu, 2010).

Climatic Factors	Physical Factors
• The type of precipitation (rain, snow, hail)	• Using of the land – the land cover
• The duration of precipitation	• Vegetation
• The severity of precipitation	• The type of soil
• The amount of precipitation	• The drainage area
• The distribution of precipitation within the stream basin	• The shape of the drainage basin
• The moisture content of earth	• The elevation characteristics
• Other meteorological and climatic factors that affects evapotranspiration	• The slope characteristics
	• The topographical characteristics
	• The drainage system
	• The presence of the reservoirs such as lake, dam, pond, moisture trap which prevents the continuity of the runoff

Runoff takes places under the control of climatic and physical factors. It refers to the surface movement of the water quantity remained as the result of the loss in the total precipitation. Settlement appears before us as the natural consequence of urbanization. Urban settlements, which go ahead in parallel with the residence, industrial, transportation and sociocultural purposes, cause changing of both ranges and the natural slope conditions in the region in which those settlements increase. In consequence of those settlements, the infiltration of the quantity of water depended on the precipitation decreases. This situation causes the increase in the quantity of water which passes to runoff. By depending upon the increase in the quantity of water, it is not possible to infiltrate the water by the soil. In parallel with this, runoff steps up and brings overflows into being. This situation appears before us as a result of urban development.

The distortion of natural slope with settlements takes place in two ways. One of them is the excavations and fillings performed within the settlements. The excavation and filling works in these areas cause the distortion of the slope. The other factor is the natural slope changes determined by firm grounds such as concrete and so on. Changing of the parts of the basin depending upon surface drainage causes both natural flow changes and the occurrence of new flow ways out of the known drainage channels by changing the natural flow directions of the slope changes in the subbasins.

The ferro concrete firm ground, occurred as the result of the settlements, prevents the infiltration of rainwater into the soil. At the same time, it decreases the friction by forming rubbed surfaces. Hereat, the flow rate of the runoff increases and this causes clustering of the big bodies of water.Apart from that, destroying of the vegetation cover is also another factor accelerating runoff (Turoğlu, 2011).

Image 1: Boğluca Creek on the transition route of Highway D-100 (Eren, 2011).

In this study, the risk zones related to the overflow taken place in the Boğluca Stream and other streams, which are within the borders of Silivri district, are determined by the methods of Geographical Information Systems(GIS).

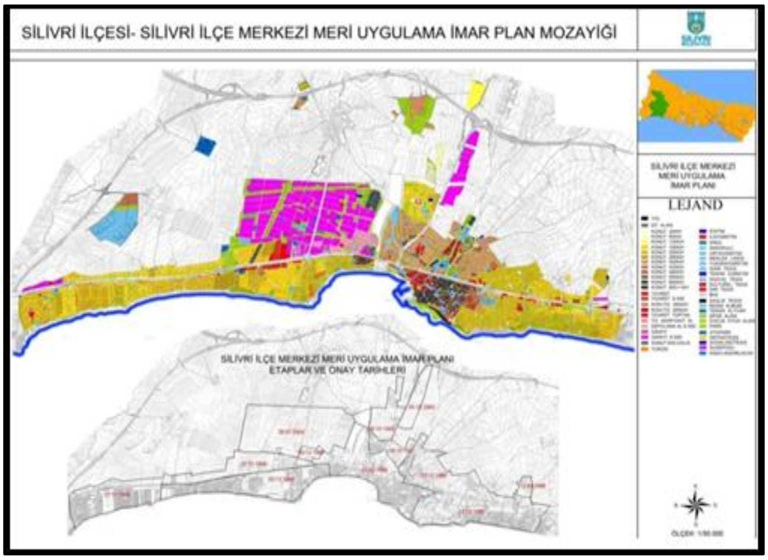
Within the context of this study, which will form a basis for other studies investigating the risk zones around the stream, the overflow risk zones in the stream are centred upon. Turkey is one of the countries experienced huge flood calamities in the world. It is known that %51 of the overflows take place in April, May, June and July in our country, numerically. When we compare the spring and summer overflows with the total amount of the overflows, it is seen that the rate is %66 of spring and summer.

By the reason of inability of the stream’s bed edge to convey the water, stream overflows towards its around and damages the area. This causes the overflow events. Sudden rain, rapid snowmelt, releasing the water unrestrainedly are the main reasons of overflows. These overflows negatively affect people’s economic and social lives. It is a crystal-clear fact that the presence of settlements on the overflow risk areas will increase the damage. For this reason, to minimize the negative effects of the overflows against the environment, people’s health, infrastructures and investments is a must. To predetermine the places that will be submerged in the overflow area and to take the required measures minimize the possible damages (Sargın, 2013).

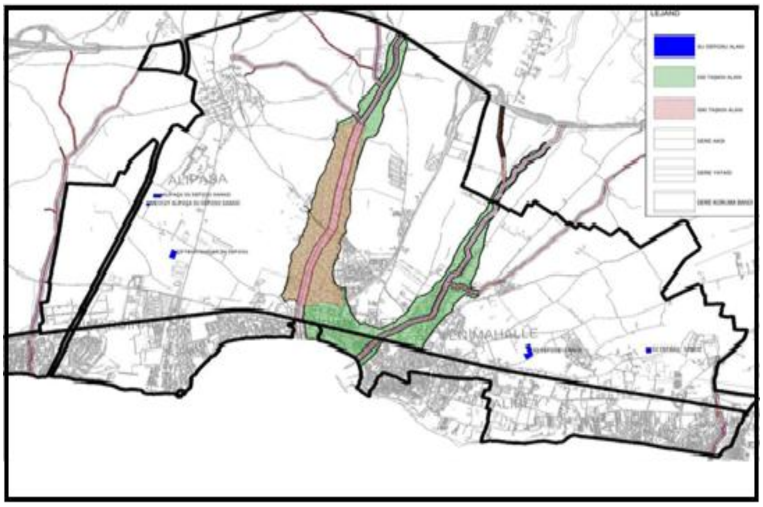
Our aim is to show location-based risk zones and the risk map of Silivri and Boğluca Stream’s flood and overflow, taken place in 2007, by using the technologies of Geographical Information Systems and to provide safety of life and property of the people by submitting the required measures to the authorized offices and officials within this scope. The stream’s overflow risk area maps are created by using Arcgis 10.1 programme, Spatial Analysis Module belonging to this programme, and the analysis methods within this module.

The Used Data

- The Map of the County Town Implementation Master Plan Mosaic in Use
- The General Directorate For State Hydraulic Works and ISKI Overflow Area Risk Map of Silivri *County Town*



Map 6: Silivri District – Silivri County Town Implementation Master Plan Mosaic in Use (Silivri Municipality).



Map 7:The General Directorate for State Hydraulic Works and Iski Overflow Area Risk Map of Silivri County Town (Silivri Municipality).

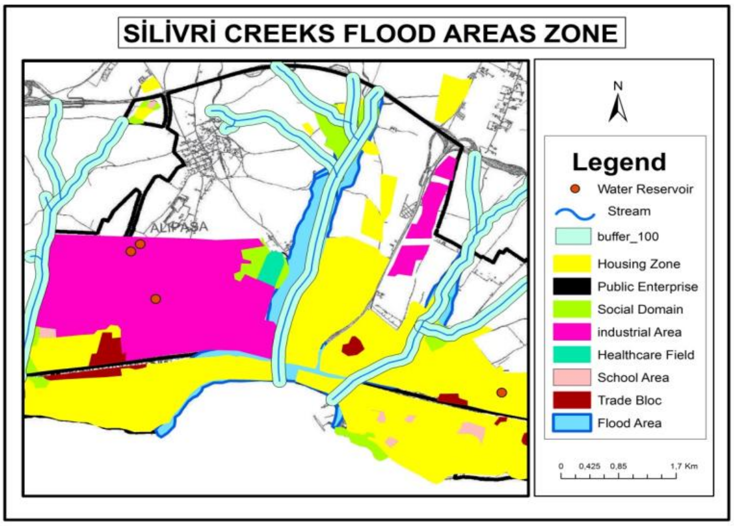
The Database Created by ArcGIS 10.1

1) Taking the Google Earth Image and Digitizing It
2) As the Vector Data, Drawing Silivri District and Cutting of This Data
3) Drawing the Border of The Domain
4) Drawing the Points of The Reservoir
5) Drawing the Stream Zones
6) Drawing the Housing Zones
7) Drawing the Government Agency Zones
8) Drawing the Social Zones
9) Drawing the Industrial Zones
10) Drawing the Healthcare Zones

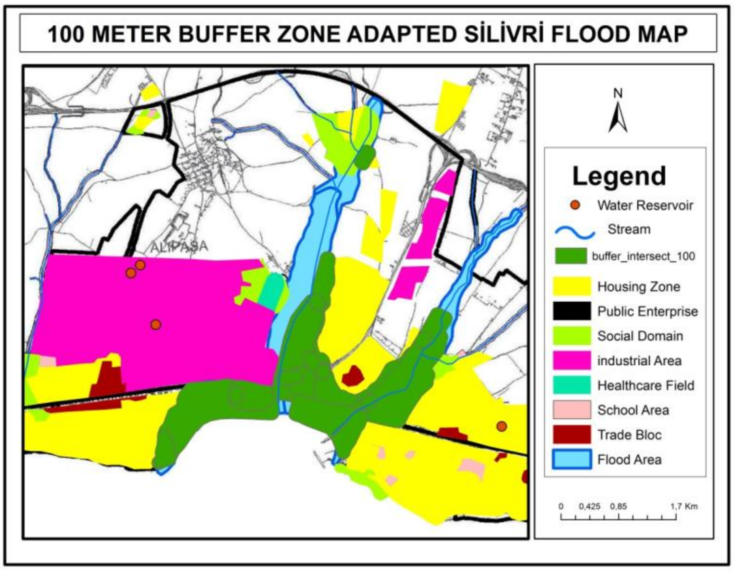
11) Drawing the Educational Zones
12) Drawing the Trade Zones
13) Drawing the General Directorate for State Hydraulic Works Overflow Area Risk Map
14) Drawing the Istanbul Water and Sewerage Administration Overflow Area
15) Creating the Map of Silivri Digital Elevation Field Model (DEM)
16) The Slope Map of Silivri
17) The Aspect Map of Silivri
18) The Physical Map of Silivri
19) The Location Map of Silivri

The Used Spatial Analysis Methods:

1) Buffer
2) Intersect
3) Multiple Ring Buffer

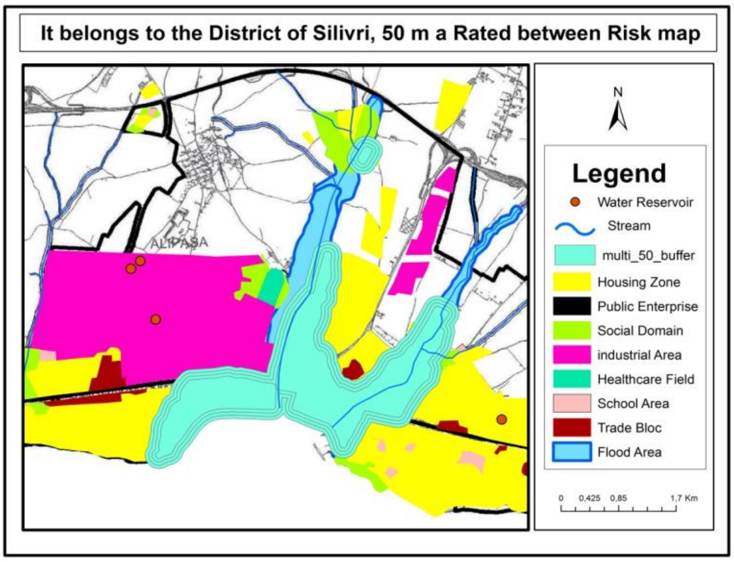


Map 8: Silivri Creeks Flood Areas Zone

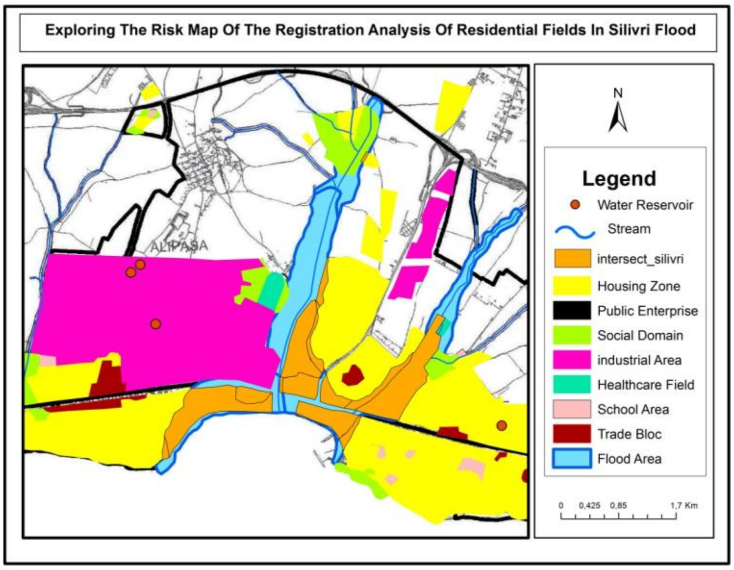


Map 9. 100 Meter Buffer Zone Adapted to Silivri Flood Map

Buffer Zone: Buffer Zone analysis is an investigation towards the requested information's within a specific geographical distance made by GIS. This analysis is made for the point, line or range characteristics in the vector data. Buffer zone analysis is made around a point as regards a diameter, at the right or left or both sides of a line as regards a specific distance and inside or outside of a range as regards a specific distance (Belsis, 2017).



Map10. It belongs to the District of Silivri, 50 m rated between Risk map



Map 11. Exploring the Risk Map of The Registration Analysis of Residential Fields in Silivri Flood

Intersect: A geometrical combination belonging to spatial data sets which protects and keeps the details in the common area belonging to the input data sets. Multiple Ring Buffer: It is benefited to form more than one buffers in specific distances and around input characteristics. These buffers are used to provide the requested integration and to form non-overlapping buffers by inputting the data regarding the values of the buffer distance. Thus, it is used to solve the problem.

Conclusion

It is aimed to determine the relation of precipitation current taken place in the flood and overflows on the dates of 08-09 September 2009 in Silivri and by examining the natural and human factors affecting this, it is also aimed to identify the problems. We can come to this conclusion as a result of the analysis and the data supply made by the Geographical Information Systems and the made field observations:

Silivri coast zone, subject to the natural slopes of the stream basins, is at the very suitable position for the precipitation having flood and rain-wash characteristics. The streams flow into the Sea of Marmara. A tendency from the ridges having suitable slope conditions for a runoff, composed of fine grained materials to the wide valley bottom, occurs with the effect of rainwater. The valley having a wide bottom and the streams having suitable slope conditions, by merging with the severe precipitation having downpour characteristics, help the water to reach the Sea of Marmara.

The roads of D-100 and TEM, passing from the region, lies down towards east and west in the stream basins. These roads, constructed on the valley crossings, has caused the change of natural slope and flow by forming weak-sloped sets blocking the flow within the valley. This situation firstly caused poundings and dependently clustering of the water to a large extent.All of these cause brimming over the stream by clustering huge amounts of water bodies in the stream and transformation into overflows.

This overflow, occurred in the area between Highway D-100 and the coast line, has caused many losses of lives and properties in 2009. The reasons of why severe precipitations has transformed into a flood calamity are the incorrect roadwork in the construction of the Highway D-100, minimizing the field by filling the stream beds in the centre of population and its around and decreasing the water-carrying capacity, to establish industrial facilities within the floodplains of the streams in the region, the presence of the collective housing constructions, concretion of the valley bottom by building public offices and the constructed summerhouses beginning from the coast because of their blocker roles against runoff.

The severe precipitations having downpour characteristics, geomorphological, hydrographical and other factors, which have an influence on runoff, create a whole and they are interconnected. With their natural slope and flow characteristics changing the drainage systems for any kind of settlement is preparing a backcloth for the calamities having hydrographic origins. It is a must to benefit from the field for preventing these kinds of natural events turning into a calamity and to make studies necessary for increasing the awareness concerning this factuality.

The downpour precipitations have a huge influence on the occurrence of the overflows in Silivri. Besides, the physical structure of the stream basin is also important. The settlements established in the stream beds are in the risk zones at the time of an overflow. Overflows may have been affected not only by natural factors but also by human factors too.

In consequence of the obtained data, these are the things to do about the overflow areas in Silivri:

1) Systematic data concerning the decreasing of the overflow risks must be provided. The required analysis has to be made and the strategies concerning decreasing the risks has to be developed.
2) In the course of any urgent warning, the evacuation of the settlements, under the risk of an overflow, has to be provided.
3) It is necessary to select the attendants correctly concerning an evacuation.
4) Entrances and exitsshould be stopped until the danger disappears in the overflow areas.
5) The opening of sand and gravel pits which may have broken down the base of the durableness of the beds and uncontrolled, excessive material buyingshas to be prevented.
6) Not having any experience about an overflow in the area again and minimizing the effects can be possible by considering the physiological characteristics that an overflow area has and by making land plannings (Özdemir&Bayrakdar, 2007).
7) Possible nuisances about zoning has to be ironed out by having a close contact with The General Directorate for State Hydraulic Works and extremely risky areas must not be opened to settlement when needed.
8) The convenience of the locations of the overflow control systems, which have already been made or will be made in the future, has to be examined and evaluated.
9) It is a must to build a TEFER (Estimating and Early Warning Against Overflows) in our pilot scheme area, Silivri District, and to be informed before a calamity. Accordingly, the measures have to be taken and served as an example for a variety of other fields in our country.
10) The overflows thatoccurred in the recent years, and affected areas has to be identified by the method of Geographical Information Systems (GIS) and by Remote Sensing(RS).
11) Overflow plannings in the densely-populated regions has to be made.
12) To decrease the quantity of water passing on a runoff in the risk areas, which will be identified in consequence of the analyses that will be made in the future, bridges and culverts has to be built correctly and the surrounding of the overflow area has to be closed to settlement.
13) Local population has to be informed about the natural disasters (Turan, 2013).

References

AkkayaT, (2011). *Görkemli bir geçmiş umut dolu bir gelecek – Silivri*. İstanbul: MercekYayınları.

Belsis (2017). *BelsisGIS tampon (buffer) analizi*.Retrieved from http://www.belsiscad.com/ Urun/Tampon(Buffer)/14 Last March 23, 2017.

Doğan S Ö, (2009) *Nüfus coğrafyası açısından birinceleme - Silivri*. *Marmara Coğrafya Dergisi*, 20, 1-19.

ErenM E,(2011).*Boğluca (Kayalı) Deresinin Taşkın riskinin irdelenmesi* (Yayımlanmış Yüksek Lisans Tezi). YıldızTeknikÜniversitesi. İstanbul.

Karakuyu M, (2002).*Şehirleşmeninküreseliklimsapmalarıvetaşkınlarüzerindekietkisi*.*Marmara CoğrafyaDergisi*, Sayı 6, 97-108.

Kömüşçü A U, Çelik S,Ceylan A, (2011). 8-12 Eylül 2009 Tarihlerinde Marmara Bölgesi'nde meydana gelen sel olayının yağışan alizi.*Coğrafi Bilimler Dergisi*, *9*(2), 209-220.

Özdemir H, Bayrakdar C, (2007). An Iinvestigation on causal factors of the Tuzla Stream flooding November 16, 2007 (Silivri - Istanbul). TürkCoğrafyaDergisi, *0*(49), 123-131. Retrieved from http://dergipark.gov.tr/tcd/issue/21232/227839.on March 23, 2017.

Özcan E, (2006).Selolayı ve Türkiye. *Gazi Eğitim Fakültesi Dergisi*, *26*(1), 35-50.

Özcan O, Musaoğlu N,Şeker D Z, (2009).*TaşkınalanlarınınCBS ve uzaktan algılama yardımıyla belirlenmesi ve risk yönetimi; Sakarya Havzası Örneği*. TMMOB Harita veKadastro Mühendisleri Odası, 12. Türkiye Harita Bilimsel ve Teknik Kurultayı, 11-15 Mayıs 2009, Ankara.

Özşahin E, Kaymaz Ç K,(2013). Taşkın riskinin değerlendirmesine bir örnek: Amik Ovası taşkınları. *Turkish Studies*,*8*(8), 2021-2039.

Sargın A H, (2013). *Coğrafi bilgisi stemleri ile taşkın riski ön dğerlendirmesi*, T.C. Ormanve Su İşleri Bakanlığı Devlet Su İşleri GenelMüdürlüğü Teknoloji Dairesi Başkanlığı.

Türkiye Meteoroloji Genel Müdürlüğü, Turkish State Meteorological Service [TSMS] (2017). Retrieved from https://mgm.gov.tr/en-US/forecast-5days.aspx March 10, 2017.

Turan B.(2013).*Taşkın alanların daplanlama Silivri Boğluca Deresiörneği* (Yayımlanmış Yüksek Lisans tezi), Bahçeşehir Üniversitesi, İstanbul.

Turoğlu H. , *u sel ve taşkınlar*. II. Ulusal Taşkın Sempozyumu, 31-43.

Turoğlu H, (2010) *Şehirsel gelişmenin İstanbul seller zerindeki etkisi*. İstanbul'un Afetlerden Zarar Görebilirliği Sempozyumu. 04-05 Ekim 2010,İstanbul, Bildiri Kitabı, s:55-69.

Turoğlu H.(2011). *İstanbul'dameydanagelenselvetaşkınlar*.FizikiCoğrafyaAraştırmaları; Sistematik ve Bölgesel, Türk Coğrafya Kurumu Yayınları No:5, 411-430.

Turkish Statistical Institute (2016). *Merkezi dağıtım sistemi*. Retrieved from https://biruni.tuik.gov.tr/ medas/?kn=95&locale=tr on March 23, 2017.