THE EXAMINATION OF GATHERING POINTS' CAPACITY REGARDING MOBILITY AND ACCESSIBILITY: CASE OF BAYRAKLI DISTRICT

N. S. Partigöç [1,*], H. E. Erdin [2], H. Zengin Çelik [2], M. B. Sılaydın Aydın [2]

[1] Department of City and Regional Planning, Pamukkale University, 20160 Kınıklı Denizli, Turkey – npartigoc@pau.edu.tr
[2] Department of City and Regional Planning, Dokuz Eylul University, 35160 Tınaztepe Izmir, Turkey - evren.erdin@deu.edu.tr,
hayat.zengin@deu.edu.tr, burcu.silaydin@deu.edu.tr

KEY WORDS: Disaster, Social infrastructure areas, Gathering points, Accessibility, Geographical Information Systems (GIS)

ABSTRACT:

The concept of accessibility that bases on continuing the flow of people, goods and services uninterruptedly is discussed as "maximum contact by minimum facility". This concept which is related with the distance has been evaluated various criteria such as physical, economic, perceptual, temporal, etc. Several assignations (optimum location, minimum distance, best distribution method, etc.) have revealed the importance of gathering points in terms of proceeding the disaster management properly. The origin point of linking "accessibility" and "transportation network" is the mobility which reveals as accessing people to adequate gathering points and services in the shortest time. These gathering points which are determined due to the specific criteria and also referred to the social infrastructure areas have a vital importance when any disaster or emergencies occur; so the site selection, availability and accessibility of these areas become extremely significant. The aim of this study is to examine the accessibility of gathering points in Bayrakli district located in Izmir city by taking minimum standards and also some recommendations into consideration. The spatial analyses based on current and potential gathering points are carried out via ArcMap software. The current and potential gathering points in Bayrakli district are examined in terms of accessibility their capacity for each neighbourhood due to their spatial distribution. According to the results, each gathering points in neighbourhoods cannot be accessible in the shortest duration by walking and also the current urban pattern affects the capacity parameter regarding the accessibility and mobility significantly.

1. INTRODUCTION

The legislation and literature related the disaster management reveals that existing settlements have a significant inadequacy of areas which can be used in an emergency case or disaster. These areas serve many critical purposes in urban area such as gathering points and temporary shelters, storage areas, logistics centres, evacuation corridors, distributing supplies to survivors during and after disasters, etc (Erdin et al, 2017).

It is appointed that certain urban facilities (parks, playground areas, open and green areas, recreation areas, etc.) are fulfilled in the built urban environment to provide necessary areas in the disaster management. Among these types of facilities, urban gaps, public areas and also open green areas are recently more important in terms of gathering points and temporary sheltering in cities. According to the overall tendency, citizens need more easily accessible and also secured open areas when an earthquake occurs and they panic in the first stage of disaster. In this general case, the closest open areas, streets and roads become the first preference by citizens. Roads and streets can be determined as a tool guiding citizens to gathering points and being enable to access these areas.

The gathering points can be defined as generally public open and green areas which are quickly and regularly accessed, easily realized and also have sufficient size. These points will provide not only secured areas to survive but also crucial advantages to survivors in terms of understanding their situation, receiving help, and hearing from their relatives and reaching essential information related the disaster. The

gathering points are so critical and vital in the first 12 and 24 hours to be inquired about the event (Maral et al, 2015). In fact, it is possible to evaluate the gathering areas as the first step of spatial organization in the disaster management. So, the alternative usage of existing open and green areas as gathering points and the querying of their adequacy should be taken into consideration in terms of the accessibility and capacity.

The purpose of this study is to examine the accessibility of gathering points in Bayrakli district located in Izmir city by taking minimum standards and also some recommendations into consideration. The spatial analyses based on current and potential gathering points are carried out via ArcMap software. The current and potential gathering points in Bayrakli district are examined in terms of accessibility and capacity for each neighbourhood due to their spatial distribution.

In the study, querying the capacity of gathering points referred as open and green areas and examining the accessibility of these areas easily in terms of the distance or duration are critical. Moreover, the assessment of the capacity and adequacy which is being carried out today over the area size will be made in the light of the findings. According to the results, it can be said that all evaluations related gathering points in urban area are insufficient when they are carried out due to only the area size and population.

---

* Corresponding author

2. THE ADEQUECY AND ACCESSIBILITY OF GATHERING POINTS

The phenomenon of accessibility has a critical role about the spatial organization and daily life in urban areas with the scope of the site selection of urban land uses, their sizes and availability, the relations between these land uses, etc. The accessibility is generally associated with the distance parameter and also is determined due to the physical, temporal and perceptual measurements (Erdem et al., 2017). On the other hand, the concept of accessibility in the disaster management varies in terms of its context based on the physical and spatial accessibility. Konstantinidou et al. (2014) define the transportation networks as the critical lifelines because of their functions and characteristics in the disaster management. These functions can be mentioned as gathering points and temporary shelters after disasters, evacuation of transportation system, emergency intervention and rescue operations (Konstantinidou et al., 2014). Especially in the emergency period when any disaster occurs, the accessibility of citizens to certain gathering points is vital to minimize the loss of life and property in disasters.

The concept of accessibility in the disaster management has different context for two different groups such as service providers (coordination units, service groups, disaster response teams) and service receivers (citizens and survivors) (Erdem et al., 2017). It is definitely known that citizens generally need safe conditions and areas in the city including roads, gathering points, evacuation areas, temporary shelters, etc. The disaster response teams aim to provide these safe conditions and areas. Therefore, the accessibility of various areas related the disaster management is crucial. As examples of these areas, there exist any disaster and danger points, deployment areas, logistics centres and warehouses, field hospitals, mobile cooking places, alternative patient care areas, areas for tent cities, container areas, public buildings and sports facilities, temporary shelters, aid and tent storage, etc. In other words, the principal aim of citizens is to reach public services due to their basic needs, while the disaster response teams' aim is to reach more people who need help (Sohn, 2006).

The site selection of urban land uses (gathering points, evacuation areas, temporary shelters) except roads is also critical in terms of the accessibility for citizens, survivors and disaster response teams (Erdem et al., 2017). At this point, the size of any functionalized area in the disaster management should be evaluated as the capacity which the population needs, while the site selection should be evaluated as the service area related the distance. In any case, certain areas that are adequate for the population with regards to the area size and capacity can be inadequate with respect the access distance. So, in the process of designing the needed areas in urban, basic necessities should be considered in the neighbourhood, region and city scale as well as the functions and special features of area like as population, the access distance for pedestrians and vehicles, etc.

The population and size of area affect the adequacy of gathering points. For the calculation of these points' adequacy is based on the essential area per person after the disaster. At this point, the time spent in these areas becomes important. In other words, the waiting period determines the behaviours of citizens. The behaviours of them are affected due to the level of damage, news from the media, the dimension of disaster, etc. (Song et al., 2014)

3. DATA AND THE STUDY AREA

The study area named Bayrakli district is located in the north-west part of Izmir metropolitan city which is one of the biggest cities of Turkey. The total settled area of Bayrakli district is 3499.3 ha (34.99 km^2) and covers approximately 4.5% of Izmir city's total area (78806.6 ha). According to the population obtained from Turkish Statistical Institute, the total population of Izmir metropolitan city is 4.279,677 people and also the total population of Bayrakli district is 314.402 people by the year 2017 (TSI, 2017). In the district, there exist residential areas in differing densities and social profiles, commercial areas, open and green areas, archaeological areas (Bayrakli Mound, remains from Smyrna Ancient City, Tantalos's Tumulus), the coastline with recreational areas and a regional railway station. The district's location is represented in Figure 1.
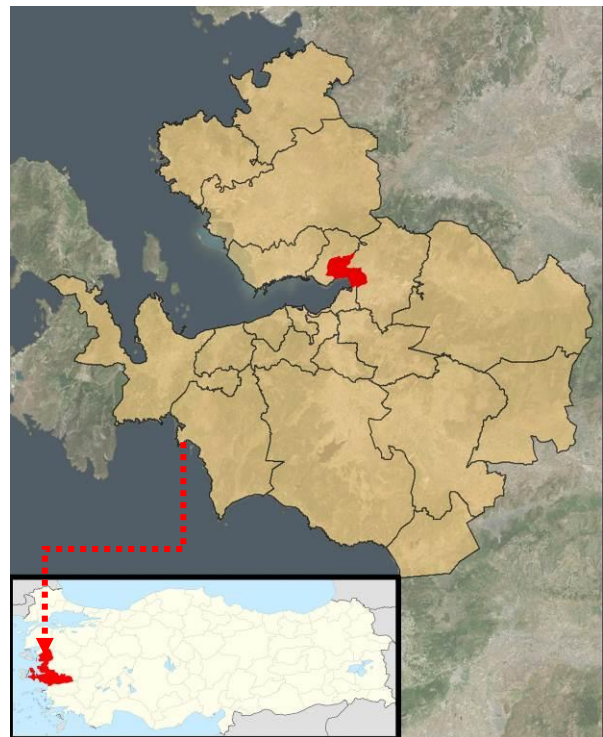

Figure 1. The location of Izmir metropolitan city and study area

Figure 2. The current urban land pattern and the spatial relation with the coastline (Bayrakli Municipality, 2018)
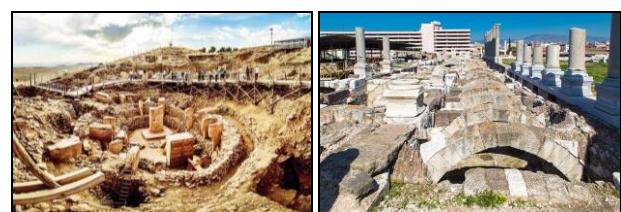

Figure 3. The Bayrakli Mound and remains from Smyrna Ancient City (Ministry of Culture and Tourism, 2018)

There exist 23 neighbourhoods in Bayrakli district which differ from each other in terms of urban pattern characteristics and population. In these neighbourhoods, the land use patterns varies such as residential areas for lower and upper income levels, business and administrative centres, urban renewal areas, green areas in urban and district scale and also gathering points that can be used during and after the disaster (Figure 2). Figure 4 represents the locations of neighbourhoods in Bayrakli district and Figure 5 represents the transportation network with road classification. Also Table 1 shows the detailed information about physical characteristics of district's neighbourhoods.
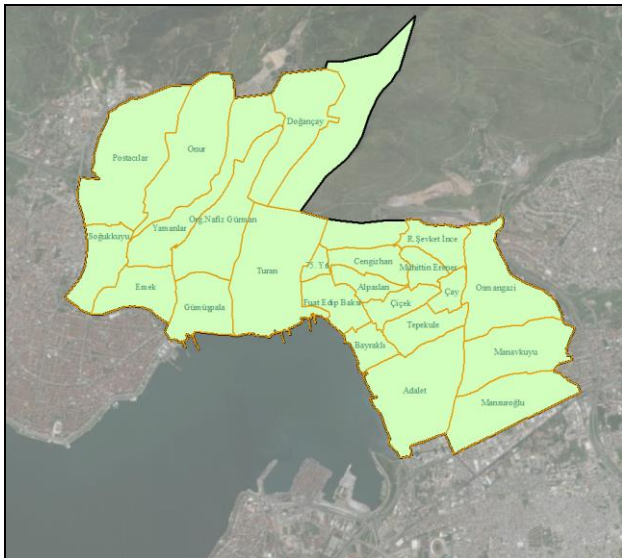

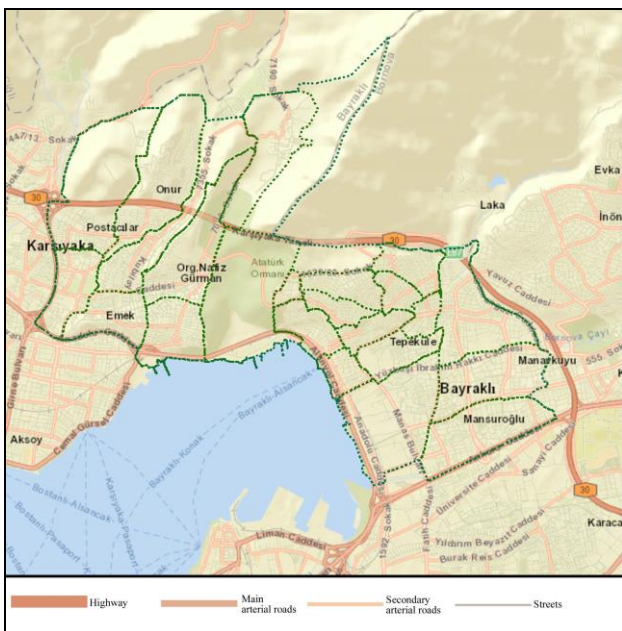Figure 4. The locations of neighbourhoods in Bayrakli district

Figure 5. Current transportation network of the district

In terms of transportation routes of Bayrakli district, main arterials that carry heavy traffic accumulations in urban centre are located near the district centre and also the coastline. This network shows that gathering points and temporary sheltering areas used during and after the disaster can be easily accessible in the shortest possible duration by automobiles and public service vehicles.

Neighborhoods	The Size of Neighborhoods (ha)	The Percentage of Neighborhoods' Sizes in Bayrakli District (%)
Adalet	190.455	8,37
Mansuroglu	135.392	5,95
Manavkuyu	129.951	5,71
Bayrakli	36.481	1,60
Tepekule	58.755	2,58
Gumuspala	84.964	3,73
Osmangazi	146.764	6,45
Fuat Edip Baksi	56.312	2,47
Cicek	39.572	1,74
Cay	25.929	1,14
Alparslan	33.343	1,46
Emek	74.960	3,29
Sogukkuyu	76.448	3,36
Postacılar	216.799	9,53
Yamanlar	140.950	6,19
Onur	180.702	7,94
Nafiz Gurman	141.797	6,23
Turan	221.580	9,74
Dogancay	136.782	6,01
75.Yil	14.855	0,65
Cengizhan	49.759	2,19
R.Sevket Ince	52.919	2,32
Muhittin Erener	29.912	1,31

Table 1. Physical characteristics of neighbourhoods

Due to Table 1, certain neighbourhoods' sizes and percentages are more than the others such as Postacilar, Adalet, Onur and Turan. This size refers the spatial magnitude of any neighbourhood. But the parameter of size is merely inadequate to determine the capacity, accessibility and mobility of gathering points.

4. METHOD AND MATERIALS

The method of this study has 4 steps. In the first step, existing information for the quality and quantity of open and green areas as "potential gathering points" in the neighbourhood scale are obtained and updated. Therefore, a database is set including the populations of neighbourhoods for the year 2016, the types and size of open and green areas and the size of gathering points in Bayrakli district. In the second step, the capacity of any gathering areas in the neighbourhood scale is calculated using values obtained from empirical studies in the literature, the adequacy of these gathering areas are compared with current sizes of them and also a classification is made related this adequacy.

In the third step, certain neighbourhoods are selected in terms of their gathering points' adequacy and accumulation, a buffer zone for a defined area in each selected neighbourhood by taking minimum standards and some recommendations into consideration, another database is set for buildings (number of floors, number of households, population and capacity) in these buffer zones which can be easily access to this gathering points in the shortest duration. In the last step, the building blocks that can get services from the defined gathering point in the neighbourhood are determined, these points are examined in terms of accessibility, mobility and their capacity for each neighborhood due to their spatial distribution.
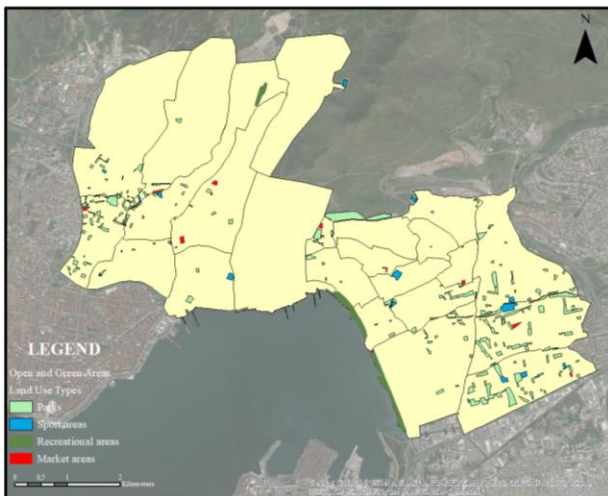
Figure 6. The classification of gathering points

In this study, existing open and green areas in the neighbourhood scale are divided into 6 classes according to their characteristics such as parks, sport areas, recreation areas, cemeteries, squares and market places. This classification and locations of these areas are shown in Figure 6. According to Figure 6, parks, market places and sport areas from current open and green areas which can be determined as "potential gathering points" are accumulated in the west part (Sogukkuyu, Yamanlar, Postacılar, Onur and Nafiz Gurman neighbourhoods) and south-east part (Osmangazi, Manavkuyu, Mansuroglu and Tepekule neighbourhoods) of the district. Moreover, recreational areas are located generally in the coastline (Figure 6).

Neighborhoods	Population (2016)	Current Size of Gathering Points (m^2)	Capacity of Gathering Points (m^2)
Adalet	20.471	127.848	51.177
Mansuroglu	26.293	158.505	65.732
Manavkuyu	31.821	167.393	79.552
Bayrakli	6.697	37.919	16.742
Tepekule	15.739	36.014	39.347
Gumuspala	15.423	18.486	38.557
Osmangazi	26.678	62.575	66.695
F. Edip Baksi	12.337	38.667	30.842
Cicek	9.988	18.014	24.970
Cay	7.763	4.789	19.407
Alparslan	8.929	2.542	22.322
Emek	12.785	5.870	31.962
Sogukkuyu	11.440	87.546	28.600
Postacılar	13.348	25.793	33.370
Yamanlar	17.978	43.251	44.945
Onur	20.154	20.196	50.385
Nafiz Gurman	15.787	21.264	39.467
Turan	347	19.839	867
Dogancay	2.236	5.889	5.590
75.Yil	3.471	22.114	8.677
Cengizhan	13.357	0	33.392
R.Sevket Ince	12.436	3.470	31.090
Muhit. Erener	8.530	333	21.325

Table 2. The size and capacity of gathering points

Then, a database is set including certain details related neighbourhoods such as population, the types and size of open and green areas and the size of gathering points in the district.

In terms of population and gathering points' sizes, there exists an accumulation in Manavkuyu, Adalet, Mansuroglu and Sogukkuyu neighbourhoods (Table 2). As the parameter of size, the population parameter is not just adequate to determine the capacity, accessibility and mobility of gathering point.

As a second step, the capacity of gathering areas in the district can be calculated based on that the essential area per person after the disaster is generally between $1 – 2.5$ m^2 in literature (Atalay, 2008). In this study, this area is selected as 2.5 m^2. For example, the population of Adalet neighbourhood is 20.471 and the essential area of gathering points for this neighbourhood should be 51.177 m^2 (20.471 people*2.5 person/m^2). After this calculation, the adequacy of these gathering areas are compared with current sizes of them and also a classification is made related this adequacy into two classes such as "adequate" or "not adequate". According to this, there exist only 9 neighbourhoods that have enough gathering points for citizens settled in these neighbourhoods (Table 3 and Figure 7).

Neighborhoods	Capacity of Gathering Points (m^2)	Adequacy of Gathering Points
Adalet	51.177	Adequate
Mansuroglu	65.732	Adequate
Manavkuyu	79.552	Adequate
Bayrakli	16.742	Adequate
Tepekule	39.347	Not adequate
Gumuspala	38.557	Not adequate
Osmangazi	66.695	Not adequate
F. Edip Baksi	30.842	Adequate
Cicek	24.970	Not adequate
Cay	19.407	Not adequate
Alparslan	22.322	Not adequate
Emek	31.962	Not adequate
Sogukkuyu	28.600	Adequate
Postacılar	33.370	Not adequate
Yamanlar	44.945	Not adequate
Onur	50.385	Not adequate
Nafiz Gurman	39.467	Not adequate
Turan	867	Adequate
Dogancay	5.590	Adequate
75.Yil	8.677	Adequate
Cengizhan	33.392	Not adequate
R.Sevket Ince	31.090	Not adequate
Muhit. Erener	21.325	Not adequate

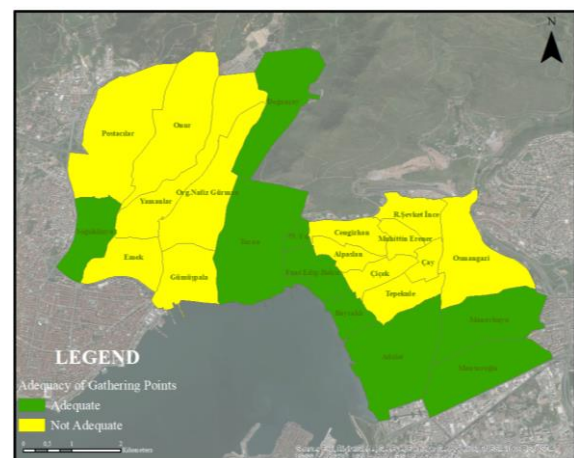Table 3. The adequacy of gathering points' capacities

Figure 7. The adequacy of gathering points in neighbourhood

Neighborhoods	Adequacy of Gathering Points	Density of Gathering Points
Adalet	Adequate	Dense
Mansuroglu	Adequate	More dense
Manavkuyu	Adequate	More dense
Bayrakli	Adequate	Less dense
F. Edip Baksi	Adequate	Less dense
Sogukkuyu	Adequate	More dense
Turan	Adequate	Less dense
Dogancay	Adequate	Less dense
75.Yil	Adequate	Dense

Table 4. The density of gathering points

In another step as the third step includes firstly certain neighbourhoods are selected in terms of their gathering points' adequacy and accumulation. According to the data obtained from Table 3, Table 4 and Figure 6, two neighbourhoods named Sogukkuyu and Fuat Edip Baksi are selected to examine the capacity and the accessibility of gathering points due to the population parameter. The principal reasons of this selection can be listed as the accumulation of gathering points in these neighbourhoods comparing to other ones and being adequate in terms of capacity. There exist some significant differences in these neighbourhoods such as the buildings' density, the level of gathering points' density, social and economic profiles. Figure 8 shows the locations of these neighbourhoods and Figure 9 shows the locations of selected gathering points.
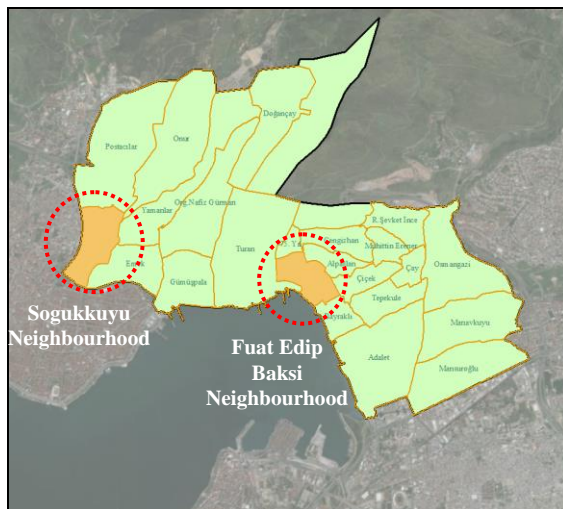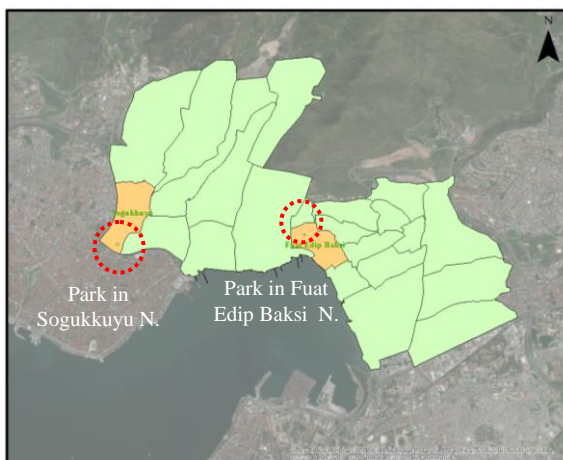

Figure 8. The selected neighbourhoods

Figure 9. The selected gathering points

Then, buffer zones are made for these two selected points by taking minimum standards and some recommendations into consideration, another database is set for buildings (number of floors, number of households, population and capacity) in these buffer zones which can be easily access to this gathering points in the shortest duration. These zones' radius is 200 meters. This value is determined in the study based on that the shortest possible walking distance during and after the disaster in literature (Tarabanis and Tsionas, 1999; OASP, 2002; Atalay, 2008).
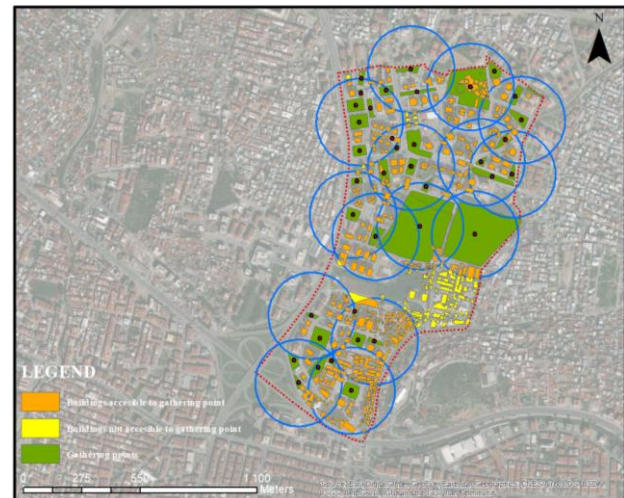

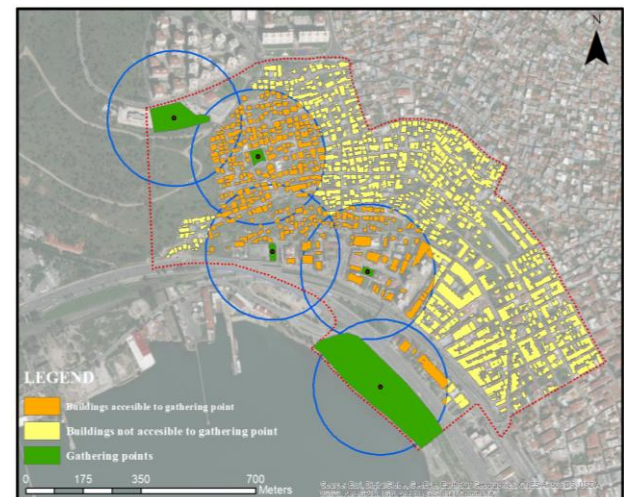Figure 10. The accessibility of gathering points in Sogukkuyu

Figure 11. The accessibility of gathering points in Edip Baksi

In Figure 10, it can be easily seen that almost whole buildings can access to the gathering points in Sogukkuyu neighbourhood except the ones located in south-east part of the neighbourhood. In comparison to this, In Figure 11, the better part of buildings in Fuat Edip Baksi neighbourhood cannot access to the gathering points especially in the north and east parts of the neighbourhood. On the other hand, buildings located in the west and south parts of the neighbourhood can easily access to these points. Due to the spatial analyses, the population that can get services from any gathering points in Sogukkuyu neighbourhood is 9680 people and the percentage of this population is approximately 85% in proportion to whole neighbourhood. Also, the population that cannot get services is 1760 people and the percentage of this population is approximately 15% in Sogukkuyu neighbourhood. In Fuat Edip

Baksi neighbourhood, 7140 people can get services from any gathering points and the percentage of this population is approximately 59%, but 5197 people cannot get any services and the percentage of this population is approximately 41% in proportion to whole neighbourhood.

For the last step, the buildings which can get services from the selected gathering points in two neighbourhoods are determined. Moreover, the population, current size of selected gathering point and also the needed capacity for population are calculated via the ArcMap software. According to the results of spatial and numerical analyses, in Sogukkuyu neighbourhood, the total population of area is 2808 people and the size of the selected gathering points is measured as 2803 m^2. The needed capacity for total population is 7020 m^2. So, this point is definitely inadequate for citizens settled during and after the disaster (Figure 12). In Fuat Edip Baksi neighbourhood, the total population of area is 2716 people and the size of the selected gathering points is measured as 968 m^2. The needed capacity for total population is 6790 m^2. So, this point is definitely inadequate for citizens settled during and after the disaster as the situation in Sogukkuyu neighbourhood. (Figure 13). Figure 12 and 13 represent these buffer zones and also building blocks included with these zones according to their land use types in Sogukkuyu and Fuat Edip Baksi neighbourhoods.

Figure 12. The selected point and buildings in Sogukkuyu

Figure 13. The selected point and buildings in Edip Baksi

5. RESULTS AND DISCUSSION

The aim of this study is to examine the accessibility of selected gathering points regarding their capacities and mobilities by taking minimum standards into consideration in Bayrakli district. Thus, a four-phased method is carried out. In these phases, there exist updating obtained data for open and green areas as "potential gathering points", setting a database for them with various data of neighbourhoods, determining the adequacy of these areas after calculations, define a diameter for walking distance in the shortest duration, examining the conditions of neighbourhoods and buildings in buffer zones in terms of adequacy, capacity, mobility and getting services from certain gathering points.

According to spatial analyses carried out via ArcMap software, there exist only 9 neighbourhoods that have enough gathering points for current populations among 23 neighbourhoods in Bayrakli district. The "adequate" neighbourhoods are generally located in the east and south parts, while "inadequate" neighbourhoods are located in west and north parts of the district. Moreover, three of these "adequate" neighbourhoods have "more dense" gathering areas, two of them have "dense" gathering areas and also four of them have "less dense" gathering areas. There is no accumulation of these areas throughout the district. While the selected two neighbourhoods (Sogukkuyu and Fuat Edip Baksi neighbourhoods) are determined as "adequate" neighbourhoods due to the size and population parameters, but there exist still certain areas which cannot get services from any gathering points in these neighbourhoods. The percentage of population that can get services from any gathering points is approximately 15% in Sogukkuyu neighbourhood and 41% in Fuat Edip Baksi neighbourhood in proportion to whole neighbourhood (Figure 10 and 11). It is determined that the percentage of current gathering point's size in proportion to the needed size is approximately 40% in the selected area located in Sogukkuyu neighbourhood and also is approximately 14% in the selected area located in Fuat Edip Baksi neighbourhood (Figure 12 and 13).

It is definitely clear that the parameters of size and population cannot merely determine the capacity, accessibility and mobility of any gathering points in an urban area. As mentioned before, certain gathering areas can be inadequate with respect the access distance which these areas are adequate for the population with regards to the area size and capacity in any case. For example, Sogukkuyu neighbourhood is easily accessible because of its location which is closer to main arterial roads, the district centre, coastline and also many gathering points are located around the neighbourhood. Although citizens settled in certain areas and buildings cannot get services from these gathering points in an event of disaster. In other words, these areas and buildings cannot be easily access to these gathering points in the shortest duration by walking.

These analyses' results are so crucial for urban areas. Because they help us understand the inadequacy of evaluations using limited parameters (size and population) related gathering points in any urban area. In fact, various criteria affect the site selection of gathering points for getting services in the event of disaster. The appropriate and specific ones for any case should be selected if the capacity of these areas is examined regarding mobility and accessibility.

ACKNOWLEDGEMENTS

REFERENCES

Atalay, H., 2008. Deprem Durumunda Kentsel Açik ve Yeşil Alanlarin Kullanimi – Küçükçekmece Cennet Mahallesi Örneği, Master Thesis, Istanbul Technical University, Istanbul.

Chang, S.E., 2003. Transportation planning for disasters: an accessibility approach. Environment and Planning A, 35(6), pp. 1051-1072.

Earthquake Planning and Protection Organization (OASP), 2002. Emergency evacuation of the population in case of an earthquake, Handbook No:3, Athens, Greece.

Erdem, U., Erdin H. E., Özcan N. S., 2017. Afet ve Acil Durumlarda Erişilebilirlik, 4. Uluslararası Deprem Mühendisliği ve Sismoloji Konferansı (UDMSK), Eskişehir. http://www.tdmd.org.tr/TR/Genel/4UDMSK/pdf2017/3887.pdf.

Erdin H. E., Zengin Çelik H., Sılaydın Aydın M. B., Özcan N. S., Erdem, U., 2017. Afet yönetimi içerisinde kentsel mekan ihtiyacı ve kentsel arazi kullanımları, Disiplinlerarası Afet Yönetimi Araştırmaları, Editörler: Zerrin Toprak Karaman, Oğuz Sancakdar, İlkim Kaya, Albi Yayınları, Izmir, pp: 255-272.

Konstantinidou, M., Kepaptsoglou, K., ve Karlaftis, M., 2014. Transportation network post-disaster planning and management: a review part I: post-disaster transportation network performance. International journal of transportation, 2(3), pp. 1-16.

Liu, L., Lin, Y., Wang, S., 2014. Urban design for post-earthquake reconstruction: A case study of Wenchuan County, China. Habitat International, 41, pp. 290-299.

Maral, H., Akgün, Y., Çınar, A.K., Karaveli, A.S., 2015. İzmir'deki afet sonrası toplanma ve acil barınam alanları üzerine bir değerlendirme. 3. Türkiye Deprem Mühendisliği ve Sismoloji Konferansı, Izmir, Turkey.

Ministry of Culture and Tourism, 2018. Official web site of Ministry. http://www.kultur.gov.tr/

Municipality of Bayrakli, 2018. Official web site of Municipality. http://www.bayrakli.bel.tr/

Sohn, J., 2006. Evaluating the significance of highway network links under the flood damage: An accessibility approach. Transportation research part A: policy and practice, 40(6), pp. 491-506.

Song, X., Zhang, Q., Sekimoto, Y., Shibasaki, R., 2014. Prediction of human emergency behaviour and their mobility following large-scale disaster, New York, USA. http://dx.doi.org/10.1145/2623330.2623628.

Tarabanis, K and Tsionas, I., 1999. Using network analysis for emergency planning in case of an earthquake. Transactions in GIS, 3(2), pp.187-197.

Turkish Statistical Institute, 2017. Population of neighbourhoods in Bayrakli district.