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Evaluation of Qualifications of Emergency Assembly Areas in Istanbul using the Spherical Fuzzy MAIRCA Process

Serap Tepe[1]
ORCID: 0000-0002-9723-6049

Serkan Eti[2]
ORCID: 0000-0002-4791-4091

Abstract

Disasters are inevitable facts of life. It is difficult to deal with disasters and emergencies because of the uncertainties they contain. Managing disasters and emergencies requires integrity with before and after processes. No matter how well-informed people may be when faced with a disaster, they may not act consciously due to the shock of the event, fear and anxiety. Therefore, the recovery phase after a disaster is very important. In the presented paper, meeting areas after a disaster for Istanbul, which is one of the closest witnesses of the earthquake reality, were examined. The motivation of the paper is to evaluate the assembly areas in Istanbul on the basis of all districts under expert opinions and to compare and rank the suitability of the currently existing emergency assembly areas for the expected major Istanbul earthquake. This ranking was made by the help of the fuzzy logic integration of the Multi Attributive Ideal Real Comparative Analysis (MAIRCA) method, which is one of the Multi-Criteria Decision-Making Techniques (MCDM). It is thought that this ranking will be useful in revealing the current situation of the districts and raising awareness. As far as is known, according to the results obtained from the paper in which the spherical fuzzy logic integrated MAIRCA technique was used for the first time, Kadıköy district was determined as the district with the best conditions assembly areas.

Keywords: *Disaster, earthquake, assembly area, MAIRCA, MCDM*

[1] Associate Prof., University of Health Sciences, Hamidiye Faculty of Health Sciences, Department of Occupational Health and Safety, E-mail: serap.tepe@sbu.edu.tr
[2] Associate Prof., Medipol University, Vocational School, Department of Computer Programming, E-mail: seti@medipol.edu.tr

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İstanbul'daki Acil Toplanma Alanlarının Niteliklerinin Küresel Bulanık MAIRCA Yöntemi Kullanılarak Değerlendirilmesi

Serap Tepe[3]
ORCID: 0000-0002-9723-6049

Serkan Eti[4]
ORCID: 0000-0002-4791-4091

Öz

Afetler hayatın kaçınılmaz gerçekleridir. Afet ve acil durumlarla mücadele etmek, içerdikleri belirsizlikler nedeniyle zordur. Afet ve acil durumları yönetmek, öncesi ve sonrası süreçlerde bütünlük gerektirir. İnsanlar bir afetle karşı karşıya kaldıklarında ne kadar bilgili olsalar da olayın şoku, korku ve kaygı nedeniyle bilinçli hareket edemeyebilirler. Bu nedenle afet sonrası toparlanma aşaması çok önemlidir. Önerilen çalışmada deprem gerçeğinin en yakın tanıklarından biri olan İstanbul için afet sonrası toplanma alanları incelenmiştir. Çalışmanın amacı, İstanbul'daki toplanma alanlarını tüm ilçeler bazında uzman görüşleri doğrultusunda değerlendirilmesi ve mevcut acil toplanma alanlarının beklenen büyük İstanbul depremine uygunluğunun karşılaştırılıp sıralanmasıdır. Bu sıralama, Çok Kriterli Karar Verme Teknikleri'nden (ÇKKV) biri olan Çok Nitelikli İdeal Gerçek Karşılaştırmalı Analiz (Multi Attributive Ideal Real Comparative Analysis, MAIRCA) yönteminin bulanık mantık entegrasyonu yardımıyla yapılmıştır. Bu sıralamanın ilçelerin mevcut durumunun ortaya konulması ve farkındalık yaratılması açısından faydalı olacağı düşünülmektedir. Bilindiği kadarıyla küresel bulanık mantık entegreli MAIRCA tekniğinin ilk kez kullanıldığı makaleden elde edilen sonuçlara göre Kadıköy ilçesi toplanma alanlarının en iyi koşullara sahip olduğu ilçe olarak belirlenmiştir.

Anahtar Kelimeler: *Afet, deprem, toplanma alanı, MAIRCA, ÇKKV*

[3] Doç. Dr., Sağlık Bilimleri Üniversitesi, Hamidiye Sağlık Bilimleri Fakültesi, İş Sağlığı ve Güvenliği Bölümü, E-posta: serap.tepe@sbu.edu.tr
[4] Doç. Dr., Medipol Üniversitesi, Meslek Yüksekokulu, Bilgisayar Programlama Bölümü, E-posta: seti@medipol.edu.tr

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Introduction

An emergency is an event that stops or interrupts the normal life and activities of the whole or certain segments of the society and requires urgent intervention, and is the state of crisis created by these events. Disaster, on the other hand, refers to natural, technological or human-induced events that cause physical, economic and social losses for the whole or certain segments of the society, and stop or interrupt the normal life and human activities (Official Gazette, 2020). Disaster and emergency management is a management approach and specialization that provides effective application in the face of an event, feeds and develops the system with the experiences gained from the events. It is a dynamic form of management because it requires continuity. In order for disaster and emergency management systems to be effective, it is necessary to coordinate the institutions responsible for different fields with each other. Successful disaster and emergency management system should cover pre-disaster, during and post-disaster stages and all stakeholders in an integrated manner (Gerdan & Şen, 2019, p.968). Thousands of people worldwide are affected by natural disasters every year. Considering the needs that emerged after the disasters experienced, it is clear that the element of shelter -especially the provision of safe accommodation areas for the disaster victims to re-establish their order- is a priority issue in terms of disaster management. Turkey is a country that is always faced with natural disasters that may occur due to its topographic and meteorological characteristics. As a result of natural disasters in this country, significant loss of life and property is experienced. Although it is not possible to prevent natural events, to minimize the damage that will occur after these events take on a disaster character and to enable people to continue their daily routines to be is a must. One of the most important of these preparations is the determination of disaster and emergency assembly points on a spatial basis (Şirin & Ocak, 2020, p.89). As it is known, disaster and emergency assembly points or gathering areas; these are safe areas where people can gather away from the dangerous area in order to prevent panic and ensure healthy information exchange during the time that will pass until the temporary shelter centers are ready after disasters and emergencies. There are some features that should be considered when choosing a Disaster and Emergency Assembly Areas and Temporary Shelter location. For example, an assembly area; should be close to basic needs. This assembly point should not pose

any additional danger. In addition, assembly areas should be chosen from places suitable for the transportation of the disabled and the elderly, accessible and easy to evacuate. Emergency Assembly Areas and Temporary Shelters should be places that respond to the needs of people physically and mentally during the first time they encounter a disaster. When people encounter a disaster, they often do not know how to act with the shock of the event. Although drills, trainings, and information are given, people's reactions when disasters occur are quite different from the above-mentioned theoric situations. Therefore, it is very important to choose Emergency Assembly Points and Temporary Shelters to make things easier. It should be foreseen that people who are trying to cope with emotions such as fear, confusion, not knowing what to do, stress, and who have also lost a limb or lost their loved ones cannot act normally under this pressure. Criteria for Emergency Assembly Points and Temporary Assembly Places have been determined by the Disaster and Emergency Management Presidency of the Ministry of Interior. These criteria have been determined as Population (population density in the region), Accessibility (Ease of access and evacuation of the area), Convenience (The area should be suitable for the transportation of the disabled and the elderly as much as possible), Risk-free (distance from secondary hazards), Feasibility (To be located on flat lands as much as possible), Shelter (close to residential areas but not affected by structural and non-structural elements), Liveability (being close to structures where basic needs such as electricity, water, toilets and similar elements can be met). The determined criteria are given in Table 1 (IRAP, 2021). These criteria have been determined in order to contribute to the struggle of people when a disaster occurs.

Table 1. Definiton of criteria

Criteria	Statement
Population	population density in the region
Accessibility	ease of access and evacuation of the area
Convenience	the area should be suitable for the transportation of the disabled and the elderly as much as possible
Risk-free	distance from secondary hazards
Feasibility	to be located on flat lands as much as possible
Shelter	close to residential areas but not affected by structural and non-structural elements
Liveability	being close to structures where basic needs such as electricity, water, toilets and similar elements can be met

Emergency Assembly Points, Temporary Assembly Places, and Temporary Shelter Areas are different places in meaning. Emergency Assembly Points are designated spots where individuals gather immediately after evacuating a building during an emergency (e.g., fire, earthquake). Typically, short-term, just long enough to account for all individuals and ensure everyone is safe. Location is close to the building, easily accessible, and outside the danger zone and they usually have minimal facilities, such as signage and possibly basic first aid.

Temporary Assembly Places are for gathering people who have evacuated their homes or buildings, but may need to stay together for a longer period compared to Emergency Assembly Points, awaiting further instructions or transportation to more secure locations. Duration is medium-term, lasting until it is safe to return to the evacuated area or move to a more secure shelter. Location is generally a bit further from the immediate danger zone, offering a safer environment for a longer stay and may have basic amenities such as water, and sanitation facilities.

Temporary Shelter Areas are designed to provide shelter and basic living facilities for individuals displaced by a disaster who cannot return home for an extended period. Duration is long-term, accommodating people until they can safely return to their homes or find alternative permanent housing. Typically located in safe areas with more comprehensive planning for extended stays. Facilities are equipped with extensive facilities including sleeping arrangements, food and water supplies, medical care, sanitation, and other support services. Understanding these distinctions ensures proper planning and response during emergencies, helping to provide appropriate care and resources for affected individuals.

Istanbul is located in the Marmara region, connecting the continents of Europe and Asia, between 28° 01' and 29° 55' east longitudes and 41° 33' and 40° 28' north latitudes. This province has a surface area of 5,712 km². There is the Black Sea in the north of Istanbul, the Marmara Sea in the south and the Bosphorus in the middle. It is neighbors with Saray in the northwest of Tekirdağ, Çerkezköy and Çorlu in Tekirdağ in the west, Marmara Ereğlisi in Tekirdağ in the southwest, Kandıra in the northeast, Körfez of Kocaeli in the east and Gebze in the southeast. The coastal length of Istanbul is 32.2 km on the Anatolian side and 46 km on the European side, including the Golden Horn. Büyükada, Heybeli, Burgaz, Kınalı and Sedef Islands, which are 9 islands in the Sea of Marmara, are open to settlement. With a total area of 16 km², approximately 542 hectares of the

islands are covered with buildings. The remaining parts are generally forested, scrub and rocky. Istanbul has 39 districts in accordance with Law No. 5747, which was accepted by the Turkish Grand National Assembly on March 6, 2008 and published in the Official Gazette dated March 22, 2008. On the European Side there are 25 districts, these are Arnavutköy, Avcılar, Bağcılar, Bahçelievler, Bakırköy, Başakşehir, Bayrampaşa, Beşiktaş, Beylikdüzü, Beyoğlu, Büyükçekmece, Çatalca, Esenler, Esenyurt, Eyüp, Fatih, Gaziosmanpaşa, Güngören, Kağıthane, Küçükçekmece, Sarıyer, Silivri, Sultangazi, Şişli and Zeytinburnu. On the Anatolian side, 14 district exists. These are Islands, Ataşehir, Beykoz, Çekmeköy, Kadıköy, Kartal, Maltepe, Pendik, Sancaktepe, Sultanbeyli, Şile, Tuzla, Ümraniye and Üsküdar. As of 30 March 2014, the status of the villages has been changed and they have been transformed into neighbourhoods. There is a total of 962 neighbourhoods in 39 districts. Istanbul has a transitional climate between the Black Sea and the Mediterranean and is one of the cities that receive the most precipitation in the Marmara Region. The lowest temperature is -11 ^{o}C, the highest temperature is around +40 ^{0}C, and the average relative humidity is 75%. The period when the city has the highest humidity is between December and January with 80-85%. There is limited snowfall in the period between December and March. Istanbul ranks first in Europe in terms of population, considering the municipal boundaries. According to TUIK data for the year 2020, Istanbul ranks first with 15,462,452 people compared to the population of Turkey (Table 2). In terms of population density, Istanbul, which is at the top of Turkey's ranking with 2,921 people/km2, has an annual population growth rate of 3%. The population in the districts shows parallelism with the intensity of industrialization (AFAD, 2020).

Table 2. The population in the districts of Istanbul

District	Population	District	Population
Adalar	16.033	Gaziosmanpaşa	487.778
Arnavutköy	296.709	Güngören	280.299
Ataşehir	422.594	Kadıköy	481.983
Avcılar	436.897	Kağıthane	442.415
Bağcılar	737.206	Kartal	474.514
Bahçelievler	592.371	Küçükçekmece	789.633
Bakırköy	226.229	Maltepe	515.021
Başakşehir	469.924	Pendik	726.481

Bayrampaşa	269.950	Sancaktepe	456.861
Beşiktaş	176.513	Sarıyer	335.298
Beykoz	246.110	Silivri	200.215
Beylikdüzü	365.572	Sultanbeyli	343.318
Beyoğlu	226.396	Sultangazi	537.488
Büyükçekmece	257.362	Şile	37.904
Çatalca	74.975	Şişli	266.793
Çekmeköy	273.658	Tuzla	273.608
Esenler	446.276	Ümraniye	713.803
Esenyurt	957.398	Üsküdar	520.771
Eyüp Sultan	405.845	Zeytinburnu	283.657
Fatih	396.594	**Total**	15.462.452

Emergency planning becomes more important in cities with high population density such as Istanbul. Possible disasters and emergencies such as earthquakes, floods, fires, forest fires, meteorological disasters, drought due to climate change, and infectious diseases that have been or may occur throughout history in Istanbul are at the forefront. The main feature of the land of Istanbul in terms of surface features is that it is a plateau with a height of 100-150 m. The average height is 117.55 m. This low plateau area forms the main area of the Çatalca-Kocaeli plateau. 75% of Istanbul's land consists of slopes and plateaus; 16% is mountains, 9% is plains and plains (IMMAR, 2017). Istanbul is under the influence of the main branches of the North Anatolian Fault Zone passing through the Sea of Marmara. The main northern branch of the North Anatolian Fault extends to the Gulf of Izmit, passes through the Marmara pits and reaches the Ganos Fault and from there to the Aegean Sea. South its branch passes through the south of Lake Iznik and reaches the Gulf of Gemlik and from there to the southern Marmara. Since 1900, 262 earthquakes have occurred in Istanbul, the largest of which is 7.6. There are 449 historical earthquake records for before 1900. As a result of the 17 August 1999 Marmara Earthquake, which is considered a milestone for our country's transition to the Integrated Disaster Management System, 18,373 citizens lost their lives and 48,901 citizens injured, 505 of our citizens were disabled, 96,796 residences and 15,939 workplaces became unusable. In this earthquake, which is about 120 km away from Istanbul, 1,823 houses and 326 houses in Avcılar were destroyed and nearly 4,000 buildings in Istanbul have been severely dam-

aged. Istanbul is not only affected by the earthquake; Floods, fires and infectious diseases have also fought over the years and the city has been affected by all these disasters to different extents. Considering the geological and seismological data, it is seen that the earthquake zone that will affect Istanbul and its surroundings is the Northern Branch of the North Anatolian Fault. Due to the fact that the North Anatolian Fault Line passes through some parts of Istanbul and very close to some parts, the expectation of a 7.0 and above Marmara earthquake is frequently and generally accepted by academic circles. The majority of buildings built before 1999 are not earthquake resistant. Considering the ground conditions, the urban transformation works should be completed urgently for Istanbul and the buildings should be made earthquake resistant, that's evident as an important goal.

The motivation of this paper is to compare and rank the suitability of the currently existing emergency assembly areas for the expected major Istanbul earthquake. For this reason, it was requested to score the suitability of the emergency assembly areas in 36 districts of Istanbul. This scoring process was done by AFAD experts. The Disaster and Emergency Presidency (AFAD) is the institution that carries out the necessary measures for the effective implementation of disaster and emergency situations and civil defense services at the country level, preparation and risk reduction before the occurrence of the events. AFAD also is an institution that intervention to be made during the event and the improvement to be carried out after the event. It is a structure established for ensuring coordination between organizations, conducting and coordinating humanitarian aid operations in the country and abroad, and developing and implementing policy proposals on these issues. AFAD experts are specialists who have received training on all disasters and the possible effects of disasters, and are knowledgeable about the geological and geopolitical structure of the country. These experts are competent and educational people in their fields. By the help of expert opinions, Multi Attribute Ideal Real Comparative Analysis (MAIRCA) method, one of the multi-criteria decision-making methods, was used with fuzzy integration and ranking was made.

Literature Review

In their paper, Şirin and Ocak evaluated disaster and emergency assembly areas in the environment of geographic information systems. In the paper, weight was assigned with the Analytical Hierarchy Process (AHP) considering the most common natural disasters in Gümüşhane, and the most suitable assembly areas were determined by weighted overlap analysis. As a result of the analysis, in addition to the existing 24 meeting areas in Gümüşhane, 26 alternative meeting areas were determined. Before the study, only 3 neighborhoods met the criteria of meeting area per capita, with the proposed alternative areas, this number increased to 12 neighborhoods and the current meeting area per capita in the city reached from 2.65 m2 to 4.6 m2. Thus, in case of any disaster or emergency, it is aimed to gather the population living in Gümüşhane in the right places in a short time and to gather the population in safe areas away from chaos until temporary shelters are prepared (Şirin & Ocak, 2020, p.86). Dayanır et al. used the Delphi method in their study and determined the criteria for post-disaster temporary shelter selection and planning. With the help of the list of site selection-planning criteria put forward by the Delphi method, they made the suitability analysis of the post-disaster temporary shelter areas proposed for İzmir and determined that a limited number of areas in İzmir could meet the requirements according to the criteria list formed as a result of the three-stage panel. In the study, it was explained why Seferihisar area, which is one of these areas, is the most suitable area, and a sample container-city situation plan was made on the area based on the design-implementation criteria obtained by the Delphi method (Dayanır et al.,2022, p.90). In their study, Gerdan and Şen examined the evaluation of the adequacy of designated assembly areas for disasters and emergencies, in particular, in Izmit (Gerdan & Sen,2019, p.963). Çınar et al. examined the studies conducted to determine the post-disaster emergency assembly and temporary shelter areas in İzmir; In the Karşıyaka District, which was chosen as a sample study area, the location and quality of the emergency assembly areas determined by AFAD were checked for compliance with national and international standards (Çınar et al.,2018,p.182). In their study, Öztürk and Kaya evaluated forty-three emergency assembly areas in a district of Istanbul under seven criteria determined by five experts on the subject. In the study, PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation), which is a MCDM (Multi-Criteria

Decision Making) method, was used to perform the analysis. Findings from PROMETHEE enabled forty-three emergency assembly areas to be listed under seven criteria. (Öztürk & Kaya, 2020, p.1245). A literature review was conducted in order to determine long-term satisfaction indicators for permanent housing use in resettlement areas. The data obtained are grouped with hierarchy and affinity diagrams. Qualitative data obtained from the literature were analyzed on nine settlements previously exposed to earthquakes in Turkey (Kürtüm Varolgüneş, 2021, p.121). Multi-criteria decision-making techniques and fuzzy set approach are frequently used in the literature. Spherical fuzzy sets are relatively new compared to other fuzzy set approaches in the literature. SF-AHP was proposed by Gündoğdu and Kahraman and developed based on spherical fuzzy sets (Kutlu Gündoğdu, Kahraman, 2019, p.341). In 2020, the gas station location selection problem was handled by Ayyıldız and Gümüş using SF-AHP and WASPAS methods. (Ayyildiz, Taskin Gumus, 2020, p.36114). Three-dimensional spherical fuzzy sets, which have some fundamental differences from other fuzzy sets, provide a wider choice for decision makers, and decision makers can define the degree of indecision about the alternative according to a criterion, regardless of membership and non-membership degrees. The theoretical basis of spherical fuzzy sets is based on the wider field approach of Pythagorean fuzzy sets and on the assumption that neutrophic sets define the instability independently. Spherical fuzzy sets combine these two approaches in a single theory (Kutlu Gündoğdu, Kahraman,2019, p.390). In this paper, the spherical fuzzy approach was preferred because of the innovations it contains.

Presented paper based on the following sections: Part 1 summarizes the literature review on the topic. Part 2 includes the proposed MAIRCA method. Part 3 applies the proposed model to the selection problem. Finally, in Part 4, the findings are discussed and evaluated, and conclusions reached.

Method

The Multi Attributive Ideal Real Comparative Analysis (MAIRCA) method is one of the multi-criteria decision-making methods used to rank the alternatives. The method in question was developed on the assessment of gaps between ideal and practical considerations. The sum of the gaps

for each criterion value represents the total gap for each observed alternative. The alternative with the largest of these total gaps is considered the furthest from the ideal estimates (Chatterjee et al., 2018, p.110). The use of multi-criteria decision-making techniques with fuzzy number sets is quite common today. It has been seen that the analysis results with fuzzy sets produce more accurate results (Ersin et al., 2019, p.483). Spherical fuzzy numbers are used in fuzzy numbers recently. The reason for using Spherical Fuzzy numbers is to better handle uncertainty in linguistic expressions. It is aimed to integrate the operations of the MAIRCA method with spherical fuzzy numbers.

The steps of the proposed method are as follows:

Step 1: Expert opinions are obtained. 7-point evaluation is converted to spherical fuzzy numbers in Table 3. (Donyatalab et al., 2020, p.716).

Table 3: Linguistic Expressions

	μ	v	π
1	0.1	0.9	0
2	0.2	0.8	0.1
3	0.3	0.7	0.2
4	0.4	0.6	0.3
5	0.5	0.5	0.4
6	0.6	0.4	0.3
7	0.7	0.3	0.2

Step 2: Equation (1) is used to obtain the average of expert opinions. m is the number of experts.

$$D^{agg} = SWAM_w(D^1, \dots, D^m) = w_1 D^1 + \cdots + w_m D^m = \langle \mu_{ij}^{agg}, v_{ij}^{agg}, \pi_{ij}^{agg} \rangle = \left\{ \left[1 - \prod_{e=1}^{m} \left(1 - \left(\mu_{ij}^{e}\right)^2\right)^{w_e} \right]^{1/2}, \prod_{e=1}^{m} \left(v_{ij}^{e}\right)^{w_e}, \left[\prod_{e=1}^{m} \left(1 - \left(\mu_{ij}^{e}\right)^2\right)^{w_e} - \prod_{e=1}^{m} \left(1 - \left(\mu_{ij}^{e}\right)^2 - \left(\pi_{ij}^{e}\right)^2\right)^{w_e} \right]^{1/2} \right\} \quad (1)$$

D^m is the expert's evaluation with spherical fuzzy numbers. W denotes the importance of experts. In the paper in question, the weights were taken as 1/m since they are of equal importance.

Step 3: The preference probabilities (P_{Bi}) are found for each alternative. Equation (2) is used to calculate the value.

$$P_{Bi} = \frac{1}{m} \tag{2}$$

Step 4: The theoretical evaluation matrix (Kp) is created. While constructing the matrix in question with the help of equation (3), the criteria weights and the preference probabilities are multiplied. Here, W_i is the importance weights of the criteria.

$$K_p = \begin{bmatrix} k_{p11} & \cdots & k_{p1n} \\ \vdots & \ddots & \vdots \\ k_{pm1} & \cdots & k_{pmn} \end{bmatrix} = \begin{bmatrix} P_{B1}w_1 & \cdots & P_{B1}w_n \\ \vdots & \ddots & \vdots \\ P_{Bm}w_1 & \cdots & P_{Bm}w_n \end{bmatrix} \tag{3}$$

Step 5: The spherical fuzzy evaluation matrix in step 2 is defuzzified with equation (4).

$$S(\check{A}_s) = \left(\mu_{\widetilde{A_s}} - \pi_{\widetilde{A_s}}\right)^2 - \left(v_{\widetilde{A_s}} - \pi_{\widetilde{A_s}}\right)^2 \tag{4}$$

Step 6: The actual evaluation matrix (Kr) is created. While creating this matrix, the criteria weights and the preference probabilities are multiplied. Equation (5-6) is used for this (Erdogan, 2022, p.1778).

$$k_{rij} = k_{pij}\left(\frac{S(\widetilde{x_{ij}}) - \min\left(S(\widetilde{x_{ij}})\right)}{\max\left(S(\widetilde{x_{ij}})\right) - min\left(S(\widetilde{x_{ij}})\right)}\right) \qquad if\ benefit\ criterion \tag{5}$$

$$k_{rij} = k_{pij}\left(\frac{S(\widetilde{x_{ij}}) - \max\left(S(\widetilde{x_{ij}})\right)}{\min\left(S(\widetilde{x_{ij}})\right) - max\left(S(\widetilde{x_{ij}})\right)}\right) \qquad if\ cost\ criterion \tag{6}$$

Step 7: The total void matrix (G) is created using equation (7) (Erdogan, 2022).

$$G = K_p - K_r = \begin{bmatrix} g_{11} & \cdots & g_{1n} \\ \vdots & \ddots & \vdots \\ g_{m1} & \cdots & g_{mn} \end{bmatrix} = \begin{bmatrix} k_{p11} - k_{r11} & \cdots & k_{p1n} - k_{r1n} \\ \vdots & \ddots & \vdots \\ k_{pm1} - k_{rm1} & \cdots & k_{pmn} - k_{rmn} \end{bmatrix}$$

$$g_{ij} = \begin{cases} 0, & k_{pij} - k_{rij} = 0 \\ k_{pij} - k_{rij}, & k_{pij} > k_{rij} \end{cases} \quad (7)$$

Step 8: The final score (Ui) for each alternative is calculated by equation (8) (Ecer, 2022, p. 5610). The value with the lowest final score is determined as the best alternative.

$$U_i = \sum g_{ij} \quad (8)$$

Findings

Dagg matrix was calculated by taking the expert averages with Equation 1. The results obtained from the expert averages according to the study data are given in Table 4.

Table 4: Dagg matrix

Districts	Population			Accessibility			Suitability			Risk-free			Feasibility			Shelter			Livability		
Adalar	0.350	0.680	0.402	0.253	0.761	0.200	0.217	0.796	0.200	0.251	0.786	0.000	0.251	0.786	0.000	0.298	0.723	0.000	0.648	0.356	0.202
Arnavutköy	0.411	0.594	0.401	0.491	0.519	0.403	0.511	0.493	0.402	0.511	0.493	0.402	0.545	0.472	0.408	0.537	0.464	0.401	0.584	0.422	0.405
Ataşehir	0.537	0.476	0.305	0.529	0.482	0.302	0.491	0.519	0.302	0.411	0.594	0.401	0.437	0.565	0.400	0.470	0.531	0.400	0.561	0.448	0.406
Avcılar	0.612	0.391	0.302	0.470	0.531	0.400	0.491	0.519	0.302	0.379	0.687	0.304	0.391	0.660	0.304	0.420	0.607	0.303	0.561	0.448	0.203
Bağcılar	0.609	0.416	0.204	0.545	0.472	0.203	0.313	0.695	0.100	0.269	0.756	0.100	0.313	0.695	0.200	0.350	0.680	0.000	0.174	0.832	0.000
Bahçelievler	0.592	0.416	0.304	0.547	0.458	0.301	0.383	0.626	0.200	0.338	0.665	0.200	0.349	0.660	0.300	0.411	0.594	0.301	0.437	0.581	0.202
Bakırköy	0.491	0.519	0.201	0.491	0.519	0.201	0.470	0.531	0.300	0.371	0.632	0.200	0.371	0.632	0.200	0.460	0.552	0.201	0.638	0.363	0.301

Başakşehir	0.437	0.565	0.400	0.533	0.493	0.409	0.537	0.476	0.305	0.437	0.565	0.300	0.431	0.585	0.402	0.500	0.500	0.400	0.537	0.476	0.305
Bayrampaşa	0.482	0.524	0.301	0.470	0.531	0.400	0.447	0.559	0.401	0.431	0.585	0.402	0.411	0.594	0.401	0.411	0.594	0.401	0.460	0.552	0.302
Beşiktaş	0.511	0.493	0.301	0.561	0.448	0.406	0.400	0.600	0.300	0.470	0.531	0.400	0.491	0.519	0.302	0.511	0.493	0.301	0.570	0.431	0.300
Beykoz	0.482	0.524	0.301	0.491	0.519	0.302	0.437	0.565	0.300	0.500	0.500	0.400	0.511	0.493	0.402	0.470	0.531	0.300	0.511	0.493	0.301
Beylikdüzü	0.437	0.565	0.300	0.482	0.524	0.301	0.460	0.552	0.302	0.421	0.608	0.402	0.431	0.585	0.402	0.477	0.543	0.403	0.477	0.543	0.403
Beyoğlu	0.561	0.448	0.304	0.612	0.391	0.302	0.511	0.493	0.301	0.437	0.581	0.302	0.420	0.607	0.303	0.363	0.654	0.401	0.437	0.565	0.400
Büyükçekmece	0.511	0.493	0.301	0.529	0.482	0.302	0.511	0.493	0.301	0.411	0.594	0.401	0.393	0.621	0.401	0.482	0.524	0.301	0.500	0.500	0.400
Çatalca	0.519	0.501	0.204	0.486	0.552	0.205	0.482	0.524	0.301	0.371	0.632	0.300	0.460	0.552	0.302	0.491	0.519	0.302	0.547	0.458	0.301
Çekmeköy	0.511	0.493	0.301	0.460	0.552	0.302	0.437	0.565	0.400	0.491	0.519	0.302	0.411	0.594	0.401	0.437	0.565	0.400	0.537	0.464	0.300
Esenler	0.577	0.438	0.305	0.511	0.493	0.301	0.420	0.607	0.303	0.350	0.680	0.402	0.409	0.632	0.303	0.327	0.711	0.402	0.269	0.756	0.300
Esenyurt	0.519	0.501	0.306	0.566	0.458	0.204	0.506	0.524	0.204	0.486	0.552	0.205	0.420	0.607	0.303	0.391	0.660	0.304	0.379	0.687	0.304
Eyüpsultan	0.631	0.378	0.203	0.561	0.448	0.203	0.511	0.493	0.301	0.477	0.543	0.302	0.286	0.727	0.100	0.460	0.552	0.302	0.491	0.519	0.302
Fatih	0.561	0.448	0.406	0.584	0.422	0.405	0.482	0.524	0.301	0.431	0.585	0.402	0.435	0.600	0.303	0.437	0.581	0.302	0.519	0.501	0.204
Gaziosmanpaşa	0.577	0.438	0.305	0.545	0.472	0.203	0.445	0.577	0.302	0.506	0.524	0.204	0.363	0.654	0.401	0.338	0.665	0.300	0.393	0.621	0.401
Güngören	0.545	0.472	0.408	0.411	0.594	0.301	0.393	0.621	0.401	0.431	0.585	0.402	0.382	0.646	0.402	0.393	0.621	0.401	0.411	0.594	0.401
Kadıköy	0.592	0.416	0.304	0.570	0.431	0.300	0.500	0.500	0.400	0.491	0.519	0.403	0.431	0.585	0.402	0.470	0.531	0.400	0.612	0.391	0.403
Kağıthane	0.460	0.552	0.302	0.545	0.472	0.408	0.313	0.695	0.300	0.313	0.695	0.300	0.298	0.723	0.300	0.411	0.594	0.401	0.447	0.559	0.401
Kartal	0.460	0.552	0.302	0.470	0.531	0.400	0.447	0.559	0.401	0.382	0.646	0.301	0.382	0.646	0.402	0.411	0.594	0.301	0.511	0.493	0.402
Küçükçekmece	0.445	0.577	0.302	0.506	0.524	0.204	0.519	0.501	0.204	0.469	0.565	0.303	0.469	0.565	0.303	0.486	0.552	0.205	0.491	0.519	0.302
Maltepe	0.561	0.448	0.203	0.547	0.458	0.301	0.511	0.493	0.301	0.420	0.607	0.303	0.350	0.680	0.402	0.383	0.626	0.401	0.537	0.476	0.305
Pendik	0.491	0.519	0.302	0.447	0.559	0.401	0.437	0.565	0.300	0.431	0.585	0.402	0.393	0.621	0.401	0.491	0.519	0.302	0.411	0.594	0.401
Sancaktepe	0.566	0.458	0.306	0.431	0.585	0.402	0.411	0.594	0.401	0.363	0.654	0.401	0.393	0.621	0.401	0.447	0.559	0.401	0.382	0.646	0.402
Sarıyer	0.400	0.600	0.300	0.537	0.476	0.305	0.437	0.565	0.400	0.445	0.577	0.302	0.431	0.585	0.402	0.511	0.493	0.402	0.612	0.391	0.403
Silivri	0.411	0.594	0.401	0.519	0.501	0.306	0.482	0.524	0.301	0.460	0.552	0.302	0.477	0.543	0.403	0.561	0.448	0.406	0.511	0.493	0.402
Sultanbeyli	0.577	0.438	0.305	0.477	0.543	0.403	0.447	0.559	0.401	0.431	0.585	0.402	0.393	0.621	0.401	0.447	0.559	0.401	0.382	0.646	0.402
Sultangazi	0.618	0.398	0.204	0.529	0.482	0.302	0.460	0.552	0.302	0.445	0.577	0.302	0.445	0.577	0.302	0.460	0.552	0.302	0.409	0.632	0.303
Şile	0.506	0.524	0.204	0.561	0.448	0.203	0.482	0.524	0.301	0.460	0.552	0.302	0.491	0.519	0.302	0.561	0.448	0.203	0.612	0.391	0.302
Şişli	0.612	0.391	0.302	0.561	0.448	0.203	0.491	0.519	0.302	0.363	0.654	0.401	0.363	0.654	0.401	0.383	0.626	0.401	0.470	0.531	0.400
Tuzla	0.447	0.559	0.401	0.545	0.472	0.408	0.511	0.493	0.402	0.393	0.621	0.301	0.431	0.585	0.402	0.437	0.565	0.300	0.584	0.422	0.405
Ümraniye	0.537	0.476	0.305	0.491	0.519	0.403	0.491	0.519	0.403	0.477	0.543	0.403	0.477	0.543	0.403	0.470	0.531	0.400	0.482	0.524	0.301
Üsküdar	0.511	0.493	0.402	0.561	0.448	0.406	0.482	0.524	0.301	0.477	0.543	0.302	0.477	0.543	0.302	0.511	0.493	0.301	0.570	0.431	0.401
Zeytinburnu	0.545	0.472	0.408	0.383	0.626	0.401	0.383	0.626	0.401	0.393	0.621	0.401	0.363	0.654	0.401	0.383	0.626	0.401	0.411	0.594	0.401

The matrix in question was obtained from expert averages using global fuzzy numbers; in other words, the matrix obtained is the common evaluation matrix of the experts. Theoretical evaluation matrix was obtained by using Equations 2 and 3. Theoretical Evaluation Matrix is given in Table 5.

Table 5: Theoretical Evaluation Matrix

Districts	Population	Accessibility	Suitability	Risk-free	Feasibility	Shelter	Livability
Adalar	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Arnavutköy	0.004	0.004	0.004	0.004	0.004	0.004	0.004

Ataşehir	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Avcılar	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Bağcılar	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Bahçelievler	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Bakırköy	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Başakşehir	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Bayrampaşa	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Beşiktaş	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Beykoz	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Beylikdüzü	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Beyoğlu	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Büyükçekmece	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Çatalca	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Çekmeköy	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Esenler	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Esenyurt	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Eyüpsultan	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Fatih	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Gaziosmanpaşa	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Güngören	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Kadıköy	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Kağıthane	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Kartal	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Küçükçekmece	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Maltepe	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Pendik	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Sancaktepe	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Sarıyer	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Silivri	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Sultanbeyli	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Sultangazi	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Şile	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Şişli	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Tuzla	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Ümraniye	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Üsküdar	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Zeytinburnu	0.004	0.004	0.004	0.004	0.004	0.004	0.004

Here, p=1/39 and w=1/7. Then, expert opinions were defuzzified by equation (4). The theoretical evaluation matrix given in Table 5 is the probabilities that show the equal probability distribution. Equation 4 is obtained by multiplying the weights and probabilities.

Table 6: Score

Districts	Population	Accessibility	Suitability	Risk-free	Feasibility	Shelter	Livability
Adalar	-0.07501	-0.312	-0.35462	-0.55538	-0.55538	-0.43407	0.175568379
Arnavutköy	-0.03737	-0.00576	0.003594	0.003594	0.014596	0.014609	0.0316815
Ataşehir	0.024644	0.019305	-0.01142	-0.03737	-0.02562	-0.01227	0.022263005
Avcılar	0.087936	-0.01227	-0.01142	-0.14101	-0.11974	-0.07903	0.06840782
Bağcılar	0.118537	0.044412	-0.30881	-0.40161	-0.23232	-0.34045	-0.662177399
Bahçelievler	0.070484	0.035869	-0.14749	-0.19719	-0.12728	-0.07406	-0.088587475
Bakırköy	-0.01707	-0.01707	-0.0245	-0.15719	-0.15719	-0.05567	0.109438173
Başakşehir	-0.02562	0.008227	0.024644	-0.05114	-0.0327	-2.30E-17	0.024644444
Bayrampaşa	-0.01682	-0.01227	-0.02293	-0.0327	-0.03737	-0.03737	-0.037276181
Beşiktaş	0.007187	0.022263	-0.08	-0.01227	-0.01142	0.007187	0.055804436
Beykoz	-0.01682	-0.01142	-0.05114	-2.30E-17	0.003594	-0.0245	0.007186723
Beylikdüzü	-0.05114	-0.01682	-0.03728	-0.04215	-0.0327	-0.01402	-0.014020335
Beyoğlu	0.045404	0.087936	0.007187	-0.05949	-0.07903	-0.06239	-0.025624341
Büyükçekmece	0.007187	0.019305	0.007187	-0.03737	-0.04842	-0.01682	-2.26E-17
Çatalca	0.010905	-0.04132	-0.01682	-0.10495	-0.03728	-0.01142	0.035869172
Çekmeköy	0.007187	-0.03728	-0.02562	-0.01142	-0.03737	-0.02562	0.029260489
Esenler	0.056295	0.007187	-0.07903	-0.07501	-0.09659	-0.09007	-0.206509004
Esenyurt	0.007264	0.066963	-0.0111	-0.04132	-0.07903	-0.11974	-0.141010329
Eyüpsultan	0.152371	0.068408	0.007187	-0.02733	-0.35825	-0.03728	-0.011422133
Fatih	0.022263	0.031682	-0.01682	-0.0327	-0.07074	-0.05949	0.010905015
Gaziosmanpaşa	0.056295	0.044412	-0.05504	-0.0111	-0.06239	-0.13169	-0.048415449
Güngören	0.014596	-0.07406	-0.04842	-0.0327	-0.0595	-0.04842	-0.037370081
Kadıköy	0.070484	0.055804	-2.30E-17	-0.00576	-0.0327	-0.01227	0.043315494
Kağıthane	-0.03728	0.014596	-0.15582	-0.15582	-0.17864	-0.03737	-0.022929136
Kartal	-0.03728	-0.01227	-0.02293	-0.11272	-0.0595	-0.07406	0.003593931
Küçükçekmece	-0.05504	-0.0111	0.010905	-0.04106	-0.04106	-0.04132	-0.011422133
Maltepe	0.068408	0.035869	0.007187	-0.07903	-0.07501	-0.05016	0.024644444
Pendik	-0.01142	-0.02293	-0.05114	-0.0327	-0.04842	-0.01142	-0.037370081
Sancaktepe	0.044788	-0.0327	-0.03737	-0.06239	-0.04842	-0.02293	-0.059502222
Sarıyer	-0.08	0.024644	-0.02562	-0.05504	-0.0327	0.003594	0.043315494
Silivri	-0.03737	0.007264	-0.01682	-0.03728	-0.01402	0.022263	0.003593931
Sultanbeyli	0.056295	-0.01402	-0.02293	-0.0327	-0.04842	-0.02293	-0.059502222
Sultangazi	0.133592	0.019305	-0.03728	-0.05504	-0.05504	-0.03728	-0.096593268
Şile	-0.0111	0.068408	-0.01682	-0.03728	-0.01142	0.068408	0.087936195
Şişli	0.087936	0.068408	-0.01142	-0.06239	-0.06239	-0.05016	-0.012270626
Tuzla	-0.02293	0.014596	0.003594	-0.09432	-0.0327	-0.05114	0.0316815
Ümraniye	0.024644	-0.00576	-0.00576	-0.01402	-0.01402	-0.01227	-0.0168205
Üsküdar	0.003594	0.022263	-0.01682	-0.02733	-0.02733	0.007187	0.02785293
Zeytinburnu	0.014596	-0.05016	-0.05016	-0.04842	-0.06239	-0.05016	-0.03737008

Since all criteria are benefit by using score values, real evaluation matrix is obtained by using Equation 5. Dagg matrix is converted to real numbers with defuzzy operations. Table 6 expresses this situation.

Table 7: Actual evaluation matrix

Districts	Population	Accessibility	Suitability	Risk-free	Feasibility	Shelter	Livability
Adalar	0.000	0.000	0.000	0.000	0.000	0.000	0.004
Arnavutköy	0.001	0.003	0.003	0.004	0.004	0.003	0.003
Ataşehir	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Avcılar	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Bağcılar	0.003	0.003	0.000	0.001	0.002	0.001	0.000
Bahçelievler	0.002	0.003	0.002	0.002	0.003	0.003	0.003
Bakırköy	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Başakşehir	0.001	0.003	0.004	0.003	0.003	0.003	0.003
Bayrampaşa	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Beşiktaş	0.001	0.003	0.003	0.004	0.003	0.003	0.003
Beykoz	0.001	0.003	0.003	0.004	0.004	0.003	0.003
Beylikdüzü	0.000	0.003	0.003	0.003	0.003	0.003	0.003
Beyoğlu	0.002	0.004	0.003	0.003	0.003	0.003	0.003
Büyükçekmece	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Çatalca	0.001	0.002	0.003	0.003	0.003	0.003	0.003
Çekmeköy	0.001	0.003	0.003	0.004	0.003	0.003	0.003
Esenler	0.002	0.003	0.003	0.003	0.003	0.003	0.002
Esenyurt	0.001	0.003	0.003	0.003	0.003	0.002	0.002
Eyüpsultan	0.004	0.003	0.003	0.003	0.001	0.003	0.003
Fatih	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Gaziosmanpaşa	0.002	0.003	0.003	0.004	0.003	0.002	0.003
Güngören	0.001	0.002	0.003	0.003	0.003	0.003	0.003
Kadıköy	0.002	0.003	0.003	0.004	0.003	0.003	0.003
Kağıthane	0.001	0.003	0.002	0.003	0.002	0.003	0.003
Kartal	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Küçükçekmece	0.000	0.003	0.004	0.003	0.003	0.003	0.003
Maltepe	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Pendik	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Sancaktepe	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Sarıyer	0.000	0.003	0.003	0.003	0.003	0.003	0.003
Silivri	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Sultanbeyli	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Sultangazi	0.003	0.003	0.003	0.003	0.003	0.003	0.002
Şile	0.001	0.003	0.003	0.003	0.003	0.004	0.003
Şişli	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Tuzla	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Ümraniye	0.002	0.003	0.003	0.004	0.003	0.003	0.003
Üsküdar	0.001	0.003	0.003	0.003	0.003	0.003	0.003
Zeytinburnu	0.001	0.002	0.003	0.003	0.003	0.003	0.003

Actual evaluation matrix is given in Table 7. The actual evaluation matrix obtained from the score values is presented in Table 7. This matrix was obtained from expert opinions. For the gap matrix, the gap between this matrix obtained from the expert evaluation and the theoretical evaluation matrix was calculated. Afterwards, row-based sums of this gap matrix were taken. These totals are given in Table 8. The row sums of the G matrix and the final score (U) values were calculated. U-matrix and ranking is given in Table 8.

Table 8: U-matrix and ranking

Districts	U	rank
Adalar	0.0219	39
Arnavutköy	0.0051	11
Ataşehir	0.0048	8
Avcılar	0.0056	17
Bağcılar	0.0150	38
Bahçelievler	0.0079	36
Bakırköy	0.0075	35
Başakşehir	0.0054	15
Bayrampaşa	0.0063	25
Beşiktaş	0.0051	12
Beykoz	0.0058	21
Beylikdüzü	0.0068	31
Beyoğlu	0.0047	7
Büyükçekmece	0.0051	13
Çatalca	0.0061	23
Çekmeköy	0.0057	19
Esenler	0.0073	33
Esenyurt	0.0065	27
Eyüpsultan	0.0045	5
Fatih	0.0054	16
Gaziosmanpaşa	0.0057	20
Güngören	0.0069	32
Kadıköy	0.0034	1
Kağıthane	0.0093	37
Kartal	0.0074	34
Küçükçekmece	0.0066	29
Maltepe	0.0046	6
Pendik	0.0065	28
Sancaktepe	0.0059	22
Sarıyer	0.0065	26
Silivri	0.0057	18
Sultanbeyli	0.0052	14

Sultangazi	0.0043	4
Şile	0.0040	2
Şişli	0.0042	3
Tuzla	0.0061	24
Ümraniye	0.0049	9
Üsküdar	0.0049	10
Zeytinburnu	0.0068	30

The rankings made according to the results obtained from the study are given in Table 9. According to both methods, the most suitable region for the emergency assembly area is Kadıköy, and the riskiest regions are Adalar and Bağcılar.

Table 9: Results obtained according to MAIRCA and SF-MAIRCA methods

Rank	MAIRCA	SF-MAIRCA
1	Kadıköy	Kadıköy
2	Arnavutköy	Şile
3	Beşiktaş	Şişli
37	Esenler	Kağıthane
38	Bağcılar	Bağcılar
39	Adalar	Adalar

According to the presented paper, it's seen that results obtained according to MAIRCA and SF-MAIRCA methods are consistent.

Discussion

Emergency assembly areas are of great importance in all processes, especially in the first times of the crisis. Because when a natural disaster occurs, people do not know how to act with the shock of the event. Although exercises are done beforehand, the effect of the real event is always different. The intensity of emotions such as surprise, fear, anxiety, confusion prevents people from thinking and acting in a healthy way. Therefore, preparedness for emergencies and disasters is very important. It is very important to raise awareness of the public, to carry out exercises, to provide training, to identify assembly areas and to make them known to everyone. Emergency assembly areas should be at a level that can meet the vital needs of people from the moment the disaster occurs until the first shock passes. For this reason, it is important to identify emergency assembly areas. In the study, the districts of Istanbul were compared according to the

emergency assembly areas. While making this comparison, the MARCIA technique, one of the multi-criteria decision-making methods, was evaluated within the framework of both classical and fuzzy logic. Thus, it is aimed to prevent difficulties in decision making and to reach the most accurate result. According to the results obtained, Kadıköy was determined as the most suitable option for emergency assembly areas. This result is related to the geographical features of Kadıköy district and its ease of transportation. The riskiest districts were identified as Adalar and Bağcılar. Kadıköy is on the Anatolian side of Istanbul. It is surrounded by the district of Maltepe in the east, the Bosphorus and the Marmara Sea in the west, Üsküdar and Ataşehir districts in the north, and the Marmara Sea in the south. Its area is 25.20 km². Although there are important elevations such as Göztepe within the boundaries of the district, gently undulating plains and stony slopes extending from the skirts of Kayış Mountain and Çamlıca to the Sea of Marmara dominate the entire land. Kadıköy is built on a fairly flat land and is approximately 21 km in northwest-southeast direction. It has a long coastline. There is a lively coastline where Haydarpaşa and Kalamış bays and Moda and Fenerbahçe headlands are located. Between Fenerbahçe Cape and Bostancı, the coastline has a fairly straight line that is not too indented. Kadıköy has an important position in terms of country and city transportation. Some of the main transportation routes connecting various centers in Anatolia to Istanbul and various districts in the city pass through Kadıköy. Thanks to these geographical features, Kadıköy is easily accessible. These features and results from the study are consistent in this respect. Islands have limited means of transportation. When examined in terms of surface area and other opportunities, various inadequacies are observed. Bağcılar district is one of the newly developing districts. In Bağcılar, there are important commercial enterprises, press centers and banking units, especially textiles. Small businesses form the main commercial fabric of the district. Green areas are insufficient compared to other districts. For this reason, it is an acceptable feature to be located at the end in the assembly areas. When the results obtained are examined, the first point to be considered is the importance of the features that the emergency assembly areas should have. These areas should be places that people can easily reach at the first time they encounter a crisis. In addition, it should not create additional risks. The study wanted to draw particular attention to this issue. Another unique aspect of the study is that the MAIRCA method was used for the first time

under fuzzy logic as far as is known. It is thought that this method used can guide other studies. In addition, bringing back the emergency assembly areas, which are of vital importance at the point of preparation for natural disasters, and raising awareness are among the other objectives of the study.

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Serap Tepe

İstanbul Üniversitesi lisans, Yıldız Teknik Üniversitesi ve İstanbul Üniversitesi yüksek lisans mezunudur. İstanbul Ticaret Üniversitesi Endüstri Mühendisliği Doktorası ve Yıldız Teknik Üniversitesi İş Güvenliği Doktorasına sahiptir. Uzun yıllar özel sektörde çalışmış, eğitim danışmanlık hizmetleri vermiştir. A sınıfı iş güvenliği uzmanı olan ve farklı vakıf üniversitelerinde görev yapan yazar, 2019 yılında Sağlık Bilimleri Üniversitesi'nde İş Sağlığı ve Güvenliği Bölümü'nde Dr. Öğr. Üyesi olarak çalışmaya başlamıştır. 2024 yılından itibaren aynı üniversitede Doç. Dr. ünvanı ile çalışmalarına devam etmektedir.

She, completed her bachelor's degree at Istanbul University and her master's degrees at Yıldız Technical University and Istanbul University. She holds a Ph.D. in Industrial Engineering from Istanbul Commerce University and a Ph.D. in Occupational Safety from Yıldız Technical University. With extensive experience in the private sector, she has provided educational consultancy services. As a certified

Class A occupational safety specialist, she has worked at various foundation universities. In 2019, she began working as an Assistant Professor in the Occupational Health and Safety Department at the University of Health Sciences. As of 2024, she continues her work as an Associate Professor at the same university.

E-posta: serap.tepe@sbu.edu.tr

Serkan Eti

Yıldız Teknik Üniversitesi Matematik Bölümü lisans mezunudur. Yüksek lisansını Yıldız Teknik Üniversitesi Sayısal Yöntemler alanında tamamladıktan sonra Marmara Üniversitesi Sayısal Yöntemler anabilim dalında doktora eğitimini tamamladı. 2017 yılından itibaren Medipol Üniversitesi'nde Öğr. Gör. ve Dr. Öğr. Üyesi unvanları ile çalışmıştır, aynı üniversitede 2023 yılından itibaren Doçent unvanı ile çalışmalarına devam etmektedir.

He, completed his bachelor's degree in Mathematics at Yıldız Technical University. He earned his master's degree in Quantitative Methods at Yıldız Technical University and his Ph.D. in Quantitative Methods at Marmara University. Since 2017, he has worked at Medipol University as a Lecturer and Assistant Professor. As of 2023, he continues his work at the same university with the title of Associate Professor.

E-posta: seti@medipol.edu.tr