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Investigation of assembly centers in the disaster areas in Merkez district of Uşak province in Turkey

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ABSTRACT

Within the scope of this study; post-disaster assembly areas in Merkez district of the Uşak province in Turkey, criteria for determining these areas, sizes of the areas, and compliance conditions with the specified standards, would be evaluated. Besides, the distribution of post-disaster assembly areas would be evaluated, and the maps prepared by using Geographical Information Systems (GIS). This study indicates that the assembly areas in Merkez/Uşak are not sufficient, especially in the populous neighborhood, and many of them have infrastructure problems. The distribution of the areas is also another problem in different neighborhoods from different reasons. The analysis made through the GIS also showed that the distribution of assembly areas is not homogenous in terms of accessibility.

1. Introduction

Turkey's Earthquake Regions Map, which was entered into force in 1996, was updated by AFAD in 2018 and entered into force on 1 January 2019 under the name of Earthquake Hazard Map of Turkey. In Figure 1, Earthquake Hazard Map of Turkey was adapted and the condition of Uşak province indicated. According to the information from Turkey's Earthquake Regions Map, Uşak province was located in the second-degree earthquake zone, except the Eşme district. Eşme district, was located in the first-degree earthquake zone. In Earthquake Hazard Map of Turkey, more detailed data is used instead of this degree system, and the concept of earthquake zone is no longer used. " The new map is prepared with much more detailed data taking into account the most recent earthquake source parameters, earthquake catalogs and new generation mathematical methods. Unlike the previous map, the new map shows the peak ground acceleration values rather than earthquake zones and replaces the 'earthquake zone' concept." (AFAD, 2019d).

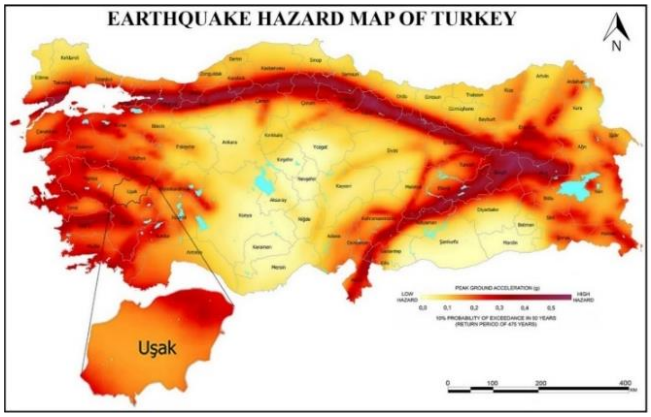

Figure 1. Earthquake Hazard Map of Turkey and the Condition of Uşak Province. (Adapted from the Earthquake Hazard Map of Turkey). (AFAD, 2019d).

2. Post-disaster assembly areas

Such criteria have included in many national and international research and studies. For example, "The Study on A Disaster Prevention/Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey" final report is prepared by the Istanbul Metropolitan Municipality (IMM) and Japan

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International Cooperation Agency (JICA) in 2002. In this report, under the title of Parks and Open Space Availability for Primary Safety Evacuation of Residents, a new urban disaster emergency evacuation system has recommended. The recommended evacuation system consists of two phases. The first one is called as Primary Evacuation Areas and constitutes the post-disaster assembly areas. The latter is called Regional Evacuation Areas and functions as shelter areas and tent villages. In the report, both phases have been explained, and the criteria for their determination have been included also. Within the Primary Evacuation Areas part of the chapter, the report also stated how much area per person should be. According to the report, for all citizens and residents in the area, the gross minimum area should be determined as 1.5 m^2 per capita. The report also states that the evacuation area should be selected from publicly-owned lands. (Tezcan et al., 2021; Zhu et al., 2016; JICA and IMM, 2002).

In another study, which examined the factors related to the planning of post-disaster assembly areas and shelter areas, it was stated that five criteria should be considered when determining the assembly areas. In the accessibility criterion, it is emphasized that the assembly areas should be accessed by every individual easily. The connection with the road axis is determined as the second criterion by this study. In the criteria for availability and multi-functionality, some of the areas that may be recommended as assembly areas are given as an example, and some examples from active and passive green areas are presented. Within the scope of this criterion, the requirement that the area should not be smaller than 500 m^2 comes to the forefront. In the context of ownership, as indicated in the report on Istanbul as well, it is stated that publicly-owned lands should be preferred as a priority. The study includes the area sizes in the last criteria, and provides several examples from other studies, in addition to the JICA and IMM report which determined the minimum areas as 1.5 m^2 per capita. For example, in another study, it is stated that the area should be determined based on building block, and it is recommended that it should be specified as 2 m^2 minimum as well. (Aşıkkutlu et al. 2021; Çınar *et al.* 2018; Xu et al. 2016).

3. Assessment of post-disaster assembly areas in Merkez district of Uşak province

In the JICA and IMM report, the gross minimum area per capita was indicated as 1.5 m^2. The area per capita standard that would be taken into consideration in this study would be 1.5 m^2 per capita, as in the report. In the scope of this study, assembly areas will be evaluated in the neighborhoods of the Merkez district. The population data was obtained from the TurkStat address-based population registration data for 2018. The names, addresses, status of the infrastructure and superstructure, and area sizes of the assembly areas were reached through the Uşak Provincial Disaster and Emergency Directorate and via e-Government. Accordingly, the infrastructure status, which is one of the seven criteria indicated by AFAD, would be examined as well. Then, the capacities of the areas were calculated, and it was identified which assembly area could serve a population of how many during an emergency. The size of the area per capita in each neighborhood was calculated. Lastly, it was indicated whether the size of the area per capita in compliance with the standards or not.

A total of 43 determined assembly areas in 28 neighborhoods of Merkez district have listed. 11 of these 28 neighborhoods do not have any assembly areas. According to inquiries via e-Government, when you click on any area in these neighborhoods, the three assembly areas that are closest to that area are listed and shown on the map. When we analyze the neighborhoods that have assembly areas in the context of area per capita, 9 of them are not in compliance with the standards (calculations made according to the specified 1,5 m^2 standard). Kemalöz neighborhood, which has the most population, meets the standards in this context as its area per capita is 2.9 m^2. After Kemalöz, the two most populated neighborhoods are Cumhuriyet and Atatürk neighborhoods, respectively. Both of them are below the accepted 1.5 m^2 standard. The area per capita in these populous neighborhoods are quite less, and there are also the less populous neighborhoods that have less than 1 m^2 assembly area per capita. Besides, some neighborhoods are well above the standard, so the areas could be used by their immediate vicinity as well.

Another criterion to be considered when determining the area is ownership. When we look at the Central District of Uşak, all assembly areas consist of parks and picnic areas and are all public ownership. According to the information obtained from Provincial Disaster and Emergency Directorate, all assembly areas in Uşak province is composed of public ownership areas, and no expropriation has been mentioned.

Another criterion is the infrastructure status and whether it is capable of satisfying the basic needs or not. In this context, the status of the electricity, water, and sewer system of the areas was examined. Water infrastructure in four of the 43 assembly areas is not capable of satisfying the needs. At the same time, in all of these four parks, the sewer system is not suitable as well. The only park where electricity infrastructure is not suitable is Halil Kaya Gedik Park in Fatih neighborhood. The biggest problem, in terms of infrastructure, is the issue of the sewer system, 23 of the 43 assembly areas are not capable of satisfying the sewerage related needs. In fact, sewage infrastructure is not suitable in all assembly areas in Aybey, Durak, Fevzi Çakmak, Işık, and İslice neighborhoods.

4. Examination of the distrubution of post-disaster assembly areas with GIS

In this study, the distribution of the assembly areas in Merkez district has examined by using the coordinates obtained from Uşak Provincial Disaster and Emergency Directorate. The study examined the distribution of the areas in the district by using neighborhood boundaries and satellite image. Using coordinate information, the locations of the areas have marked, and the distribution of the areas on central neighborhoods has shown with ArcMap 10.6. Figure 2 shows the locations and distribution of 43 areas according to the neighborhoods.

Assembly areas that are near to the center have more densely located, and their numbers and frequency decrease as they move away from the center. The areas that are far from the center comprise the areas, which are generally larger and have a use as a picnic area. Towards the center, the parks, which are smaller and have the characteristics of neighborhood parks, are located as an assembly area. Especially as you move away from the center, the number of easily accessible areas is not much. However, some of the areas that are easily accessible and too close to the buildings have some safety concerns such as the collapse of buildings during an emergency.

The densities of the assembly areas are shown in Figure 2, according to their distribution and area sizes. The Kernel Density map prepared in ArcGIS with Kernel Density tool by using the point features of the assembly areas. "The Kernel Density tool calculates the density of features in a neighborhood around those features. It can be calculated for both point and line features." (Esri n.d.). As is seen from the kernel density map and the information so far, high-density areas are the large-sized assembly areas far from the center. Even though the number of areas is more in the center, their sizes are not even close to the ones with the highest density areas.

Another analysis in ArcGIS has made using the Multiple Ring Buffer tool. This tool creates multiple buffers around the input with specified distances. So in this study, the distances specified as 100, 300, and 500 meters around the assembly areas. Accessibility to the areas easily by each individual is crucial during an emergency. So, the walking should be 500 meters or less. (Aksoy *et al.* 2009; Çınar *et al.* 2018; Şentürk 2017; Tarabanis and Tsionas 1999). In that case, Figure 3 shows that they are not sufficient even in central neighborhoods, in terms of accessibility. The distances of 100 and 300 meters from the assembly areas could serve a very small area in each neighborhood. Even the maximum distance of 500 meters could not serve the whole neighborhoods. So, in emergency, the areas are not in the easily accessible distance for many individuals.

Acknowledgement

Assembly areas are of vital importance during the first 12-24 hour period after the disaster. Therefore, its role in disaster management and planning is quite much. In the event of a disaster, it is very crucial to reach the people who are exposed to the disaster to the assembly areas in the shortest time possible. Therefore, the capacity should be sufficient to serve all citizens. Although areas that are large and capable of serving many people are considered as favorable, the main point is the determination of building block scale and neighborhood-scale assembly areas that can serve each settlement. Easily accessible assembly areas would be lifesaving during a disaster, especially by raising public awareness about the areas beforehand. There should not be any problems in terms of infrastructure and superstructure in the assembly areas, and the areas should be in good condition to respond to the vital needs of the disaster victims. All of this is very valuable in the event of a possible disaster.

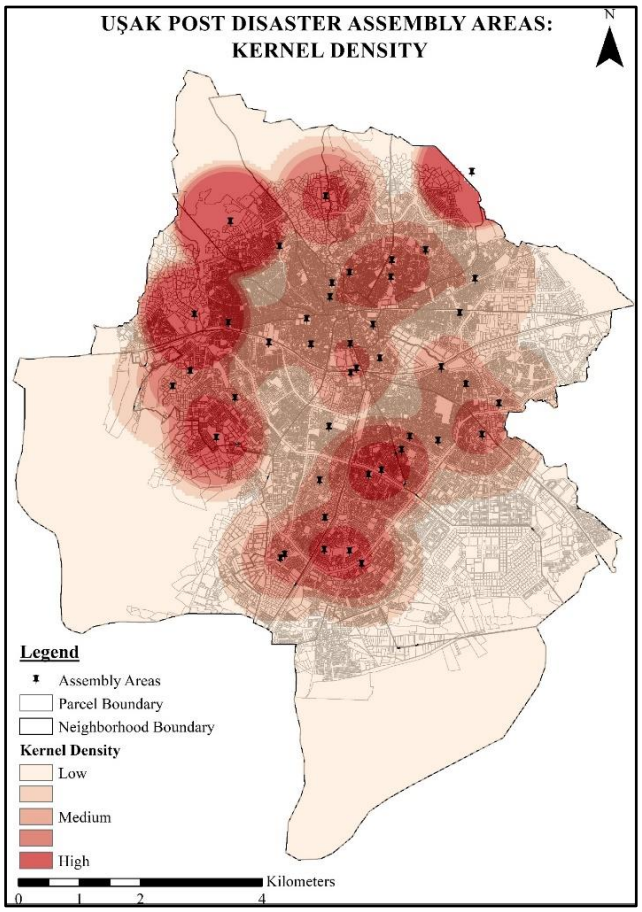

Figure2. Merkez/Uşak Post-Disaster Assembly Areas: Kernel Density.

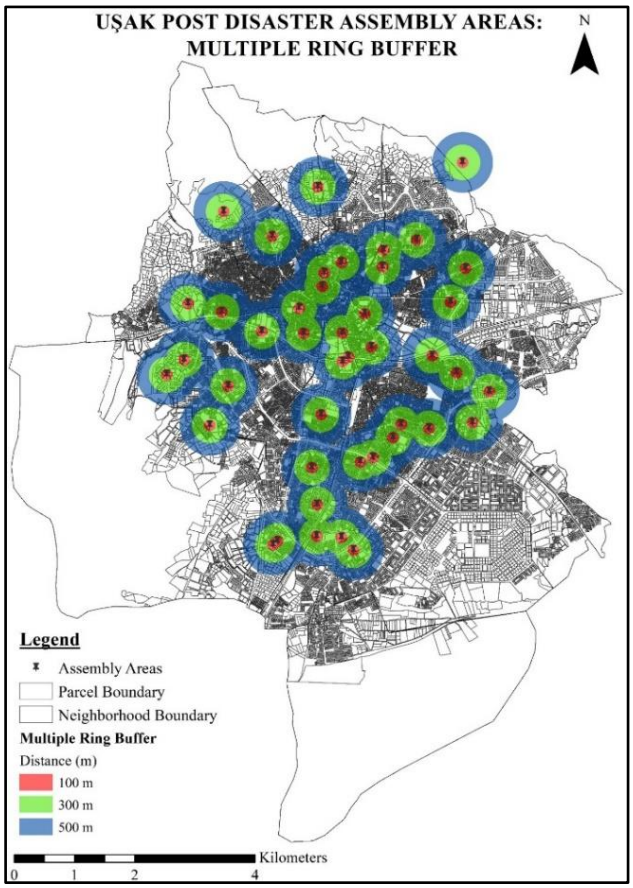

Figure 3. Merkez/Uşak Post-Disaster Assembly Areas: Multiple Ring Buffer.

In this study, the compliance with the standards of the assembly areas in Merkez/Uşak has examined, and the distribution of these areas has also evaluated by using GIS. All 43 assembly areas determined in the district are located in the central neighborhoods, and some of these areas are not sufficient, especially in the populous neighborhoods. While 11 of the 28 neighborhoods do not have any assembly area, area per capita is below the accepted standard in 9 of the 17 neighborhoods which have an assembly area. Besides, most of the assembly areas have infrastructure problems, especially in sewage infrastructure. In respect of the distribution of areas, while there is a more homogeneous distribution in some neighborhoods, there are problems, especially in neighborhoods where single and larger areas are determined as assembly areas. So, this distribution causes trouble in terms of accessibility to assembly areas. Also, the safety concerns such as collapse of buildings should be considered besides the accessibility. In the event of a disaster, accessibility to those areas in a safe way would be as important as the sufficiency of the areas. For this reason, easy-to-access areas that can respond to smaller settlements on the building block scale and neighborhood-scale should be determined as assembly areas. The deficiencies in the assembly areas need to be corrected, and new assembly areas need to be determined in the neighborhoods where the areas are not sufficient. With GIS, the analysis and use of spatial and non-spatial data could be achieved easily. That's why it would be very advantageous using GIS to identify deficiencies of the assembly areas and to determine the new areas.

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