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Kültürel Miras Alanlarında Sel Hasar Görebilirliğinin Değerlendirilmesi ve Dirençliliğin Artırılması: Ankara, İstiklal Mahallesi Örneği

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Öz

Türkiye'de son yıllarda sıklığı artan sel olayları, yıkıcılık etkisi yönünden depremlerin ardından ikinci sırada gelmekte; çok sayıda can kaybına ve ekonomik kayıplara neden olmaktadır. Gelecekte küresel iklim değişikliğine bağlı sel riskinin, özellikle sosyo-ekonomik ve mekânsal yapısı nedeniyle kırılgan olan kentlerde artacağı öngörülmektedir. Yerel iklim koşulları, topoğrafya ve bitki örtüsü gibi atmosferik ve çevresel koşulların yanı sıra, yanlış arazi kullanımı ve yetersiz drenaj sistemleri gibi insan kaynaklı etkenler su baskınlarına sebep olmaktadır. Bu bağlamda, seller, kentsel kültürel mirası tehdit eden tehlikelerin de başında gelmektedir. Korunması gerekli tarihi dokuların bilimsel yaklaşımlarla sel riskinin değerlendirilmesi, bu alanlarda risk azaltımına yönelik önlemler alınması ve dirençliliğin artırılması günümüzün öncelikli konularından biridir.

Bu çalışmanın amacı, kentsel kültürel miras alanlarının sel hasar görebilirliğini etkileyen etkenleri tespit etmek ve sel hasar görebilirliğinin değerlendirilmesi için bir yaklaşım geliştirmektir. Mevcut bilimsel çalışmalar değerlendirilerek, kültürel miras alanlarının sel hasar görebilirliğini etkileyen parametreler tanımlanmış ve indikatör temelli kantitatif bir değerlendirme yaklaşımı benimsenmiştir. Çalışma alanı olarak Ankara'nın tarihi kent merkezi Ulus'ta, kentsel sit alanı içinde yer alan İstiklal Mahallesi seçilmiştir. Çalışma kapsamında, geleneksel konut dokusu içinde yer alan 32 adet yapı çalışılmıştır. Alanın tarihi, coğrafi ve sosyo-kültürel bağlamı, kentsel doku özellikleri, yapıların mimari özellikleri araştırılmıştır. Saha çalışması ile tarihi dokunun drenaj sistemi, sokak eğimi ve malzemesi, geleneksel konutların ise yapısal durum, cephe malzemesi, açıklıkların konum ve boyutları gibi hasar görebilirliği etkileyen niteliklerine ilişkin veriler toplanmıştır. İndikatör temelli kantitatif değerlendirme yöntemi kullanılarak yapıların sel hasar görebilirlik seviyeleri hesaplanmış ve sel hasar görebilirlik endeksi oluşturulmuştur. Hasar görebilirlik haritalarının hazırlanmasında Coğrafi Bilgi Sistemlerinden yararlanılmıştır.

Çalışmadan elde edilen bulgular, önerilen analiz yaklaşımı ile kentsel kültürel miras alanlarında sel hasar görebilirliğinin değerlendirilmesinin önemini ortaya koymuştur. Geleneksel yapıların sel hasar görebilirlik seviyeleri belirlenerek kentsel ölçekte ve yapı ölçeğinde sel riskinin azaltılmasına yönelik öneriler geliştirilmiştir. Çalışma alanında sel riskinin azaltılması için yağmur suyu drenaj sisteminin iyileştirilmesi gerektiği tespit edilmiştir. Kültür varlığı niteliğindeki konutların korunması gereken değerleri de dikkate alınarak, yapıların hasar görebilirlik seviyelerinin düşürülmesine yönelik çatı onarımları yapılması, suyun yapılara nüfuz etmesini önlemek için yalıtım ve açıklık detaylarının iyileştirilmesi gibi müdahale yöntemleri ve alanları tanımlanmıştır. Bu araştırmanın sonuçları, tarihi dokularda sel hasar görebilirliğinin değerlendirilmesinin, afet risk yönetiminde risk önleme ve azaltmaya yönelik etkili stratejilerin geliştirilmesi, eylemlerin önceliklendirilmesi ve dolayısıyla kentsel dirençliliğin artırılması açısından önemini ortaya koymaktadır. Çalışmanın yöntem ve sonuçlarının benzer tarihi çevrelerde sel riskinin azaltılmasına yönelik çalışmalara katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Kültürel Miras, Sel, Hasar Görebilirlik, Risk Azaltma, Afet Risk Yönetimi

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Assessing Flood Vulnerability and Enhancing the Resilience of Cultural Heritage Areas: The Case of İstiklal District in Ankara

Abstract

In Turkey, following earthquakes, floods are the second most destructive disasters that cause casualties and economic losses. As a result of climate change, the frequency of flooding events is already having adverse impacts, especially in cities due to their spatial and socio-economic conditions. Specifically, environmental factors such as climate, topography and vegetation as well as human-induced factors such as rapid urbanization, uncontrolled development and land use, and inadequate drainage systems increase vulnerability to flooding. When disasters such as floods strike, the effects can be catastrophic in cities. Therefore, assessing the flood vulnerability of historic urban tissues, and taking effective measures based on an informed judgment about risks is critical to prevent and mitigate risks and increase resilience in historic urban landscapes.

This study aims to develop an approach for assessing flood vulnerability in urban cultural heritage sites. Based on the current state-of-the-art on the flood vulnerability of historic buildings, vulnerability parameters were defined and an indicator-based quantitative assessment approach was proposed. İstiklal Neighborhood, which is located in the urban conservation area in Ulus, the historical city centre of Ankara, was chosen as the study area. Within the scope of the study, 32 traditional dwellings were studied. The historical, geographical and socio-cultural context and urban and architectural features of the study area have been researched. Data regarding the vulnerabilities of the studied buildings have been collected through a site survey using survey sheets. Following an indicator-based semi-quantitative assessment approach, the flood vulnerability levels of the buildings were calculated and a flood vulnerability index was created. Geographic Information Systems were utilized in the preparation of vulnerability maps.

The results of the study revealed the importance of assessing flood vulnerability in urban cultural heritage areas. Based on the assessment results, proposals have been developed to reduce the risk of flooding. Measures at city, neighbourhood and building scales should be undertaken. To decrease the flood vulnerability of the study area, raised street levels should be lowered to their original levels to prevent water penetration into the buildings. The drainage systems should be maintained. The condition of the buildings should be improved based on structural reinforcement and architectural conservation projects developed by conservation specialists. In addition, design solutions should be developed for openings that may be exposed to water penetration from the streets without having adverse impacts on the heritage values of the buildings. Assessing the flood vulnerability of historical structures allows decision-makers and users to develop effective strategies for risk prevention and mitigation, prioritize actions, and thus increase urban resilience. The proposed approach could contribute to the studies on reducing flood risk across a range of historic environments.

Keywords: Cultural Heritage, Flood, Vulnerability, Risk Mitigation, Disaster Risk Management

1. Introduction and Research Aim

The frequency and intensity of extreme meteorological events, including flooding, have been rising in recent years due to changing climate. Failures in land use planning and implementation, and inadequate drainage systems increase vulnerabilities to flooding in settlement areas. Weather-related hazards turn into a disaster in vulnerable urban areas, especially in historic urban tissues (AFAD, 2021; Aon, 2021). Factors that affect the vulnerability of historic urban districts range from infrastructure problems to the condition and architectural characteristics of historic buildings. Historic settlement areas are highly vulnerable to flooding because of changing climatic conditions and the wide array of urban and architectural characteristics (e.g., building-street relationships, condition of public open spaces and buildings) specific to those areas. Therefore, assessing the flood vulnerability of historic urban tissues, and taking effective measures based on an informed judgment about risks is critical to prevent and mitigate risks and increase resilience in historic urban landscapes. With this perspective, this study aims to identify flood vulnerability indicators and develop a flood vulnerability assessment approach for historic urban tissues.

2. Methodology

Risk is defined as a function of hazard and vulnerability (Accardo et al. 2003; Accardo, Giani, and Giovagnoli 2003; Stovel 1998). In addition, according to Act no. 5902 (article 2-h), risk is defined as a measure of values which will be lost because of the probability of danger in a specific area. Vulnerability assessment is a significant stage of risk prevention and mitigation strategies. UNESCO et al (2010) define vulnerability as susceptibility or exposure to hazards. Vulnerabilities may result from physical intrinsic aspects as well as managerial and contextual (i.e., surrounding physical context) factors (Yildirim Esen et al, 2018). For the purposes of this research, both physical intrinsic and contextual vulnerability factors are addressed. Specifically, urban and architectural aspects that contribute to the flood vulnerability of traditional dwellings located in a historic urban context are taken into account. However, social vulnerability is not examined in the case study area because assessment data on social vulnerability could not have been collected due to the COVID-19 pandemic restrictions at the time of field surveys.

2.1. Study Area: İstiklal District in Ulus, Ankara

The case study area of this research is İstiklal Neighborhood, an urban conservation area in Ulus, Ankara. It is in very close proximity to important focal areas like Ankara Castle, Atatürk Boulevard, Gençlik Parkı, and Ulus Square. Ulus is the historic urban core of Ankara, which is a multi-layered city possessing buildings and remnants of previous civilisations. From the 16th to the 20th centuries, the Istiklal neighbourhood had been a multicultural residential neighbourhood[2]. In addition to traditional dwellings from the 19th and early 20th centuries, monuments including historic mosques, a synagogue, and a public bath could have been conserved until today. Landmarks and monuments and residential units from different periods relay an array of values from multiple eras (Altınsay et. al., 1988).

Several urban development/conservation plans have been prepared for the city and its historic core since the 1920s[3]. As a result of the planning decisions, the surrounding area of the district has gone through rapid urbanization. The 1957 Yücel – Uybadin Plan led to the enlargement of Anafartalar and Denizciler Streets, and the demolishment of buildings along these axes. New high-rise buildings constructed along these streets left the neighbourhood secluded from the rest of the city and made it less accessible. In 1980 İstiklal District was declared a

[2] Istiklal district was a multi-cultural neighbourhood with a Jewish community. The population of Jews in Ankara has decreased to a great extent as a result of migrations to other cities. Currently, there is no Jewish population left in Istiklal District; and the social structure of the neighbourhood has completely changed. Currently, 75% of the users are tenants with medium to low income (Hosanlı and Altınöz, 2016).

[3] 1927 Heussler's Sıhhiye Plan initiated the development of the areas destroyed by the 1916 fire, new road constructions, and solving infrastructure problems like water, sewage, gas, and electricity (Altınsay et. al., 1988). 1928 Jansen Plan aimed to deal with conserving the traditional fabric including buildings and street layouts (Altınsay et. al., 1988). İstiklal neighbourhood could have been preserved and was left untouched. In 1990, Ulus Historical City Center Conservation Project by Raci Bademli was initiated but then cancelled in 2005. From 1990 to 1994, street rehabilitation projects within the historical centre took place, including one Street in İstiklal District. In 2005, Ulus Historical Urban Center was declared a 'Renewal Area' with the Law numbered 5366. In 2007 Ankara Historical City Center initiated a Renewal Area Project by Hassa Mimarlık Anonymous Company but then got cancelled right after the approval of the plan. In 2013, Ulus Historical City Center Urban Site Conservation Master Plan was prepared by UTTA Planning later to be cancelled in 2015.

conservation site. Currently, an urban conservation plan for urban conservation in which the district is located does not exist.

Currently, the Jewish quarter is considered a heritage area and hosts 66 registered buildings. Most of the buildings are still in use with their original residential function but there are also abandoned and partially used buildings in the area. There are quite a few dwellings in poor condition due to abandonment or lack of maintenance. Within the scope of the study, 32 traditional houses, 22 of which are registered, have been studied. In the area, there is one primary school and one high school.

2.2. Characteristics of the Traditional Residential Buildings

The historic urban tissue in the study area represents the characteristics of a traditional residential district with its organic street pattern and Ottoman houses. Dwellings are mostly in the attached order. The traditional Ottoman houses feature stories between 1 and 4, with 2-storey-high houses being the most common ones. Some houses have basement floors as well. Building-building and building-street relations, dimensions and proportions of buildings and public open spaces are designed to a “human scale”.

The studied buildings are *hımış* (i.e., a composite construction system) houses. Their ground floors are mostly composed of stone or mud-brick masonry with timber tie beams, and upper storeys and roofs of timber. The infill of timber frame walls is made using mudbrick, stone, or brick. Some dwellıngs have third floors that are made using a cladding or ‘lath and plaster’ technique, which is known as *bağdadi*. Roofs are covered with tiles. (Hosanlı and Altınöz, 2016).

The buildings in the study area are exposed to heavy rain, and hence at risk of flooding due to the urban and architectural factors that contribute to their vulnerabilities. For example, some openings are below street levels with clear gaps due to the change in the street level.

2.3. Data collection and analysis

This research consists of three phases. First, the historical, geographical, and socio-cultural context of the area, the architectural and urban texture of the buildings and past disasters have been researched. Flood vulnerability parameters that can be used in the vulnerability analysis of cultural heritage sites are identified based on the current state-on-the-art on the vulnerability of historic structures. Second, data regarding the vulnerabilities of the studied buildings have been collected through a site survey using survey sheets. Several factors that may affect vulnerability have been identified during field surveys. Infrasture and drainage system, material and slope of the streets, the structural condition, facade characteristics, and condition of buildings have been examined. A GIS (Geographical Information Systems) database, which includes spatial data about the neighbourhood, was obtained from the Greater Municipality of Ankara. Third, a database which includes data collected through field surveys is developed to be used for analysis and mapping. ArcGIS is used to integrate attribute and spatial data about buildings and open spaces for performing analyses and producing maps.

3. Proposed Flood Vulnerability Assessment Framework

3.1. Parameters for Flood Vulnerability

Various flood vulnerability indicators and assessment methods have been proposed in the literature (e.g., Stephenson and D’Ayala 2014, Blanco-Vogt and Schanze 2014, D’Ayala et al. 2020). In this research, D’Ayala et al.’s (2020) approach to quantifying flood vulnerability is adopted in measuring the vulnerability level for each building and generating a vulnerability index. A semi-quantitative, urban scale assessment approach is proposed. Accordingly, both building and urban fabric characteristics that contribute to flood vulnerability have been taken into account. This approach can be used to comparatively estimate the susceptibility of each building at an urban scale.

Parameters used in the assessment include the number of floors, door threshold, existence of a basement floor or a floor below street level, windowsill, and the effectiveness of roof drainage. Moreover, addressing the water resistance of the building envelope, the indicators including building fabric (materials), and condition are taken into account. Finally, the last parameters identified are related to the near surrounding characteristics that can affect the vulnerability, including surface condition (i.e., inclination, permeability), the efficiency of the drainage system, and the existence of flood prevention measures.

3.2. Flood Vulnerability Calculations and Vulnerability Index

Vulnerability parameters are scored based on a verbal or numeric scale, as suggested by D'Ayala et al. 2020 (See Table 1).

Table 1. Vulnerability Parameters and Their Scores (Reprepared after D'Ayala et al. 2020)

Parameter	Sub-parameter	Possible outcome	*Value*
1. Number of floors		3	100
		2	55
		1	10
2. Door threshold	Door to plinth (street/courtyard)	Below street level (>0)	100
		At street level (0)	55
		Above street level (<0)	10
3. Existence of basement or a floor below street level (negative site drainage)		yes	100
		no	10
4. Windowsill	Window to plinth	<0	100
		(0, 0.5]	55
		(0.5,1]	10
		>1	0
5. Roof drainage	Effectiveness	no	100
		yes	10
6. Building fabric		Timber	100
		Mudbrick	70
		Stone	40
		Plaster	10
7. Building condition		poor	100
		medium	70
		fair	40
		good	10
8. Surface condition	Inclination	towards the building	100
		flat	55
		away from the building	10
	Permeability	no	100
		poor	55
		good	10
9. Drainage system		no	100
		poor	55
		good	10
10. Flood prevention features		no	100
		yes	10

Based on the scores identified for each parameter, the vulnerability rating for each building is defined as VRij (i is for building ID and j is the parameter ID which is taken into consideration). Based on D'ayala et. al.'s (2020) approach, parameters are assumed to be equally important (D'ayala et. al., 2020). Therefore, the overall vulnerability rating of building VIi resulting from all the parameters is calculated as the sum of all scores for each parameter as represented in Equation 1, where the maximum rating can be 1100 and the minimum rating can be 110 for each building.

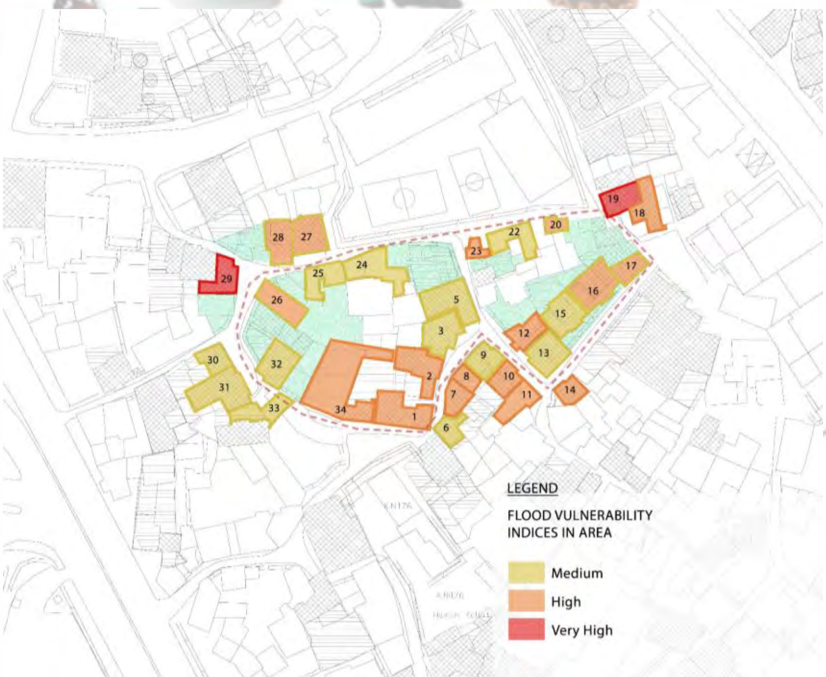
$$\mathrm{VI}_i = \sum_j \mathrm{VR}_{ij} \tag{1}$$

A flood vulnerability index was created with equal intervals, where the minimum rating is 110 and the maximum is 1100 to determine low, medium, high and very highly vulnerable buildings to flooding. According to the indexing, a rating between 100-349 represents a low vulnerability, 350-599 represents a medium vulnerability, 600-849 represents a high vulnerability, and 850-1100 represents a very high vulnerability to flooding.

4. Assessment Results and Discussion

Factors that affect the vulnerability of historic urban districts range from the infrastructure, slope, pavement and condition of streets to the condition and architectural characteristics of historic buildings. For example, the lacking of a proper street drainage system and later interventions such as changing street pavements with impermeable ones increase the likelihood of a flooding incident. In addition, raising street levels, and accordingly, damaging building entrance-street relationships, increase the flood vulnerability of historic buildings with entrances below street level. Architectural characteristics such as the presence of basements, and windows that are close to the street level and the existence of finishing materials of the street facades (e.g., timber, mudbrick) are among the parameters of vulnerability to flooding. Moreover, the poor condition of buildings due to the lack of maintenance and problems such as plaster loss, material deterioration or clogged or inefficient roof drainage affect the negative impacts of heavy rains.

Vulnerability to flooding was calculated separately for each building. The vulnerability levels of buildings are presented in Figure 1. Assessment results show that there is no building in the low vulnerability category. 13 buildings are in the medium, 17 buildings are high, and the remaining 2 buildings are in the very-high vulnerability category.



Vulnerability Range	No. Of Buildings
100-349	0
350-599	13
600-849	17
850-1100	2

Figure 1. Flood Vulnerability Indices Map in Case Study Area

The findings of this research show that measures both at city, neighbourhood and building scales should be taken. There is an urgent need for a Conservation Master Plan which takes into account the vulnerabilities to natural disasters. In addition, Disaster Risk Management Plans should be prepared for the urban conservation site. To decrease the flood vulnerability of the study area, raised street levels should be lowered to their original levels to prevent water penetration into the buildings. The drainage systems should be maintained. The condition of the buildings should be improved based on structural reinforcement and architectural conservation projects developed by conservation specialists. In addition, design solutions should be developed for openings that may be exposed to water penetration from the streets without having adverse impacts on the heritage values of the buildings.

5. Conclusion

This article presents a flood vulnerability assessment approach that is applied to a historic urban tissue. One of the significant aspects of this approach is that it allows decision-makers and users to make informed decisions to prevent and mitigate flood risks and enables prioritizing actions both at urban and building levels. This approach can be improved in the future by addressing social vulnerability considering the characteristics of residents like age, gender, disabilities and awareness levels. This approach can be applied to other similar settings and heritage buildings to improve their resilience to weather-related disasters.

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