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Spatial Analysis of Physical Resilience of Shiraz Metropolitan in Dealing with Flood Risk

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1-Introduction

Understanding the levels of urban resilience and planning to reduce the effects of various risks has a key role in managing urban crises. This research aims to identify areas with different resilience in the eleven districts of the Shiraz metropolis to deal with the flood crisis. Efforts to prevent crises or catastrophes in a part of a city should be designed to increase the community's resilience and sustainable development in several areas (5). By definition, urban resilience is the ability of a city to absorb disruption and maintain its function and structure (6) and the ability to absorb, adapt and respond to changes in urban systems (7), and the ability of an organization to adapt to changes in the environment and it is economic and institutional (8). Unfortunately, in our country, less attention has been paid to the resilience of cities against various hazards, including floods. This study mainly identifies areas with different resilience in the eleven areas of Shiraz to adopt appropriate policies and programs to reduce vulnerability and increase resilience.

2-Methodology

Shiraz has eleven regions, the development of which is mainly towards region 10 and the western and northwestern parts. In this study, while using the criterion of relief level (sub-criteria of the density of fire centers, emergency, medical centers, hospitals, police, and Red Crescent), the status of accommodation (sub-criteria of the density of temporary settlements, population density and occupied spaces), status Access (arterial type density criteria and width of passages), worn texture and equipment placement status by Fuzzy-AHP method in ArcGIS 8.1 software also as a decision support system to pay attention to the degree of resilience in Shiraz and identify areas with less resilience was used. Areas with very high flood risk, high, medium, and low, from the map resilience, were extracted and analyzed to identify areas with different resilience levels (poor, moderate, good, and very good) in flood risk. The present study was performed by kernel function, overlap, membership degree, scalar, and mask, after extracting the relief level criterion (sub-

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criteria of fire centers, emergency, medical centers, hospitals, police, and Red Crescent), status location (sub-criteria of the density of temporary settlements, population density and occupied spaces), access status (sub-criteria of the density of arterial type and width of passages), worn texture and equipment location, to identify areas with different levels of resilience poor, average, good and very good). Flood risk areas (high, high, medium, and low) were extracted from the resilience map and evaluated to assess the resilience status in flood risk.

3-Results and Discussion

3-1-Relief level

The location of fire stations, emergency stations, medical centers, hospitals, police, and red crescent centers has been identified. Currently, there are 22 fire stations, 29 emergency stations, 59 hospitals, 212 medical centers, 42 law enforcement centers, and 2 red crescent centers in Shiraz. Visual analysis shows that rescue centers' main focus is in the center of the Shiraz metropolis. The southern part of areas 1 and 8 has a high level in terms of relief level. Our results indicate poor relief and, consequently, a poor illumination level in areas far from the city center.

3-2-Worn Texture

Urban worn-out structures are more dangerous and vulnerable than other urban lands due to the low quality of building materials and lack of resistance to floods, so they have a weak resilience unless special arrangements are made. In Shiraz, most of the worn tissue density is located in the middle and southeastern parts, so these areas have poor resilience, which is shown as red spots on the map.

3-3- Equipment placement status

According to the information from Shiraz Municipality, crisis tools and equipment are generally located in the region's municipalities and used in the response phase. Based on the location of the municipalities in the area on the map, the lower membership scores (0.21) belong to the areas located in the northwest and southern parts, which in terms of equipment location criteria, from the level they have low resilience in times of crisis.

3-4-Access level

Proper access to roads and providing adequate services to flood victims also reduce vulnerability and promote resilience. In this study, an arterial type map and passage width were prepared based on the information layers of highways, inner-city streets, and alleys

received from the FAVA Organization of Shiraz Municipality. The overlap of these information layers showed that access is generally higher in the western, southeastern, and southwestern parts of the Shiraz metropolis.

3-5-Location status of settlements

Population density and density of spaces occupied were used to evaluate this criterion from the sub-criteria of the density of temporary settlements (parks, squares, and sports halls). Presently, there are 208 parks, 11 gyms, and 92 stadiums in the Shiraz metropolis, all denser in the central, southeastern, and southwestern parts of the city. One of the other components considered in this study was the sub-criterion of population density, which was prepared using data from population blocks obtained from the FAVA organization of Shiraz municipality. Another sub-criterion used in this study was the density of occupied spaces, which Figure 7 (f) shows the situation of inadequate resilience in the central and southeastern part of the metropolis of Shiraz in terms of this sub-criterion. The location map (Figure 7g), which results from the overlap of the components considered in this part of the study, shows the middle, southeast, and southwest parts of Shiraz metropolis, generally from low membership rates and, therefore, less competitive.

3-6-Analysis of resilience based on flood risk areas

To assess the resilience status of flood risk, flood risk areas (high, high, medium, and low) were extracted from the resilience map and evaluated. This study showed that in very high flood risk areas, only 2.83% of the zones had a very good resilience level, and almost half had a good resilience level. (44.51) and moderate (46.26). In high, medium, and low-risk areas, most of the literacy level was moderate, so measures should be taken in the implementation sector and the management levels of the province and city to improve the literacy level. In the face of floods, executives and responsible organizations should consider very high, high, and medium risk areas.

4-Conclusions

This study aimed to identify areas with different resilience rates in the eleven areas of Shiraz at the time of exposure to floods which was carried out to adopt appropriate policies and programs to reduce vulnerability and increase resilience. This study results indicate that areas located in the southeastern parts of District 3 of the municipality and the northern, northwestern, and northeastern parts of District 7 have a low level of resilience in very high flood risk areas. In areas prone to high flood risk in Region 7, the northern parts, northwest, northeast, and also a small part in the south of this region have the least flood resistance. Also, the areas located in the southeast of Zone 3, the north and

northwest of Zone 2, and the northern and northwestern parts of Zone 10 had poor resilience.

Keywords: Urban Resiliency, Flood Disaster, Fuzzy-AHP-GIS, Shiraz Metropolis.

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