Spatial Analysis of the Protected Zone and Vulnerability of Urban Facilities in Mashhad to Useful Airstrikes, from a Passive Security Viewpoint

Hassan Mahmoudzadeh[a], Azar Pouyan Jam[b*], Salimeh Asgharzadeh[c]

[a] *Assistant Professor, Department of Planning and Environmental Sciences, Tabriz University*
[b] *MA in Remote Sensing in Geographic Information System, Tabriz University*
[c] *MA in Remote Sensing in Geographic Information System, Tabriz University*

Received: 31 August 2019
Accepted: 24 December 2019

1. Introduction

By raising the number of wars, especially during the last century, and by increasing the harm and loss of human lives and financial and psychological damage to people, efforts and movements were studied and considered in scientific terms under the passive defense. Today, the aim of targeting the cities with weapons and destroying urban infrastructures, primarily through aerial strikes, is to disrupt morale and cause harm to economic conditions and social systems, which can cause many disasters in case of destruction of such centers because of the high numbers of service users. Considering the importance of urban infrastructures during war, especially during air fights, proper attention to the principles of the passive defense approach has much higher priority in site selection and design. Mashhad is one of the most vulnerable cities of Iran in terms of war for having a high density of population and buildings, vast quantities of deteriorated texture. Since the aerial attack in this city has not been applied, we are trying to investigate the spatial safety of its urban infrastructures.

Many researches have been carried out in Iran on various topics related to passive defense. This research is modeling with the ANP-DEMATEL-GIS approach of boundary protection and vulnerability of urban infrastructures against airstrikes. The following are some of the most significant research activities in this field. Parisi, et al . (2014) used passive defense criteria in Saqqez to enhance urban safety and the need for it at the national and regional levels. Mohammadi Dehcheshmeh (2014) applied passive approach to civil defense on the Ahvaz, which led to the recognition of local standards for particular land use. Sajjadian, Alizadeh and Parvizian (2016), analyzed the risk associated with hospital location in Ahvaz from the perspective of passive defense. Iraqi (2011), Kamran and Hosseini Amini (2012), Zarehpour (2012), Hosseinzadeh (2013), Khmer (2015), and Alizadeh (2015), showed the importance of passive defense studies in urban development and safety of cities.

*. Corresponding author: Azar Pouyan Jam. Tel: +989157640602 E-mail: azar_puyanjam@yahoo.com

2. Materials and Methods

To achieve the objectives of the research, infrastructure Indicators were extracted, including particular infrastructure, emergency services, public and management facilities, and 1560 infrastructure with desk studies and questionnaire planning. To measure the neighborhood pattern, fourteen significant layers in infrastructure vulnerability were identified and determined by distance operator for each layer against the Mashhad airstrikes and weighted using ANP-DEMATEL's combined methods. By adding these weights, standard distance maps were prepared by the ArcGIS spatial analyst and fuzzy overlay tools, and through the Geoda software regression tool, the trend pattern of four category infrastructure were calculated for urban infrastructure distribution against airstrikes.

3. Results and Discussion

The vulnerability can be considered an inherent flaw in the specific dimensions of the city's environment, which is prone to damage to the biological and physical properties of the city and modeling spatial vulnerability in terms of passive defense for the city's potential safe prospects. In the present study, after extraction of damage indices in the urban infrastructure of Mashhad in airstrike, using a hybrid model ANP-DEMATEL-GIS, the analytical level and spatial relationships, as well as the priorities of the vulnerability level from very high risk to very low risk were determined. The results of the vulnerability distribution of urban infrastructure in Mashhad is separable in two levels:
After analyzing the neighborhood trend using ANP-DEMATEL, in the field of effectiveness and influence, health and industrial are recognized as most effective indicators and warehouses and religious buildings classified as most affected indicator. The effectiveness and affectedness of indicators are of the most critical factors in such a way that the risk is recognized from the viewpoint of passive defense and partly on the safety of the effects. The final weight of the model also indicates that police centers, urban facilities and administrative centers respectively have the highest weights of 0.12, 0.118 and 0.117. Religious centers and health centers have the lowest weights of 0.008 and 0.009, respectively. The pattern trend in the evaluation of useful indicators classes in vulnerabilities shows that the highest coefficient between the influential factors of vulnerability is for particular infrastructures and management infrastructures with a coefficient of 1.55 and 1.18 and the lowest coefficient is related to the public infrastructure which is 0.002.

4. Conclusion

Spatial results clearly show that more than 60 percent of the infrastructures are in a vulnerable and insecure condition and that just 5 percent of all urban infrastructures are in a safe or low-risk condition.

Keywords: Spatial Modeling, Vulnerability, Urban Infrastructure, Passive Defense, Mashhad

References (In Persian)

Amanpour, S., Parvizian, A., & Alizadeh, M. (2016). سنجش وضعیت توسعه یافتگی در شهرستان‌های استان ایـلـام [Assessing the status of development indicators in the cities of Ilam province]. *Ilam Culture Extension Scientific Journal*, *16*(48&49), 7-27.

Bemian, M. R., Rafieian, M., Khalesi, M., & Bemian, R. (2013). کاهش خطرپذیری شهر از بلایای طبیعی (زلزلـه) از طریق برنـامـه ریزی کاربری زمین [Reduce the city's risk of natural disasters (earthquakes) through land use planning]. *Scientific Research Crisis Management*, *1*(2), 5-15.

Ghorbani, F. (2014). بررسی وضعیت ساختمان های فرهنگی – مذهبی شهرشیراز به منظور برنامه ریزی و مدیریت بحران شـهری [Investigating the situation of cultural and religious buildings in Shiraz in order to plan and manage the urban crisis]. (Unpublished master's thesis). Islamic Azad University, Najafabad Branch, Najafabad, Iran.

Hosseinzadeh Dalir, K., Maleki, K., Shafati, A., & Heydarifar, M. R. (2012). پدافند غیرعامل و توسعه پایدار شـهری با تاکید بر کاربری های تهدید پذیر کلانشهر تبریز از منظر جنگ. [Passive defense and sustainable urban development with emphasis on the endangered users of Tabriz metropolis from the perspective of war]. *Geography and Environmental Sustainability*, *2*(4), 1-24.

Kamran, H., & Hosseini Amini. H. (2012). تحلیل موقعیت شـهرک اداری شهریار براساس اصول پدافند غیرعامل. [Analysis of the location of Shahriar administrative town based on the principles of passive defense]. *Geography and Environmental Planning*, *23*(3), 163-176.

Khmer, Gh., Salih Gohari, H., & Hosseini, Z. (2014). امکان سـنجی مکان گزینی پناهگاه شـهری با استفاده از مدل IO و روش AHP مطالعه موردی ملات ۱۳گانه منطقه یک شـــهر کرمان [Ability to locate urban shelters using model (IO) and method (AHP) (Case study: 13 neighborhoods in Kerman's first district)]. *Urban Structure and Functional Studies*, *2*(7), 29-54.

Meymandi, S., & Kazeminia, A. (2015). پهنه‌بندی آسـیب‌پذیری شـهر کرمان بر اسـاس اصـول پدافند غیرعامل [Kerman vulnerability zoning based on passive defense principles]. *Land Management Magazine*, *7*(1), 119-144.

Mohammadi Dehcheshmeh, M. (2014). ایمنی و پـدافنـد غیرعـامل شـــهری [Safety and passive urban defense]. Ahvaz, Iran: Shahid Chamran University Press.

Mohammadi Dehcheshmeh, M., & Alizadeh, M. (2018). های شـــهری پذیری زیرســـاخت‌ارزیابی آســـیب کوهدشـــت با تاکید بر پدافند غیرعامل [Assessing the vulnerability of Kuhdasht urban infrastructure with emphasis on passive defense]. (Unpublished master's thesis). Shahid Chamran University of Ahwaz, Ahwaz, Iran.

Naderi, K., Movahed, A., Firoozi, M. A., Hadidi, M., & Isafi, A.(2014). شناسایی و اولویت بندی بافت فرسـوده شـهری با اسـتفاده از مدل تحلیل سـلسـله مراتبی فازی (FAHP) [Identification and prioritization of worn-out urban fabric using fuzzy hierarchical analysis model (FAHP)]. *Space Planning*, *18*(1), 153-180.

Qanawati, E., Qalami Sh., & Abdoli, A. (2009). توانمند سـازی مدیریت بحران شـهری در جهت کاهش بلایای طبیعی (زلزله) (نمونه موردی: شـــهر خرم آباد) [Empowerment of urban crisis management in order to reduce natural disasters (earthquake) (Case study: Khorramabad city)]. *Journal of Natural Geography*, *3*(4), 15-24.

Sajjadian, N., Alizadeh, M., & Parvizian, A. (2014). سنجش استقرار بیمارستان‌های کلان شهر اهواز مبتنی بر اصول پدافند غیرعامل [Assessment of the establishment of Ahvaz metropolitan hospitals based on the principles of passive defense]. *Journal of Spatial Geographical Planning, 6*(24), 169-183.

Shakiba Manesh, A., & Hashemi Fesharaki, SJ. (2009). ملاحضات پدافند غیرعامل در تاسیسات زیربنایی شهری. [Passive defense considerations in urban infrastructure facilities]. Paper presented in *The First Conference on Infrastructure Management*. University of Tehran, Tehran, Iran.

Shams, M., Poursakamoush, J., Saeedi, Sh., & Shahbazi, H. (2011). بررسی مدیریت بحران زلزله در بافت های فرسوده شهر کرمانشاه (مطالعه موردی: محله فیض آباد) [Investigating the earthquake crisis management in the worn-out areas of Kermanshah (Case study: Faizabad neighborhood)]. *Regional Planning Geographical Quarterly, 3*(11), 1-20.

Shojaee Iraqi, M., Tulayi, S., & Ziaian, P. (2011). مکان‌یابی بهینه پایگاه‌های پشتیبانی مدیریت بحران با استفاده از سیستم اطلاعات جغرافیایی (مطالعه موردی منطقه ٦ شهرداری تهران) [Optimal location of crisis management support bases using geographic information system (case study of District 6 of Tehran Municipality)]. *Urban and Regional Studies, 3*(10), 41-60.

Siami, Q., Latifi, Gh., Taghianjad, K., & Zahedi Klaki, E. (2014). آسیب شناسی پدافندی ساختار شهری با استفاده از تحلیل سلسله مراتبی (AHP) و GIS. (مطالعه موردی شهر گرگان) [Defensive pathology of urban structure using hierarchical analysis (AHP) and GIS. (A case study of Gorgan city)]. *Journal of Spatial Geographical Planning, 3*(10), 23-43.

Soleimani, R., & Mehrabi, A. (2014). مدل سازی مکان‌یابی شعب بانک با استفاده از سیستم‌های اطلاعات جغرافیایی GIS (بانک رفاه کارگران): مطالعه موردی [Modeling bank location using Geographic Information Systems (GIS): A case study of the Workers' Welfare Bank]. (Unpublished master's thesis). Shahid Chamran University of Ahwaz, Ahwaz, Iran.

Teymouri, P., Rahmani, B., & Iraqi, S. (2010). بافت فرسوده ملایر و راه‌های ساماندهی آن [The worn texture of Malayer and the ways to organize it]. *Geographical Journal of Environmental Management, 3*(8), 118-134.

Zarepour, M., Jafari, S., & Bonabi, S. (1390). امنیت سامانه‌های متحرک [Security of mobile systems]. Tehran, Iran: Islamic Azad University Press.

References (In English)

Alexander, D. (2007). Disaster management: From theory to implementation. *Journal of Seismology and Earthquake Engineering, 9,* 49-59.

Coaffee, J. (2009). *Terrorism, risk and global city.* Birmingham, Iran: Birmingham University Press.

Gaetani, F., Parodi, A., Siccardi, F., Miozzo, D., & Trasforini, E. (2008). The structure, role and mandate of civil protection in disaster risk reduction for South Eastern Europe. *United Nations International Strategy for Disaster Reduction (UNISDR), Geneva*.

Hossein A, Hassan, A, Shayesteh, Brnafr, M. (2010). Evaluating the structure Langeroud Passive defense planning. *Applied Research Journal Science Geography, 18,* 18-29.

Kapucu, N. (2012). Disaster and emergency management systems in urban areas. *Cities, 29,* 41–49.

Leritina, G., Hauskenc, K. (2011). Preventive strike vs false targets and protection in the fence strategy. *Reliability Engineering and System Safety, 96,* 912-924.

Li, A., Nozick, L., Xu, N., and Davidson, R. (2012). Shelter location and transportation planning under hurricane conditions. *Transportation Research Part E: Logistics and Transportation Review, 48,*

Tang, A. & Wen, A. (2009). An intelligent simulation system for earthquake disaster assessment. *Computers and Geosciences, 35,* 871–879.

Yang, J. L., & Tzeng, G. H. (2011). An integrated MCDM technique combined with DEMATEL for a novel cluster-weighted with ANP method. *Expert Systems with Applications, 38,* 1417–1424.