Investigating the Optimal Spatial Establishment of Urban Green Spaces Using the Fuzzy Logic Method in GIS Environment (Case Study of District 4 in Tabriz)

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1. Introduction

Due to the emergence of the concept of sustainable cities and the creation of vibrant urban space, the significance of urban green spaces and their establishment has become more evident than before. It is now in the urgent need of attention given the problems such as the increase of urbanism, population density, – pollution, and the warming of urban atmospheres. One of the major relevant challenges is the proper distribution of green spaces in modern cities. This is a dominant aspect of spending leisure time for people in cities, which also enables citizens to have a better chance of access. Hence, the establishment of urban green spaces as a manifestation of urban renewal has been a topic of concern in the past century, and it has been accelerated during the recent decades. However, this issue should be treated more scientifically. Due to the mentioned challenges and their significance, this research measures the optimal establishment of urban green spaces in District 4 in Tabriz. District 4 is the most populated urban residential area in Tabriz. Despite the district condensed population, it involves only a few green spaces. Therefore, building and locating urban green spaces-tailored to the needs of the district population is quite necessary.

2. Theoretical Framework

Green urban space is considered as a level of urban land use with vegetation, bearing both the ecological and the social outcomes. Ecological outcomes include the beautification of urban areas, decrease in environment temperature, oxygen supply, and increase in soil infiltration in the presence of different types of

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precipitation. By contrast, social outcomes of green urban spaces should be sought in the improvement of life quality, and the increase of social happiness and spirit. Urban parks are important public service spaces in a city. They play a vital role in promoting social, cultural, economic and environmental conditions of urban areas. As urban areas grow and become populated, societies come to acknowledge the role and value of parks and green spaces. Various strategies are invented and employed to properly locate and distribute such spaces in urban environments.

3. Method
This is a descriptive-analytic research. To analyze the optimal spatial establishment of urban green spaces in district 4 in Tabriz, the required data were gathered in two phases, namely descriptive(via studying library documents) and analytical phase. In the analytical phase, the layers of 12 selected land uses were fuzzified using fuzzy membership functions in GIS software environment. Then, they were evaluated by using fuzzy gamma operator.

4. Discussion and Conclusion
To analyze the research data, first, the layers that were constructed in Arc GIS 10 software were given fuzzy membership after being digitalized and categorized in the form of spatial analysis toolbox and fuzzy membership analysis package. To investigate the fuzzified indexes, fuzzy operators had to be utilized. In this research, three thresholds (7.0 , 8.0 and 9.0) were tested in defining fuzzy gamma operator threshold. The findings from testing the threshold showed that considering the existing conditions for establishing the selected land uses in this research, threshold 0.7 was more successful in making a flexible compatibility between increasing and decreasing trends in land use with respect to the urban green spaces establishment and proximity. The final maps derived from the outputs of the fuzzy analysis showed that given the present condition of establishing land uses in District 4 in Tabriz, and their increasing and increasing trends, threshold 0.7 analyzed the optimal spatial establishment of the urban green spaces more properly in comparison with the other two thresholds. In this threshold, regarding the proximity and locating of urban green spaces, the results of industrial workshops were applied to this district with more sensitivity and precision compared with the other two thresholds. According to the findings of this operator, some central and southeastern areas of this district were more proper for the establishment of urban green spaces given the existing conditions.

5. Suggestions
Shifting or transferring land use into industrial and military functions - mostly in the form of military or industrial workshops, which are also in the proximity of residential areas - prevents the establishment and improvement of compatible

applications including urban green spaces in the district. Vast agricultural land and barren lands could be changed into green spaces for spending leisure time given the large population of the district.

Keywords: Green space, Fuzzy logic, Spatial establishment

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