Geographical Expression of Urban District Sustainability based on Spatial Multi-criteria Analysis (Case Study: Mashhad Metropolitan City)

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Extended Abstract

1. Introduction

Sustainability is one of the most important multi-dimensional challenges in cities. Certain issues faced by metropolitan cities in developing countries include the multiplication of urban areas, formation of low-density textures in suburbs, service provision problems, and social challenges which has increase the severity of urban unsustainability. In this study, urban sustainability assessment is introduced in several continuous optimistic and pessimistic scenarios. Notably, the innovation here involves the use of spatial quantities at a local level (per capita, access, density, population under coverage) as well as the approach of using spatial multi-criteria decision making methods in creating a scenario for urban sustainability. The purposes of this study are as follows: first, to determine the sustainability level and ranking of Mashhad municipality districts based on sustainable city indices; and second, to indicate sustainability scenarios according to the extent of importance and effectiveness of each index within various dimensions of sustainability across Mashhad city districts.

2. Review of Literature and Theoretical Framework

There are numerous academic studies conducted on sustainable city and sustainable development both in Iran and in the world. Research on sustainability in urban areas gradually began in academic and political environments since the late 1980s and 1990s. Rachel Carson's book, *Silent Spring* in 1962 was the beginning of the modern environmental movement (Dobson, 1991). Sustainability has been broadly defined as a development style that meets the needs of current generations without endangering future generations' ability to meet theirs (Mebratu & White, 1998). Mathur, Price, Austin, and Moobela (2007) examined the status of beneficiaries' influences in projects based on multi-criteria systems aimed at sustainability. Walter, Kropp, and Lein (2013) assessed sustainability in an urban environment using a method with a mix of scenario and spatial multi-criteria decision making. It appears that the demand for sustainable urban development is one of the most important challenges faced by mankind in the 21st century (Bikdeli, Shafaghi, & Vosughi, 2017). The sequential weight average multi-criteria decision making is a

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method for obtaining sequential weights. Consequently, the sequential weight average approach enables the assessment of an extensive spectrum of consequences brought about by various management strategies. In this method, a fuzzy quantimeter is used to apply a verbal variable in the integration of layers. In ranking for instance, "all" criteria should present or half of the criteria. By indicating the proper sequential weight, an extensive spectrum of resulting plots (decision making strategy) can be produced which demonstrate the results obtained from different attitudes of the decision maker with respect to risks.

3. Method

The present inquiry is a developmental, applied study conducted using the descriptive-analytical method. The investigated indices included 53 variables and indices in six social, economic, physical, environmental, cultural and administrative dimensions; indices were given weights through the specialized comments of experts and pair comparison. The entire data were located and ranking, spatial analysis, and scenario creation were carried out in ArcGIS and Expert Choice using the sequential weight average multi-criteria decision making model.

4. Results and Discussion

In this study, the extent of indices' risks were selected based on their impact on humans' health and lives. As a number of indices involved recreational aspects, the type and the extent of risk did not significantly impact district sustainability. According to the effective variables on the six examined dimensions in this study, the selected scenarios (verbal quantimeter) were indicated as follows: "Half" for dimensions of management-institutional and cultural-recreational; "Many" for physical-infrastructural and economic; "Most" for social; and "All" for the environmental dimension. Ultimately, given the status quo of indices and the considerable importance of the environmental dimension, a pessimistic scenario was drawn for all dimensions related to city district sustainability. Compared to the results of previous studies, the findings of this research is different in method and scale; the superiority of this method in producing multifold scenarios involves portraying a spectrum of different unsustainability conditions for cities which was unattainable in previous methods. The second is the scale of this study and providing results at district level; the present inquiry has a different feature where variables are geographical as opposed to previous. Both the optimistic and pessimistic scenarios were investigated in the modelling in this study. In the neutral, medium risk scenario (Half), highest ranking districts based on all sustainability criteria included Razi, Shariati, and Shahed (District 10), Jahed Shahr and Sadeghieh (12), Ershad and Kuy-e-Doctora (1), Onsori District (8) and AghaMostafa Khomeini (5). The most unsustainable districts included Shahid Ma'ghoul, Keneh Bist and Mahdi Abad (5), and Motahhari (2).

5. Conclusion

The sustainable city is considered as a sensitive global subject in the sustainable development approach (Arman 11). It is a subject that should be addressed with utmost seriousness both at local and global levels. Nevertheless, there are shortcomings in information, method, and type of planning and policymaking, the issues of which are obviously much more apparent at the local level. The sustainability status was determined with respect to the type of selected scenario in districts; therefore, it is necessary to provide sustainable development strategies to improve these districts. The superior capabilities of sequential weight average over other multi-criteria decision making methods include flexibility and scenario creation. Ultimately, it is recommended that considering the efficiency of the model in ranking systems and esp. the spatial multi-criteria, perfectly appropriate and diverse patterns can be provided for managers and planners. Moreover, results of scenario creation in this model offers urban authorities and managers a context to compare different scenarios and alpha changes and consequently, changes in district raking, in addition to the involvement of all factors. Determining the extent of risk-taking and recognizing variables' ability in compensation are the most important principles in determining verbal quantimeter and requires special examination and using the comments of experts. The main challenge in continuing the path toward sustainability include index creation and possession of timely, correct, precise, and located data based upon global indices and standards, from the local to international level according to domestic circumstances which should be prioritized by municipalities.

Keywords: Assessment, Ranking, Sustainable City, Sequential Weight Average, Mashhad Metropolitan City

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