Application of RS-GIS Models in Urban Expansion Optimization with Emphasis on Environmental Protection (Case Study: Hamedan City)

Ahmad Roumyani [1]
Ph.D. Candidate in Geography and Rural Planning, Ferdowsi University of Mashhad, Mashhad, Iran

Heidar Salehi Mishani
Ph.D. Candidate in Geography and Urban Planning, University of Zanjan, Zanjan, Iran

Leila Vosoughi Rad
Ph.D. Candidate in Climat Hazard, University of Zanjan, Zanjan, Iran

Bahman Ghaderi
Ph.D. Candidate in Geography and Urban Planning, Shahid Beheshti University, Tehran, Iran

Samad Amraie
M.Sc. in Geography and Urban Planning, Islamic Azad University, Malayer Branch, Malayer, Iran

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Extended Abstract

1. Introduction

In recent decades, the growth of cities, especially in developing and underdeveloped countries, has led to the marginalization of villages, the increase of population growth and the migration of a large part of the rural population to urban centers, and thus causing many problems for such countries. This, in addition to changing land use patterns, has had widespread effects on society, regional and local economy, and the environment.

2. Theoretical Framework

Given the population growth and the expansion of cities in the world, it is expected that around 60% of the world's population will live in urban areas by 2030, of which 90% will be in developing countries. Therefore, monitoring urban changes requires consideration of two key points: 1. changes based on description and analysis of spatial distribution and structural characteristics of urban land use, 2. modeling and predicting the change of space time and turning it into important issues. Recent advances in remote sensing, GIS, space earth techniques and advances in fields such as the ecologic perspective on quantity, monitoring, modeling and prediction of urban development have a significant impact on the management of the city's physical expansion on the one hand and the preservation of environmental resources on the other hand. Therefore, using remote sensing data, one can understand the changes in urban patterns, model the development and changes of urban processes, and prepare physical development maps of the city and analyze the map of the land cover in relation to it.

1. Corresponding author: aromyani@gmail.com

The physical development and growth of Iranian cities was coordinated to meet the needs of urban communities and environmental resources several decades ago, but with the advent of new developments, cities (especially the big cities) quickly embraced changes and upheavals. These transformations have become uneven and disproportionate to the environment in the form of rapid population growth and accelerated physical expansion of cities. According to UN statistics in 2011, the percentage of population living in urban areas in Iran in 2020 will be 70.6% and in 2050 it will reach 78.2%. This causes the greatest damage to the natural and environmental resources of the city. This has led many scholars to study this matter. Therefore, although there are relatively many studies on the use of satellite imagery in land use mapping, integrating this process with the optimal location of future expansion with taking into account the environmental issues will be a novel idea.

3. Method

The main objective of this study was to evaluate the expansion of Hamadan during 1986-2011 and predict how it will expand by 2025 in order to provide an appropriate model for finding the best directions for the expansion of the city. To achieve this, remote sensing data (RS), geographic information system, and hierarchical model are used. The main source of remote sensing data is Landsat satellite imagery, which was used after applying radiometric and geometric corrections. According to the objectives of this research, firstly, the land use map was developed using the FUZZY ARTMAP model. To evaluate the accuracy of this classification, images of Google Aras which has a quality of half a meter were used. Then, land use changes were calculated using the LCM model during the study period, and based on land use variations in this interval, the trend of these changes by 2025 was determined using the CA-MARCOV model. In the next step, in order to optimize the location of the city's development process, appropriate indicators were selected and each of the indicators was evaluated according to the purpose and according to the experts' opinion in the hierarchical analysis model. Finally, each of the layers was combined with respect to their relative weights using the Weighted Overlay function, and the final map was obtained.

4. Discussion and Findings

This research was conducted to evaluate and optimize the physical development of Hamedan city with emphasis on environmental protection. For this purpose satellite images were first examined in 1986 and 2011. Then, considering the current trend of the city, the CA-MARKOV model was used to predict its expansion by 2025. Finally, in order to optimize the city's development, the criteria were selected and the best areas were identified with the AHP model. Therefore, in Hamedan, surveys show a sharp decline in agricultural lands and gardens as a result of their conversion into lands. Thus, using the AHP model, land characteristics were divided into five categories according to the needs of urban development, from the very appropriate to completely inappropriate, so that the future development of the city has taken place only in lands without vegetation that has the proper conditions for the physical development of the city.

5. Conclusion and Suggestions

The results of evaluation of satellite images showed that the highest increase in user levels in the urban area of Hamedan during the mentioned years was the use made for the lands. Meanwhile, agricultural lands with the gardens of the region show the highest decline. If the city continues to expand, by 2025, an area equivalent to 720.6 ha of agricultural land and vegetation will be destroyed. Therefore, finding the location for optimal city development is essential. Therefore, the findings showed that the area of 18012.52 hectares in the region was 77.71% with perfectly suitable conditions for the mentioned purpose. According to the findings, the best places to expand the future of Hamedan are mostly in the northwest and east of the city. Also, southern parts due to dense plant cover, high quality agricultural land, limitation of elevation and gradient lack proper value for urban development. According to the results of the research, it is better to make this expansion in perfectly suitable places to minimize damage to the environment.

Keywords: Optimization of Urban Development, Hamedan, GIS, Remote Sensing.

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