Changes in Urban Spatial Structure in Lahijan, Iran, Using Landscape Ecological Concepts and Metrics

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Extended abstract

Introduction

Earth's landscape is continously changing due to natural and human factors. Changes of cities and urban sprawl become faster because of human intensive modification of environment in favor of economic land uses for utilization of society. Urban sprawl is the most important socioeconomic and spatial phenomenon that makes environmental changes faster and widespread. Landscape and land uses are changing rapidly due to driving forces of urbanization and population growth. Analyses of the composition of land-uses in a natural environment and understanding how they may change over time and space are central for planning. Analysis of spatial and temporal variations of landscapes is linked to prediction of future development of the city and its control is one of the main concerns of environmental managers and planners. For this purpose, remote sensing techniques and geographic information systems are essential tools to assess urban landscape to determine the changes in urban development. Remote sensing technology is the best tool for monitoring environmental changes and rapidly extraction of land uses. Landscape is a mosaic, tens of kilometers wide in which local ecosystems and land uses are repeated and as a matter of fact it is the nature and general characteristics of an area. Landscape metrics are a suitable tool for quantitative characterization of spatial patterns. Quantitative measures can be obtained by assessing the landscape metrics, which illustrate the quantitative changes of the current state of the landscape. The purpose of this study is to investigate spatio-temporal variations in Lahijan city to evaluate the process of structural changes in urban land use and the landscape principles and metrics.

Methodology

To achieve this goal, Landsat images of ETM+ and OLI in the years 2000 and 2016 were used to prepare land use maps at first and the study area were separated in ENVI 5.1. The classification has been done through maximum likelihood algorithm in this software, by one of the methods of supervised classification. For monitoring the change detection of land use in this period, the produced maps of 2000 and 2016 were compared in IDRISI SELVA software. The land cover changes map of the period from 2000 to 2016 were created using CROSSTAB algorithm. The rate of land use change during this period was calculated. Converting the rate of a land use change to another and the area of each land use was calculated separately. Finally,

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using landscape ecology metrics approach the following metrics were calculated in two levels of class and landscape; these metrics are including Class area, Number of Patches, Largest Patch Index, Landscape Shape Index, Total Edge, Eudidean Nearest Neighbor Distance, Patch Area Mean, Perimeter-Area Fractal Dimension, Contagion, Shannon Diversity Index. Spatial pattern was determined with Fragstats 4.4 software to extract landscape metrics in two levels of class and landscape. This software includes a complete series of landscape metrics that are suitable for spatial pattern analysis.

Results and discussion

The results revealed that the matrix area is agriculture and also the trend of changes shows that the area of agricultural land use has increased. This means increases in semi-natural land use. The number and the total edge of the agriculture patches have decreased; this means more aggregation and compactness of these patches. Increase in the Largest Patch Index and Patch Area Mean shows that agriculture land use became more integrated. Increases in the Eudidean Nearest Neighbor Distance indicated that distance between agriculture patch has increased. The Perimeter-Area Fractal Dimension of agricultural land use has augmented slightly and, therefore, its complexity has increased.

Increases in the area and the number of urban developed patch showed a fragmentation in the urban built class and creation of new man-made areas. The shapes of urban built patch were increased and, therefore, it was disaggregated and total edge was increased and this land use was disconnected. The Largest Patch showed belongs to urban class. Reducing Eudidean Nearest Neighbor Distance of urban patches leads to an increase in aggregation and slight decrease in Mean Patch Area. The Perimeter Area Fractal Dimension for urban built class was increased and its complexity has also increased. The area and the number of greenery land patches were decreased, and also landscape Shape Index was decreased. This led to green cover class to become more aggregated and compact. Decrease in the values of Total Edge, Largest Patch Index and Patch Area Mean for green cover class indicated a destruction in natural and forest areas. Decreases in the metric of Perimeter Area Fractal Dimension of green cover resulted in decreasing its complexity. Increases in Eudidean Nearest Neighbor Distance of green cover led to isolation of these patches and, therefore, decreases in ecological connections between them. Examining the metrics on the landscape level revealed that the complexity of the landscape of the region became simple and the diversity of the landscape pattern is decreased. The results of monitoring the changes between 2000 and 2016 indicated that the dominant land use changes belong to conversion of natural land cover class into agricultural land use. In the later stage, all types of land uses tend to be converted into urban construction class. Increase in urban constructions means increase in man-made patterns and more influences on natural areas.

Conclusion

In this paper we evaluated the dynamics of urban land-uses and the changes as one of the biggest human impacts on the terrestrial environment. Understanding this change in the spatial configuration of urban areas and urban growth over time will be important for decreasing the impacts of urban growth. The results of this research showed that to prevent destruction process of forest cover by increasing the unplanned urban development, it is essential to prepare development plans for resource management to achieve sustainable development. It seems that if this process is continued in the future, it can destroy green areas. If appropriate and professional policies are not made, all of patches are changed into urban built areas and even this city may be linked to another city. It was suggested that we should use predicting models to determined future developments and make decisions based on sustainable development goals to prevent unsuitable development.

Keywords: landscape ecology, metrics, remote sensing, land cover, urban built.

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