Modeling Land Use and Land Cover Dynamic Changes in Tianjin City

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In recent years, urban areas are expanding at a very high speed in the developing world, and with the rapid urban growth, many environmental and social problems are emerging. Under these circumstances, analysis of the land use and land cover (LULC) changes is a useful method to catch the urban trend and to forecast the feature of LULC conditions. LULC changes exert a direct impact on biodiversity, water and radiation budgets, emission of greenhouse gasses, carbon cycling, and livelihoods. The study of LULC and its dynamics is necessary for environmental management, particularly regarding sustainable agriculture and forestry.

Taking Tianjin, China as a study area, an attempt is made here to study land use changes and their driving factors. China is a developing country, and Tianjin is a municipality under the central government. Tianjin, one of China's four municipalities with a famous international port, is a birthplace of modern industry. Tianjin is also one of the earliest coastal cities opening up the north China's shipping and industrial centers. From 1995 to 2015, many factors such as land price, environmental damage, population and GDP increase have caused the rapid transformation in the LULC. The general trend of LULC is unalterable. Therefore how to forecast and evaluate the urbanization tendency is critical for planning the healthy city development.

Remote Sensing and Geographical Information Systems are useful tools for detecting geographical objects and phenomena changes. Landsat images are used in this study. All the Landsat images are pre-processed in ENVI and ArcGIS. The processing techniques include bands composition, mosaic, classification, etc. IDRISI software is adopted for analyzing summary statistics, Markov probabilities, and cellular automata simulation. First of all, using remote sensing to make classification maps in 1995, 2005 and 2015 respectively. And then using simulation models, an attempt is made to evaluate the land use and land cover changes during the 20 years. At last, by employing Markov Model and Cellular Automata Model, the LULC scenario in 2025 and 2035 was simulated and forecasted on the basis of land use type interpretation using DEM, slope, and range of distance in 2005 and 2015.

The result of the land use map analysis in 1995, 2005 and 2015, shows that most of the cropland areas were transformed into the built-up. The expanding speed into the built-up was in accordance with the growth of GDP per capita. Some of the medium cities were transformed into the regional hubs. Water and forest areas were stable with few changes. Protected areas were maintained as the preservation of natural resources.

This study demonstrates that the integration of satellite remote sensing and GIS is an effective approach for analyzing the rate of growth and spatial changes in land use and land cover in growing megacities. Furthermore, the combination of these two technologies with Cellular Automata Modeling and Markov modeling are useful for understanding the LULC change process.

Keywords: Urban Growth; Cellular Automata Model; Markov Model; Neighborhood Interaction; Remote Sensing; GIS

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