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Urban economy development and ecological carrying capacity: Taking Beijing city as the case

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Abstract

A city can obtain most of natural resources from outside of city for its development, but the ecological carrying capacity of it is limited. Urban economic development in some countries or areas is still maintained a high speed, but their ecological environment has deteriorated sharply. That means their economic has grown out of the limit of ecological carrying capacity. In the paper, the urban ecosystem is divided into population subsystem, economy subsystem, and resources and environment subsystem; the relationship among the three subsystems is analyzed based on eco-economic theories; after then, a theoretical framework of urban ecological carrying capacity is established. Due to urban ecosystem is a dynamic system with complex feedbacks, a System Dynamics model including three subsystems for is set up to measure urban ecological carrying capacity. Finally, the relationship between ecological carrying capacity and economic development in Beijing city from 1996 to 2012 were analyzed. Three scenarios in different economic growth pace are designed; the tendencies of deterioration of ecological environment in Beijing under different Scenarios are analyzed to explore the balance between economic development and ecological protection.

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Keywords: urban economy development, ecological carrying capacity, ecosystem, system dynamics model

1. Introduction

Cities have played very important roles in national economic development, but due to the high concentration of population and consumption of resources, the destruction of the urban environment have become more serious. It is generally believed that the city's economic development and human activities

will dramatically affect the ecological environment. However, what is exactly the relationship between economic growth and ecological carrying capacity in a city? How does the urban development impact on the environment? How to find a balance between economic developments with environmental protection in a city?

Most scholars^[1-2] have analyzed the relationship between single ecological indicator with some economic indicators, such as water resources carrying capacity, land carrying capacity, and so on. Some of scholars^[3-4] conducted a comprehensive study, and calculated some ecological carrying capacity and economic indicators. Due to using static theories and methods, it is hard to deal with the dynamic processes, as well as the ecological carrying capacity. Although evaluation of single factor carrying capacity is currently mature, but city is a more comprehensive, complex feedback system with a number of factors, which include resources, population, environment, socio-economic, and technique, policy, etc.,. System dynamics can be a good solution to deal with a complex feedback system, including ecological carrying capacity^[5-8]. By the method of computer simulation, the relationship among factors and subsystems, and the variation tendency can be explored, and pursuit the optimal solution by adjusting system parameters and structure^[9].

The innovation of this paper lies in: the theoretical framework of urban ecological carrying capacity is established; an open system dynamics model of urban eco-economic system is set up, which is divided into the population subsystem, economy subsystem and resources and environment subsystem. The city's resources are divided into external and internal resources, which are individually considered into urban ecological carrying capacity according to their different roles.

2. Data and Method

2.1. Study Area and Data

This paper will take the Beijing city as a case to analyze the relationship between economic development and ecological carrying capacity. Beijing city is an international metropolis with more than 21 million permanent residents, and 8.0% economic growth rate (China City Statistical Yearbook 2014). The general urban problems in the world, such as population concentration, air pollution problems, are existed in Beijing city also. At the end of 2013, the city's resident population is 21.148 million people. The density of resident population is 1,289 people per square kilometer. And the density of population in the center districts of Beijing (Dongcheng District, Xicheng District, Haidian District, Chaoyang District) is 9529 /km². For recent 5 years, the mean of GDP growth rate has been more than 7%, but the environmental pollution has become more and more serious, especially the long-standing serious haze weather, get the attention of the whole world.

In the study, the data came from them: Beijing statistical yearbook(1995-2012); China statistical yearbook(1995-2012); China environment statistical yearbook(1995-2012); China land resources statistical yearbook(1995-2012); China City Statistical Yearbook(1995-2012); Beijing state of the Environment Bulletin(1993-2012). And some official website in China, such as the National Bureau of Statistics website (<http://www.stats.gov.cn/>), China Ministry of land and resources website (<http://www.mlr.gov.cn/>), Chinese Meteorological Administration website (<http://www.cma.gov.cn/>), the Beijing Meteorological Bureau website (<http://www.bjmb.gov.cn/>)

2.2. Methods

Ecological carrying capacity system is a complex system composed of internal relations complex, interconnected subsystems. Carrier of environmental carrying capacity is the "environment", bearing

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