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Development priority zoning in China and its impact on urban growth management strategy

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ABSTRACT

Urban growth management is a popular topic for study area all over the world. Despite the increasingly rich literature, however, little has been considered of the complex relationship between the various urban development factors and their feedback structure. This paper contributes in understanding the mechanism of, and establishing a link between, urban growth management oriented by zoning in China (namely development priority zoning or DPZ). A system dynamics urban growth model is presented that is integrated with China's socio-economic development situation. With Yiwu city and Qingtian County as case studies, the model is applied in simulating urban growth under different driving modes. The results indicate that the DPZ in these two areas has an influence on urban growth management strategy, with the driving mode of urban growth affecting economic development levels, migration and types of land conversion. It is concluded that different driving modes are needed for different types of regions according to the functional positioning of their DPZ and that the model contributes to their identification.

1. Introduction

Managing urban growth is an important contemporary topic worldwide. Due to rapid economic growth and urbanization, there has been widespread urban sprawl in western cities since World War II (Sheridan, 2007), causing many problems, such as deterioration of the environment and the inefficient land use (Freeman, 2007; McCann & Ewing, 2003; Carruthers & Ulfarsson, 2003; Kahn, 2000; Zeng, Liu, Liu, & Qiu, 2013; Elbeih, Shalaby, & Deen, 2013; Ewing, Pendall, & Chen, 2010; Lata & Rao, 2001). These have presented a great threat to urban sustainability, leading to many new urbanism theories and practical methods (Smith, 2002; Filion & McSpurren, 2007), with growth management becoming widely used by western nations. In North America, Europe and Japan, urban growth management provides an important means of controlling urban sprawl and encouraging intensive development (Martin, Pendall, & Fulton, 2002; Munton, 1983; Sorensen, 2003). The effect of acceleration of economic development and globalization on urban sprawl has not only troubled North America, Western Europe and other developed countries, but also many developing countries too (Sun, Tang, & Zhang, 2011), which have even more pressure in managing urban growth (Wu, Han, & LAI, 2009).

China has been experiencing a period of rapid urbanization, with its urban population reaching more than 50% of the total population in 2011 according to National Bureau of Statistics data - entering the upper half of the "S-shaped urbanization curve" (King & Golledge, 1978). By 2014, it had increased to 54.77% from the original 17.92% in 1978, with an annual average growth of 1% (National Bureau of Statistics, 2015). It is predicted that China will have an additional 310 million urban residents by 2030 (UN, 2013). However, the population and industrial distribution deviation index shows that there is a huge mismatch between the spatial distribution of the population and economy activities in China (Xiao & Shen, 2012). Moreover, urban-rural construction involves a dual inefficient expansion phenomenon. It is inefficient in that urban land in cities is mainly expanding outwards, while the farming population in rural areas continues to reduce because of migration, increasing the amount of rural residential land. How to guide migrant movement, so that the population and economy agglomeration are matched, therefore, is a question of considerable importance in China.

In order to solve these problems, the Chinese government has implemented a strategy of development priority zoning (DPZ) since 2011, with the target of regulating the order of space development and forming a rational structure. There is no doubt that, as a spatial planning

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strategy (Fan, 2009), DPZ can it be carried out well only when it focuses on land (Wu, Peng, Zhang, Skitmore, & Song, 2012). Cities are the main driving force for regional development, however, and, as Ding (2005) points out, China's urban land use has excessive expansion and extensive growth spatial development characteristics. This kind of urban sprawl leads to the decreased efficiency of urban land and a waste of land resources, as well as environmental degradation and the reduction of cultivated land. In other words, against the current background of rapid urbanization, the utilization of urban land not only determines the efficiency of land use, but also maintains the ecological function of the land. Rational urban growth is therefore the key to the rational use of regional land, and is one of the preconditions for fulfilling the DPZ strategy.

This paper contributes to understanding the mechanism of, and establishing a link between, urban growth management in China oriented by DPZ. Starting from urban growth strategy, we investigate the adaptation of DPZ and the driving mode of urban growth. In terms of the research approach, there is a lack of studies in both developed and developing countries of the complex and changing relationships between various urban development factors and their feedback structure. The dynamics and feedback characteristics of the system dynamics model can be used to explain the change of urban growth in a more comprehensive way. Therefore, the system dynamics approach provides a suitable means for carrying out the urban growth boundary (UGB) in the complex system associated with DPZ and urban growth management in China today. In this paper, a system dynamics model is used to describe and design the feedback relationships between the population, economy, land and DPZ strategy.

2. Development priority zoning (DPZ) and the urban growth boundary (UGB).

2.1. Development priority zoning (DPZ)

DPZ is the guideline for optimizing the spatial pattern of regional development in China, which entails both theoretical and methodological innovation in the academic field of economic geography (Fan, 2009). As a Chinese innovation, DPZ was gradually formed based on summarizing the practical experience gained from the country's regional development strategy and learning from developed countries about the relative conceptions of national spatial development. Although Western countries do not use the DPZ concept, the origin of its ideology can be traced back to the Western concept of *zoning* (Peng, 2009). Zoning is one of the main tools used by urban planners to control urban development, including the types of land use, open space and construction density (Wilson et al., 2003). Internationally, using zoning to promote the reasonable development, or protection, of resources is also the concern of academe. Conway and Lathrop (2005) use a simple spatially explicit model to explore potential build-out conditions under different sets of regulations, and assert that it is a way to examine the impact of future urbanization and alternative land use regulations on the environment before irreversible changes are made. Deboudt, Dauvin, and Lozachmeur (2008) note that the institutional framework for coastal zone management in France has often foundered due to difficulties related to natural heritage reservation and land use planning designed to control urban expansion in coastal areas, arguing that the coordination of management and protection activities can considerably improve the situation. Moreover, studies such as the economic analysis of zoning (Crecine & Jackson, 1967) and methods for ensuring fairness between different zones (Wolfram, 1981) have a particular significance for China for improving the policies of DPZ.

Based on the theoretical foundation of developed countries, China's strategy of DPZ covers a series of concepts, including spatial equilibrium, development according to resource capacity, providing ecological products, adjusting spatial structure and controlling development intensity (Yang, Yuan, Zhang, Dong, & Sun, 2012). However, DPZ planning was initiated very recently and therefore academic research has mainly concentrated on theoretical principles (Li & Mi, 2008; Zhu, Qiu, & Ma, 2007; Fan, 2009), partitioning approaches (Zhang & Li, 2007; Ding, Gao, & Zhou, 2010) and supporting policies (Zhang, Chen, & Zhang, 2007). While the literature indicates that DPZ has become the most important policy influencing China's urban growth, there is nevertheless a lack of studies into the complex and changing relationships between DPZ strategy and urban growth management. With its further implementation, the effects of development factors such as land expansion, economic promotion and population growth are expected to be the subject of new studies.

2.2. Urban growth boundary (UGB)

The UGB is one of the most widely used planning tools in growth management to control urban sprawl, curb speculative behaviour, improve the efficiency of city services and conserve the areas outside boundaries (Jun, 2004; Tayyebi, Pijanowski, & Tayyebi, 2011; GreenbeltAlliance, 2012). The American Planning Association suggests that UGB be established "to promote compact and contiguous development patterns that can be efficiently served by public services and to preserve or protect open space, agricultural land and environmentally sensitive areas" (Meck, 2002). As a proactive growth management tool, the UGB limits urban development to within a reasonable and fixed area (Calthorpe & Fulton, 2001; Anderson, 1999) to promote compact and continuous urban development, and avoid low-density and dispersed development (SmartGrowthBC, 2012). On the other hand, some argue that UGB can yield undesirably draconian outcomes (Brueckner, 2000). It is important to understand that, rather than limit and conflict, the purpose of urban growth management is to provide a balance. As Chinitz (1990) notes, growth management is aimed at maintaining the equilibrium between development and protection, form of development and infrastructure supply, public service demand and financial capacity, as well as progress and equity. It is a dynamic process in which governments balance local and regional interests, as well as conflicts over land use objectives, to adapt to community development (Chapin, 2008). This is reflected in Lv and Xu's (2010) research, which argues that, although it presents a boundary between construction and non-construction areas, UGB is essentially the balance of growth and restriction, demand and supply, and power and resistance.

With the rapid development of urbanization in China, studies of UGB in urban growth management have gone further. In its early stages, many researchers (e.g. Lv & Zhang, 2005; Feng, Wu, & Wei, 2008) discussed the use of UGB in western countries and its potential for China. Later, major studies turned to the adaptability of UGB in China (Wu & Zhong, 2011; Han, 2014). Because of the similarity between the delineation and control methods, in the broad sense, Wu et al. (2009) argue that the combination of China's current forbidden zones, limited construction areas and the urban construction land boundary is effectively China's UGB. Recent studies are mainly concerned with modelling and performance evaluation. Fu, Hu, and Zheng (2016) use the BP artificial neural network method combined with GIS and RS technology to establish a UGB prediction model, while Long, Han, and Lai (2015) propose an analytical framework for the evaluation of the adoption of UGBs in China. A key aspect is in deciding on how much urban land is to be included inside the boundaries and when it should be extended. To support such decisions, Knaap and Hopkins (2001) propose a land inventory model based on the concept of inventory management, with time- and event-driven modes to control the UGB. Han and Lai (2011) suggest that event-driven mode costs are lower than those for the time-driven mode, while Wei (2013) finds that if the holding cost of land is low, the event-driven mode can become an ideal way of controlling UGB. In contrast, if the holding cost is very high and the land management system is inadequate, governments are more likely to choose the time-driven mode. When demand is uncertain, the event-driven system is more effective, partly because it does not need to