Evolution of a multidimensional architectural landscape under urban regeneration: A case study of Jinan, China

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ABSTRACT

Urban regeneration is a key to achieving the main goals of China's urbanisation plan. How to analyse the urban landscape of the rapid development in order to meet the challenges of urban planning and build liveable cities is a concern for both government and society. This analysis is based on a case study on downtown Jinan, China, covering the period 2001–2011. It explores urban architectural changes in the horizontal and vertical landscapes after a decade of urban regeneration, focusing on two aspects: construction purpose and number of floors. The study uses the land use transfer matrix method, along with landscape indexes and spatial autocorrelation analysis, based on cadastral data. Results show that the horizontal architectural landscape changed at the city's edges, with no apparent change in the city centre. With changes in urban functions, horizontal landscapes became broken, but patch shapes did not manifest obvious changes. Residential, commercial, and industrial landscapes were the dominant types. Most converted areas became residential landscapes. Vertical landscapes tended to feature upward development. Patch shapes became more complex and broken, landscape richness increased, and building types became less densely aggregated. The dominant landscape type changed from bungalows to multi-layer and low-layer buildings. Vertical space utilisation became increasingly intensive. Urban regeneration was carried out locally. Respective areas marked by horizontal or vertical architectural renewal showed significant positive spatial correlation, implying increasing spatial centralisation. Vertical landscape patches largely changed in line with the horizontal types, but not the other way round. Ramshackle areas and shantytowns were transformed. Urban land use developed intensively, forming vertically dense landscapes. These results will serve as reference source for urban planning, regeneration, land resources management, urban architectural design and layout, optimisation of the ecological environment, and construction of liveable cities.

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1. Introduction

China has been emphasising expansion and scale, while ignoring potential and efficiency, to meet the increasing pressure on urban land and the demands of urban development. To guarantee sustainable development and ease the supply and demand for land, the Chinese government began regulating urban regeneration as a means to establish intensive and efficient urban development patterns. In the pre-reform era, the main motivation for Chinese urban regeneration was to prevent the ageing of urban infrastructure, for example, by removing dilapidated buildings and improving living conditions. Currently, urban regeneration is mainly driven by China's profound social and economic changes and the population's increasingly sophisticated infrastructure requirements.

The concept of 'urban renewal' evolved from 'urban redevelopment', a term used in the United States Housing Act of 1949 to describe a process of demolishing and reconstructing cities' downtown areas. In the Housing Act of 1954, 'urban renewal' came into official use, referring to a process that was both more active and more comprehensive than urban redevelopment. The aim was to solve housing problems in a whole community through housing policy reforms.

After World War II, Western countries implemented large-scale plans to tear down, redevelop, and rebuild urban areas (Yan et al., 2011a, 2011b). This was the subject of considerable academic

research, including the extension of urban regime theory and the development of urban renewal coalition theory (Harvey, 1989; Quitzau et al., 2013). In the late 1980s, a series of political economy theories were developed to consider the reform of urban management and public policy in Western countries, such as those of the entrepreneurial city and place marketing (Biddulph, 2011). Subsequently, community regeneration, neighbourhood renewal, and other regeneration concepts were incorporated into novel research on urban governance theory as it applied to urban development and regeneration (Huu and Wakely, 2000; Fraser, 2004; Cook, 2009). With the rise of new regionalism and 'flat management' trends in public policy, urban governance studies have been increasingly alluding to the relevance of social capital, embedding, empowerment, and other sociological theories for urban redevelopment projects (Yan et al., 2011a). In addition, other urban regeneration theories such as creative cities theory (Florida, 2002) and urban diversity theory (Kutsche, 1962) have informed modern urban regeneration and development.

Amidst global economic integration and regional shifts in production chains, urban regeneration has become the primary means of responding to economic recession (Eksted, 1999) and population decline (Walker, 1985) plaguing former manufacturing city centres. A UK study defines urban regeneration as a 'comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change' (Roberts and Sykes, 1999). Urban regeneration aims to solve urban problems and make long-term improvements to the economic, physical, social, and environmental conditions of an area (Alpopi and Manole, 2013). Urban regeneration is essentially the process of recycling urban land reasonably and economically through maintenance, renovation, and improvements in local ownership, urban management, and the socioeconomic well-being of local residents to change the geographical distribution of industrial and urban population. It includes demolition to strengthen urban functions, improve quality of life, promote the healthy development of the city, renovate dilapidated downtown buildings, relocate shanty towns, and retain historical sites, thus creating a suitable working and living environment (Mao et al., 2012; Ha, 2007; Farid, 2011).

Such goals are highly relevant to the Chinese context, within which there has been considerable prior work on urban regeneration. Scholars have offered solutions based on urban renewal models (Wang et al., 2008), urban infrastructure modernisation (Ren, 2011), and strategic practice (Vicente et al., 2014), to solve problems such as: over development of old town areas, resource allocation imbalance and waste, social relation issues and benefit structural distortions, disintegration of a large number of old town communities (Wang, 2009), lack of identity in residential areas, lack of public spaces, high urban density, widening of roads, green area creation, and so on.

These previous studies show that China has entered a certain stage in its urban regeneration process. China's current urban regeneration involves changes to and reconstruction of physical and human spaces based on accelerated industrialisation, economic changes, and a range of shifts in the social background, manifesting in temporal and spatial variations in the architectural landscape. Landscape—even urban landscape—is often studied in combination with ecology (Guo, 2013; Duan and Zheng, 2006). Scholars have studied urban ecological landscapes considering ecological changes and characteristics, influencing factors, protection strategies, and other aspects (Tumer and Ruscher, 1988; Ding and Zhang, 2005; Li et al., 2004; Zhou and Wang, 2012). Because most urban land is built upon, scholars tend to study the urban architectural landscape, extending landscape theory to urban reconstruction.

Such work in China includes studies on architectural landscape characteristics and factors influencing ecology during urban transformation, based on building height data (Zhang et al., 2011, 2012; Zhang and Hu, 2013). Scholars combined landscape pattern indexes with artificial neural networks, Markov chains and a cellular automata model, spatial relationships, etc., to explore the landscape characteristics of urban land and land change probabilities (Yang et al., 2010, 2014; Fan and Myint, 2014).

Urban reconstruction, which aims to make the living environment more liveable, involves architecture type conversion. Research on urban regeneration has focused on the construction of theoretical ideas, social significance, and methods for design. It reveals the development law of construction layout and functionality by examining the evolution and spatial layout of architectural landscapes based on integration of purposes and number of floors under urban regeneration from a landscape ecology perspective.

Although some urban regeneration studies have focused on the overall expansion and reconstruction of horizontal urban landscapes, the literature has not discussed the evolution of multidimensional architectural landscapes. We aim to fill this gap through a case study of Jinan, China. We do not consider holistic landscape phenomena but, rather, analyse architecture type conversion set at horizontal and vertical macro scales. This approach allows us to study multidimensional architectural landscape changes under urban regeneration.

We apply three techniques (land use transfer matrixes, landscape indexes, and spatial autocorrelation analysis) to vector cadastral data from urban land use change surveys at different periods. The analysis examines replacement tendencies in horizontal and vertical urban architectural landscapes due to changes over the course of 10 years of urban regeneration. We summarise the architecture type conversion characteristics and the evolution of the urban regeneration process. The results, based on a case study on the construction of liveable cities, provide reference points for not only urban planning, reconstruction, and land resources management but also urban architectural design and layout and optimisation of the ecological environment.

2. Study area

Jinan City is located in mid-western Shandong Province, China, between N36°01′–37°32′ and E116°11′–117°44′, straddling the low hills in south-central Shandong and the alluvial plain transfer belt in the north-west. Spread over an area of 8177 km², Jinan is bordered on the south by the Tai Mountain and on the north by the Yellow River. Its southern portion is higher in elevation than its north. Jinan underwent constant expansion and reconstruction from 2001 to 2011 to satisfy its population's requirements; the city's built-up area increased from 217 to 410 km². The shantytowns in the old city largely disappeared in this process, its architectural landscape changing dramatically. The present study considers only the built-up area as of 2001, but not the city's extensions from 2001 to 2011 (Fig. 1).

3. Materials and methods

3.1. Research design and roadmap

Fig. 2 depicts the basic research process. We use land use transfer matrixes, landscape pattern indexes, and spatial autocorrelation analysis to analyse vector data from surveys of urban land use change.

To show changes in the multidimensional architectural landscape and the spatial variation resulting from urban regeneration between 2001 and 2011, we first use the land use transfer matrix