



Scale, distribution, and pattern of mixed land use in central districts: A case study of Nanjing, China



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ABSTRACT

Mixed land use (MLU) promotes urban diversity and vitality as well as high population density, especially in a city's central district, which tends to have the most concentrated MLU distribution. However, the existing planning management system in China does not define MLU nor provide a corresponding management model, making the development of China's MLU highly individualized. In the 30 years since its reform and opening up, owing to the country's rapid urbanization and transformation to a market economy, MLU has evolved. In order to identify the essential characteristics of this development of MLU, this paper uses the case of the Xinjiekou central district of Nanjing city to study the scale, distribution, and pattern of MLU. Methodologically, it uses detailed data from every five years between 1978 and 2008 and analyzes the spatial-temporal patterns and driving forces that characterize this 30-year period in which MLU presents a marked growth trend. The results suggest three main findings. At the scale level, the degree of MLU has risen, although the function of such land use has maintained a steady percentage. At the distribution level, MLU has gradually agglomerated towards central and high-traffic accessibility areas. At the pattern level, MLU has displayed higher plot strength, building height, and land density. Finally, it is shown that the emergence of MLU has been influenced by land price fluctuations, land development models, and land policy.

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Introduction

As a densely populated country, China has limited land available for urban construction activities. Hence, the economical use of land resources and promotion of compact urban development are important issues for urban development projects in China. Some scholars (Song & Knaap, 2004) agree that mixed land use (MLU) is an effective way to use land resources economically, promote compact urban development, stimulate urban vitality and encourage urban safety. Moreover, MLU can help reduce traffic congestion and revive cities' central districts (McNeill, 2011). In addition, ECTP (1998) points out the important role of MLU in the promotion of diversity and vitality in a city, especially in its central district.

MLU arose from the criticism of the urban functional division principle of the Athens Charter. Cities are integrated, complex, and multifunctional systems whose forced functional division results in reduced efficiency, resulting in many urban problems (Ying, 2009). As a result, MLU has become an important tool for urban development and revitalization and a factor in many new urban development theories such as "New Urbanism" (Peter, 1993), "The Compact City" (Burton, Jenks & Williams, 2003), and "Smart Growth" (Barnett, Benfield, Kaid, Paul, & Poticha, 2007).

Grant (2002) considers the development of MLU to have three main features: increased intensity of land use, increased types of land uses, and a variety of integrated land use types. In addition, many scholars have researched MLU theory and practice, including MLU concepts and models (Eric and Erik, 2005; Rowley, 1996), the relationship between MLU and forms of the urban environment (Hildebrand, 1999; Schmitz & Scully, 2006), and the implementation and management of MLU (Phillips, 1993).

MLU has been included in policy considerations for the past decade in the West. However, in China, the new land-use standard

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enacted in 2011 titled “Code for the classification of urban land use and planning standards for the development of land” made no provisions for and offered no guidance on MLU. Fortunately, some local governments have begun to formulate relevant policy on the unified management and control of MLU, such as the “Regulatory planning guidelines” proposed by the Shanghai government (Wang, 2011).

Against this background, research on the space form of MLU has gradually been carried out. The vast literature on the spatial-temporal pattern of MLU mainly uses remote sensing, GIS, and other technical methods in order to research land use changes and development (Liu, Liu, Zhuang, Zhang, & Deng, 2003) and emphasizes macro-scale land use changes. In international research, attention has particularly been paid to the influence of MLU on employment and traffic congestion (see the examples of Martinuzzi, Gould, and Ramos Gonzalez (2007), Wheaton (2004), McDonald (2009), and Tong and Wong (1997)). All these scholars find that MLU can form dispersed employment centers that increase nearby employment opportunities and reduce commuting traffic, an effective way to alleviate traffic congestion in urban centers.

Research on the space morphology of MLU has thus far comprised large-scale space and static studies that use remote sensing technology, mostly focused on plots that have a mixture of different functions within a certain geographical range. Thus, the morphological characteristics of MLU in one plot (i.e., at the micro-scale) remain unclear. In particular, the ways in which the dense MLU found in a city's central district has developed and evolved are under-researched, a gap in the literature that this study attempts to bridge.

To understand the essential characteristics of MLU development, interference by related anthropogenic planning activities should be avoided and we should rather aim to observe the evolution of MLU in a free market environment. However, the existing planning management system in China does not define MLU nor provide a corresponding management model in order to create a relatively free development environment for MLU. This absence suggests that the development of MLU in China has a high degree of self-organization and thereby a high research value.

MLU in central districts

Definition and types of MLU

The definition of MLU varies depending on cultural differences, land management strategies, and so on. In line with China's actual situation, MLU in this study refers to one plot in which there are two or more kinds of functional uses. This definition involves two aspects, namely the definition of a plot and that of mixed use. Hereafter, a plot is construed as the minimum land use unit that includes separate buildings and ancillary facilities (Fig. 1), while mixed use functions have a certain scale and agglomeration effect rather than an isolated existence (Fig. 2).

Owing to intense land use competition, the typical central district has several types of MLU, including mixtures of commercial, entertainment, and residential buildings. For the statistical analysis, we categorize the public facilities² in central districts into three main functions: lifestyle services, commercial services, and public services (Yang, 2013). These three services together with residential dwellings constitute the main functions in a central district, leading to the following six combinations of MLU: lifestyle services and

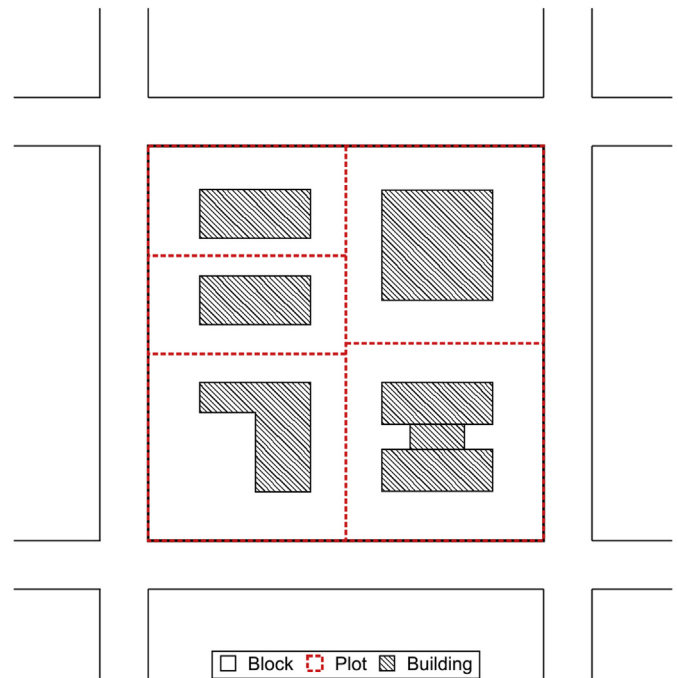


Fig. 1. Schematic diagram of a plot.

residential dwellings (Cb1), lifestyle services and commercial services (Cb2), lifestyle services and public services (Cb3), commercial services and residential dwellings (Cb4), commercial services and public services (Cb5), and public services and residential dwellings (Cb6). Of these, lifestyle services include retail commerce, catering, vegetable markets, supermarkets, and entertainment; commercial services include finance, insurance, artistic/media, business, and hotels; and public services include administrative offices, scientific research and education institutes, health care centers, cultural activities, and social welfare. Specifically, this study uses the Xinjiekou central district of Nanjing as its case study subject.

Data acquisition and analysis

Nanjing is the capital of Jiangsu Province and an important hub city in the Yangtze River Delta region, meaning that it has some representation among China's megacities (Fig. 3).

As early as the period of the Republic of China, the “Capital Plan” comprised the framework of Nanjing. Because the city was built along the east-west Zhongshan Avenue and north-south Meridian Avenue, the interlocked area of Xinjiekou offered optimal local conditions, rivaling the traditional commercial centers of the Confucius Temple district and Taiping South Road district (Fig. 4). Between the founding of the People's Republic of China and the reforms, economic and social order was restored, but the actual development of the city was relatively slow. After the reforms, the Xinjiekou central district began to grow and develop rapidly, gradually becoming the most congested, densely populated, and commercially active area in Nanjing. During this process, the expansion of the city made Xinjiekou its geometric center. Furthermore, Xinjiekou had excellent traffic connections and sufficient space to become the main city center. Indeed, the urban planning of the Nanjing program enacted in 2012 clearly states that the Xinjiekou central district should continue to develop as the main center of Nanjing.

This study examines the development of the investigated central district over a 30-year period from 1978 to 2008. Data

² The category of public facilities is considered from two aspects in this study: the main service targets of public facilities and their main space forms.

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