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Effectiveness of urban construction boundaries in Beijing: an assessment*

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Abstract: Based on the remote sensing (RS) and geographic information system (GIS) analysis of the Landsat multispectral scanner (MSS) and thematic mapper (TM) satellite images of 1983, 1993, and 2005, the present research examined the effectiveness of the urban construction boundaries (UCBs) in containing urban growth within the 6th Ring Road of Beijing Municipality. Three indicators on boundary control were proposed, through which the effectiveness of boundary containment, land inventory sufficiency and illegal adjacent development to the UCBs were explored. The results suggested that, first, the UCBs were limited in effectiveness in containing urban growth; second, the area encompassed by the UCBs might not be designed large enough to accommodate new development. The frustration of the urban growth control through the UCBs mainly resulted from the lack of a transparent system for urban land use planning and control to provide sufficient information, the limitation of the traditional land use prediction method to consider contingencies, and the absence of a mechanism to monitor and adjust the UCBs to respond just in time to urban change.

Key words: Urban construction boundary (UCB), Urban growth boundary, City master plan (CMP), Beijing, Remote sensing (RS)
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INTRODUCTION

The comprehensive planning approach to managing urban growth as manifested by limiting cities in compact forms is being widely applied. For example, in Japan, the Senbiki (literally meaning drawing a line) system was adopted by the City Planning Law as early as in 1968, to promote compact development and preserve open space (Ishida, 2004; Sorensen, 2002). In Europe, the Green Paper was publicized on the Urban Environment in 1990, strongly advocating compact development to reduce energy consumption and CO_2 emissions by limiting future development within current urban boundaries (Commission of the European Communities, 1990). This was also supported by the popularization of the “compact city” idea in the early 1990s (Breheny, 1992; Jenks *et al.*, 1996). In the United States, “growth management” policy and “smart growth” concept were developed primarily to curb widespread urban sprawl (Porter, 1986; DeGrove and Miness, 1992; Stein, 1993; Nelson and Duncan, 1995; Urban Land Institute, 1998; Porter *et al.*, 2002; Szold and Carbonell, 2002; Bengston *et al.*, 2004; Barnett, 2007). Among different approaches to managing urban growth, urban containment policy, widely adopted in the United States, has been extensively introduced to many countries (Bengston and Youn, 2006; Couch and Karecha, 2006; Millward, 2006). Urban containment

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policies basically have three major forms: urban growth boundaries (UGBs), urban service boundaries (USBs), and greenbelts (Pendall *et al.*, 2002). Urban development is steered to area inside the boundaries and discouraged from taking place outside them (Nelson and Dawkins, 2004). All these forms aim at promoting compact and contiguous development patterns that can be efficiently served by public services, and preserving open space, agricultural land, and environmentally sensitive areas that are not currently suitable for urban development (Nelson and Duncan, 1995).

UGB is probably the best known in these urban containment boundaries and has been widely discussed in China (Zhang, 2004; Liu, 2005; Feng *et al.*, 2008; Huang and Tian, 2008; Han *et al.*, 2009; Zhao *et al.*, 2009). Most of the previous studies tended to hold a positive attitude toward UGBs, and advocated the application of UGBs in China to solve the domestic urban problems. However, while these studies acknowledged the limitation of existing urban limit lines in Chinese cites, such as “Green Line” and “Construction Limitation Line” (Zhang, 2004; Liu, 2005; Lu and Zhang, 2005; Long *et al.*, 2006; Zhang, 2006), they failed to discuss the effectiveness of these boundaries in managing urban growth through empirical and quantitative studies. Especially, the urban construction boundaries (UCBs), which have an implementing mechanism similar to the UGBs in the United States and have been implemented as legal boundaries of managing urban growth in China, was evidently neglected in the previous studies, which is the topic the present paper addresses. Though UGBs or UCBs serve multiple purposes concerning urban sprawl, we focus on their function as containing urban growth.

In China, there is a tradition of managing urban growth pattern through land use regulation tools. A city master plan (CMP) has traditionally been a crucial type of spatial plan to both envision city development perspective in the future and implement land use control over a specific time period, typically 20 years. According to the Standard for Classification of Urban Land and for Planning of Constructional Land promulgated by the Ministry of Construction, all land in the CMP area is classified into ten categories, among which nine categories belong to urban construction area (Ministry of Construction, 1991). The UCBs, encompassing all these nine categories of land use, have been applied for a long time as the basis to issue land development permit. Although the UCBs were never intactly marked in the land use maps of a CMP, they have functioned as special and important boundaries to distinguish urban land from rural area. The studies on the UCBs of Chinese cities have been limited for a long time, mainly because of the insufficient elementary land use data. Although the CMPs have provided probably the most detailed existing spatial land use data in China, these data have been neither accessible to nor accurate enough for scholarly research. Recently, the development of the remote sensing (RS) technology has largely filled this gap. Many studies have analyzed the historical land use pattern of Chinese urban growth and have successfully described the geographic characters of urban land use change in several Chinese cities using the RS data (Cheng and Masser, 2003; He and Chen, 2003; Li *et al.*, 2003; Dai *et al.*, 2006; Wu *et al.*, 2006; Mu *et al.*, 2007; Xu *et al.*, 2007; Yu and Ng, 2007). However, since the periods of research in previous studies had little correspondence with the CMP periods, the influence of the CMP policies on land use change remained unclear. To our knowledge, no research has been developed yet to examine the effectiveness of the UCBs over several consecutive and intact CMP periods and explain why.

This study selects Beijing City as the case of examination. As the capital and one of the most rapidly growing cities in China, as well as the host city for the 2008 Olympic Games, Beijing has attracted world attention. The Beijing CMP, one of the most important tools to direct and control urban growth, has been revised frequently over time. However, the planned UCBs in the CMP have been kept as a basic spatial instrument to locate urban infrastructures and to contain urban growth. Through the analysis of CMPs maps and selected satellite images, this study examines the effectiveness of the UCBs in containing urban development during the past 20 years in Beijing City. This study would provide helpful policy implications to generate and implement the current Beijing CMP and the newly promulgated Urban and Rural Planning Law. It would also shed useful light on whether the comprehensive approach to managing urban growth works elsewhere.

STUDY AREA AND DATA OF ANALYSIS

Study area

Beijing is the capital as well as one of the four directly-controlled municipalities of China, which are equivalent to provinces in China's administrative structure. Located in the northern part of China (115°25′~117°30′ E and 39°28′~41°25′ N), it borders Hebei Province to the north, west, south, and for a small section to the east, and Tianjin Municipality to the southeast. Beijing Municipality occupies a total area of 16410.54 km^2 and accommodates a permanent population of about 15.81 million, with an average population density of 963 persons/km^2 in 2006 (Beijing Municipal Bureau of Statistics, 2007). The administrative area currently consists of four central city districts, twelve suburban districts, and two rural counties. The Beijing city area or the central city of Beijing usually comprises the four central city districts and portions of suburban districts in a CMP (Beijing Municipal Institute of City Planning & Design, 1982; 1992; 2005). A ring-concentric growth pattern has been developed in Beijing City, including six ring roads and over ten radiated roads.

The 6th ring road is selected in this research as the study area due to the following two reasons. First, the 6th ring road is the outmost ring road of Beijing Municipality and is easy to identify. Second, the area inside the ring road is large enough to encompass the central city of Beijing and much of its surrounding open space for the estimation of urban growth intensities.

Data of analysis

In this research, both the CMP maps and satellite images are applied as the basic data for analysis to assess the effectiveness of the UCBs on urban growth. Since the 1980s, there are altogether three versions of CMPs: the Beijing CMP (1981~2000) was put forward in 1982 and approved in 1983; the Beijing CMP (1991~2010) was put forward in 1992 and approved in 1993; the Beijing CMP (2004~2020) was put forward in 2005 and approved in 2005 (Beijing Municipal Institute of City Planning & Design, 1982; 1992; 2005). Consequently, the Beijing CMP (1981~2000) actually functioned from 1983 to 1993, the Beijing CMP (1991~2010) from 1993 to 2005, while the Beijing CMP (2004~2020) from 2005 to the present. In this research, the three Beijing CMPs are denoted as the 1983 CMP, the 1993 CMP, and the 2005 CMP according to their common titles. Moreover, the actual implementing period of the 1983 CMP is denoted as "the first planning period", and that of the 1993 CMP as "the second planning period". The effectiveness of the UCBs on urban growth is to be examined through both the first and the second planning periods.

This research utilizes the land use planning maps in these two CMPs as the basic maps to trace the boundaries of the UCBs. Since the 6th ring road is beyond the CMP boundaries of the central city, both the land use maps for the central city and for Beijing Municipality were used to outline the UCBs. ArcGIS is applied to make image geometric correction according to the 1:50000 topographic map of Beijing. The maps of the UCBs in the 1983 CMP and the 1993 CMP are shown in Fig.1.

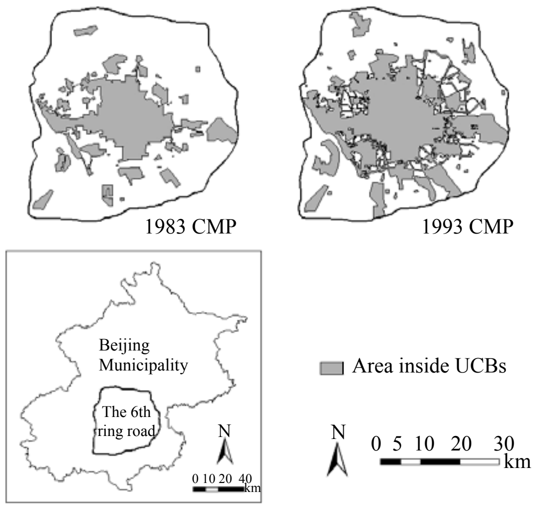

Fig.1 UCB maps in the 1983 CMP and in the 1993 CMP

According to the traced boundaries, the total area in the UCBs in the 1983 CMP is 549 km^2, and the area between the UCBs and the 6th Ring Road is 1757 km^2. In addition, the total area in the UCBs in the 1993 CMP is 935 km^2, and the area between the UCBs and the 6th ring road is 1371 km^2.

To examine the effectiveness of the UCBs, it is crucial to distinguish the land uses they allow and encourage from those they prohibit and discourage. Consequently, the land use within the 6th ring road was classified into urbanized land areas and open space in this research. This research defines urbanized land as all types of developed land, including urban and rural built-up areas and urban green space, such as developed parks, golf courts, and other urban green space for recreation. At the same time, open space is defined as land for agricultural use (according to its broad definition in China), including farmland, woodland, pastureland and orchards.

Three Landsat multispectral scanner (MSS) and thematic mapper (TM) images dated on July 5, 1983, June 6, 1993, and May 6, 2005 were selected to make land classification. Geometric correction was conducted on these images using a 1:50 000 topographic map of Beijing as a reference. The 1983 MSS Landsat image was resampled and transferred into the scale of 30×30 m^2/pixel to be compared with the 1993 and 2005 TM Landsat images.

To distinguish urbanized land from open space, the decision tree method was applied to make the first land classification of the three Landsat images. Most of the urbanized land areas except for urban green space were identified through this method. During the accuracy assessment, 100 pixels were randomly selected from both the original TM images and classified images and compared for each land cover class. The overall accuracy was over 90% in the 1993 and 2005 TM images and over 80% in the 1983 MSS image. At the same time, the Kappa coefficient was over 0.8 in the 1993 and 2005 TM images and over 0.7 in the 1983 MSS image. During the post-classification process, the urban green space was outlined by the street maps of Beijing City and site survey, and integrated into urbanized land area.

METHODOLOGY

A common method to assess the effectiveness of urban containment boundaries on urban growth is to compare developments outside and inside the boundaries (Nelson and Moore, 1993; 1996). In Nelson (1996)'s empirical study on the UGBs in Oregon, USA, other issues, such as the density and configuration of exurban development adjacent to the UGBs as the constraint on future development were also considered during the analysis. The present research examines the effectiveness of UCBs basically by comparing developments outside with those inside the boundaries since the land use data extracted from Landsat satellite images are not qualified to analyze the density and detailed configuration of development.

Three presumptions are identified to assess the effectiveness of the UCBs. The first presumption is that less urbanization should occur outside the UCBs than inside if the UCBs are effective to contain urban growth. The second is that the total possible increase in urbanized land area should be less than or equal to the existing open space within the UCBs at the beginning of each planning period in order to achieve effective urban containment, meaning that the area of land consumed should be no more than supplied. The third is that the urban growth immediately outside the UCBs should be avoided if the UCBs are effective to contain urban growth, as that growth would significantly undermine the urban containment objective by encouraging urban sprawl.

According to these presumptions, three quantitative indicators are defined for the assessment of the UCBs, i.e., boundary containment ratio (BCR), boundary sufficiency ratio (BSR), and boundary adjacent development ratio (BADR), as follows:

$$BCR = A_2 / A_1, \quad (1)$$

$$BSR = (A_1 + A_2) / A_3, \quad (2)$$

$$BADR = L_1 / L_2, \quad (3)$$

where A_1 and A_2 are areas of urbanized land increase (open space consumption) inside and outside the UCBs during the planning period, respectively; A_3 is the area of open space inside the UCBs at the beginning of the planning period; L_1 and L_2 are lengths of the UCBs with and without new land development immediately outside, respectively.

Fig.2 illustrates conceptually all the above types of areas and boundaries.

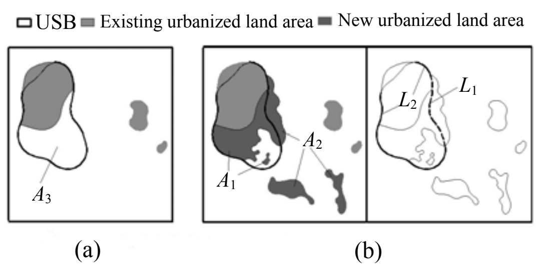

Fig.2 Illustration of the areas and boundaries of analysis. (a) Beginning of the planning period; (b) End of the planning period

A high value of BCR indicates a large share of urban growth outside the UCBs. A value of zero means no urban growth outside the UCBs, suggesting complete effectiveness of the UCBs in containing urban growth. A value from zero to one indicates limited effectiveness of the UCBs. A value more than or equal to one means the urban growth outside the UCBs is no less than inside the UCBs, suggesting complete failure of the UCBs in containing urban growth.

A high value of BSR indicates an insufficient size of the UCBs. When the BSR is smaller than or equal to one, it means that all the new urban growth outside the UCBs could have been accommodated in the UCBs, as the development density outside the UCBs are usually less than that inside the UCBs. This indicates that the UCBs have been planned large enough. On the other hand, when the BSR is larger than one, it means that the new urban growth outside the UCBs could not have been accommodated in the UCBs with the same density. However, since development is usually more compact inside the UCBs, it becomes difficult to judge whether the UCBs are sufficient to accommodate all the newly developed land. The more a BSR is greater than one, the higher the probability is that the size of the UCBs is insufficient.

A high value of BADR indicates a high proportion of urban growth occurring immediately outside the UCBs. A value less than one means that fewer UCBs have urban growth occurring immediately outside, suggesting limited effectiveness of the UCBs in containing urban growth. A value more than one means more UCBs have urban growth occurring immediately outside, suggesting poor effectiveness of the UCBs in containing urban growth.

In short, the higher the values of these three indicators, the less effective the UCBs on containing urban growth.

The analysis is developed through the following steps:

(1) Based on the TM satellite images of 1983, 1993, and 2005, all land area is classified into two types: urbanized land and open space.

(2) By the recently publicized CMP maps, the planned UCBs of the 1983 CMP and the 1993 CMP are traced, respectively.

(3) Through the overlay analysis of the planned UCBs and the urbanized land boundaries extracted from the satellite images, four types of land use data—urbanized land area inside the UCBs, open space area inside the UCBs, urbanized land area outside the UCBs, and open space area outside the UCBs in 1983, 1993, and 2005 are calculated, respectively.

(4) By comparing the data of four types of land use in 1983 and 1993, the spatial patterns of the actual urban land growth during the first planning period are concluded. Similarly, the spatial patterns of the actual urban land growth during the second planning period are summed up by comparing the data of four types of land use in 1993 and 2005.

(5) Three indicators—BCR, BSR, and BADR in the first and the second planning periods are calculated and compared.

(6) Some explanations for the success or failure of the UCB control are discussed according to the above analysis.

(7) Finally, the assessment of the effectiveness of the UCB control in the Beijing CMPs is concluded at the end of the research.

RESULTS

The First Planning Period

Through the analysis of the satellite images in 1983 and 1993, the urbanized land area change inside and outside the UCBs during the first planning period can be calculated and is listed as follows (Fig.3, Table 1).

The result shows that during the first planning period, the urbanized land area inside the UCBs increased from 333.3 km^2 in 1983 to 474.6 km^2 in 1993. At the same time, the urbanized land area between the UCBs and the 6th ring road increased from 76.3 km^2 in 1983 to 239.2 km^2 in 1993. During the first planning period, the urbanized land area increased by 141.4 km^2 inside the UCBs, consisting of 46.5% of the total urbanized land growth in the 6th Ring Road; while it increased by 162.8 km^2 between the UCBs and the 6th ring road, consisting of 53.5% of the total urbanized land growth in the 6th ring road.

Moreover, urban growth was found to have occurred immediately outside the UCBs. At the beginning of the first planning period, 22.0% or 134 km of all UCBs had already been adjacent to the existing land development outside them. During the first planning period, 28.2% or 172 km of all the UCBs had new land development immediately outside them. And by the end of the first planning period, only

49.8% or 304 km did not have any land development immediately outside the UCBs (Fig.4).

The Second Planning Period

Through the analysis of the satellite images in 1993 and in 2005, the urbanized land area change inside and outside the UCBs during the second planning period could be calculated and is listed as follows (Fig.5, Table 2).

The result shows that during the second planning period, the urbanized land area inside the UCBs increased from 619.1 km^2 in 1993 to 807.1 km^2 in 2005. At the same time, the urbanized land area between the UCBs and the 6th ring road increased from 94.2 km^2 in 1993 to 336.3 km^2 in 2005. During the second planning period, the urbanized land area increased by 188.0 km^2 inside the UCBs, consisting of 43.7% of the total urbanized land growth in the 6th ring road; while it increased by 242.1 km^2 between the UCBs and the 6th ring road, consisting of 56.3% of the total urbanized land growth in the 6th ring road.

Moreover, urban growth was also found to have occurred immediately outside the UCBs. At the

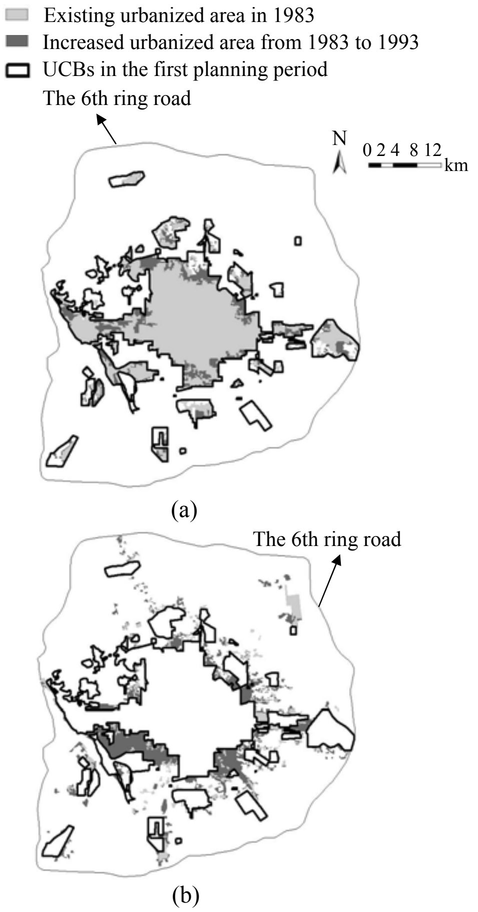

Fig.3 Urbanized land area change during the first planning period. (a) Inside the 1983 UCBs; (b) Outside the 1983 UCBs

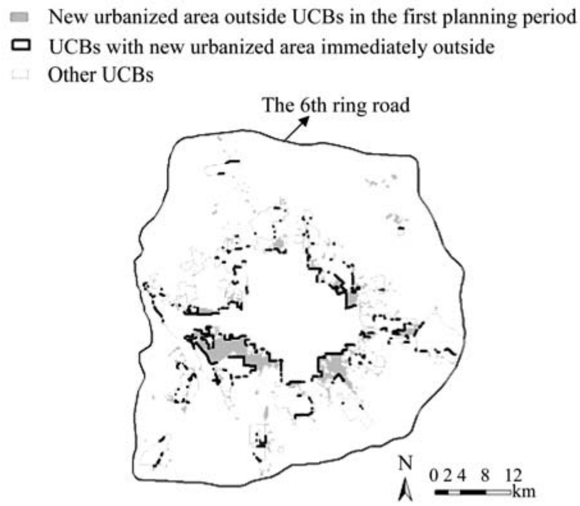

Fig.4 UCBs with urbanized land growth immediately outside during the first planning period

Table 1 Land area change inside and outside the UCBs in the first planning period 1983~1993 (km^2)

Item	Urbanized land area		Open space		Urbanized land area change	Open space change
	1983	1993	1983	1993	1983~1993	1983~1993
Inside UCBs	333.3	474.6	215.7	74.4	141.4	−141.4
Outside UCBs	76.3	239.2	1680.7	1517.8	162.8	−162.8

Table 2 Land area change inside and outside the UCBs in the second planning period 1993~2005 (km^2)

Item	Urbanized land area		Open space		Urbanized land area change	Open space change
	1993	2005	1993	2005	1993~2005	1993~2005
Inside UCBs	619.1	807.1	315.9	127.8	231.4	−231.4
Outside UCBs	94.2	336.3	1276.8	1034.7	242.1	−242.1

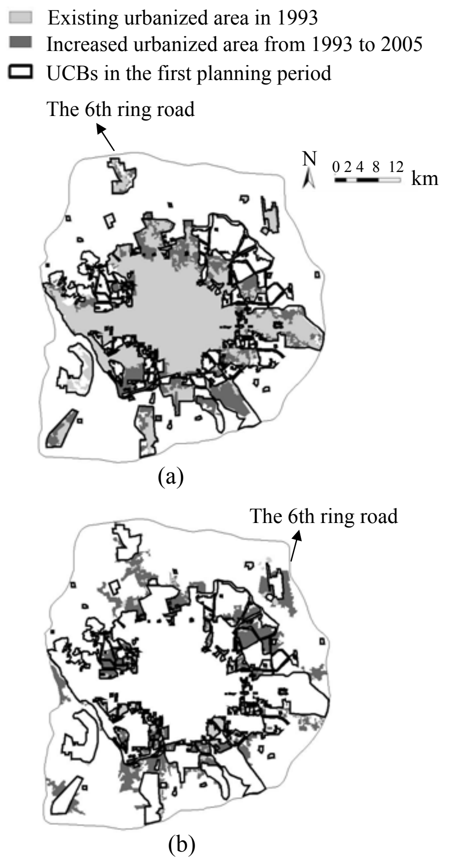

Fig.5 Urbanized land area change during the second planning period. (a) Inside the 1993 UCBs; (b) Outside the 1993 UCBs

beginning of the second planning period, 41.9% or 518 km of all UCBs had already been adjacent to the existing land development outside them. During the second planning period, 25.3% or 313 km of all the UCBs had new land development immediately outside them. And by the end of the second planning period, only 32.7% or 404 km did not have any land development immediately outside the UCBs (Fig.6).

Implementation of UCBs in the two planning periods

The maps of urbanized land area change during the two planning periods showed that the UCBs failed to contain new urban development within the boundaries. The open space which had been planned to separate several major urban lumps was almost filled up by new urban development. Most of the uncontrolled urban development or open space encroachment was connected to the existing urban lumps; while leap-frog development was not significant. Such uncontrolled urban development or open space encroachment mostly happened in the southwest and southeast of Beijing City during the first planning period, and happened in the urban fringe area of all directions during the second planning period. Moreover, new development was found spreading from the city center to urban fringe areas, regardless of the UCBs set in between, indicating the limitation of UCBs in controlling the location of urban growth.

By calculating the three BCRs, BSRs, and BADRs in the two planning periods, respectively, a comparison was made to analyze the implementation effectiveness of the UCBs in the Beijing CMPs from early 1980s to mid 2000s (Table 3). The results are summarized as follows.

(1) The BCR was 1.15 in the first planning period and 1.05 in the second planning period. It indicates that the urban growth outside the UCBs had a larger share of the total growth than that inside the UCBs in both planning periods.

(2) The BADR was 0.57 in the first planning period and 0.77 in the second planning period. The high values of BADR suggest that large amount of urban growth had occurred immediately outside the UCBs.

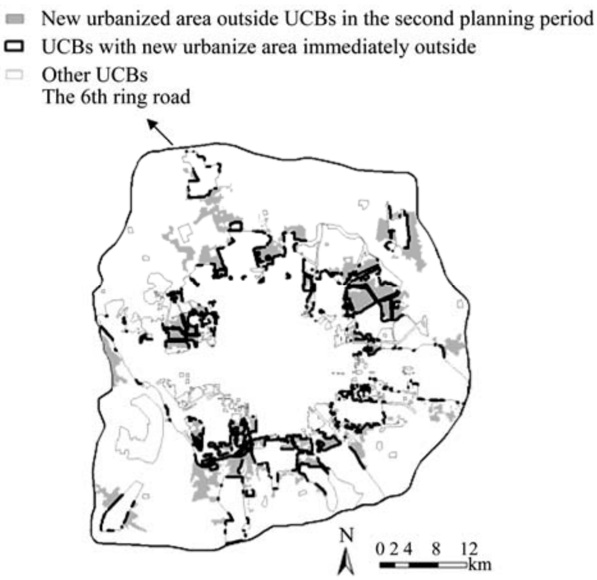

Fig.6 UCBs with urbanized land growth immediately outside during the second planning period

Table 3 Comparison of the implementation of UCBs in the two planning periods

The first planning period			The second planning period		
BCR	BADR	BSR	BCR	BADR	BSR
1.15	0.57	1.41	1.05	0.77	1.50

(3) The BSR was 1.41 in the first planning period and 1.50 in the second planning period. Both are greater than 1. It suggests that the UCBs were not planned encompassing areas large enough to accommodate all new urbanization if measured by the actual development density in both planning periods.

According to the analysis process, several factors might influence the final results. First, as there are usually one or two years' lag in land development, many land parcels that had been legally converted into construction use may remain agricultural characteristics and would be identified as open space in the satellite images. Second, the precision of land use classification in the land use planning maps might also have impacts on the results. In the land use planning map of 1983, there were only 50 UCB parcels. The average area of each parcel apart from the central one was 4.0 km^2. While in the land use planning map of 1993, the number of UCB parcels increased to 67 and the average area of each parcel apart from the central one decreased to 2.0 km^2. Since roads and rural settlements scattered, the map with smaller UCB parcels would accord better with the actual land use conditions. This means that the 1983 land use planning map might have omitted more land use information than the 1993 one, and fluctuated the results. Third, based on the Landsat satellite images with the resolution of 30×30 km^2/pixel, small residential and industrial development, primarily in the rural areas, can not be identified during the interpretation. This may result in the underestimation of urbanized land area in this research. Notwithstanding the above limitations in the research, we argue that they would be insignificant in drawing conclusions.

DISCUSSION

From analyzed above, it can be found that the UCBs in the Beijing CMPs were not successful in containing urban growth. The failure of the implementation of UCBs might result, among others, from the following three factors.

The first factor is the lack of a transparent system for urban land use planning and control. In China, land use control is implemented through a "CMP-RDP (Regulatory Detailed Plan)—Land Development Permit" system (Yeh and Wu, 1999; Tan, 2005). The land use available for development of a city is first predicted, albeit imperfectly, in a CMP. The RDPs then follow the basic design principles of the CMP to make the land use classification more detailed. A land development permit is usually issued according to the requirement in an RDP. To successfully implement the UCBs in a CMP, all the CMPs, the RDPs and the permit issue process need to be supervised carefully in a coherent way. In Beijing Municipality, although the text and some maps of the CMPs have been publicized on the government's website in recent years, the RDPs have still been kept secret by the planning authority. The information on the land development permits is also impossible to access. Therefore, it has been extremely difficult to examine the coherency of the implementation of the UCBs through different levels of the urban planning and control process. It also means, whenever changes or contradictions occur between an RDP and a CMP, or between a land development permit and an RDP, requirement for coherency would be much weaker. This became a big loophole for the UCB control and the other urban planning policies. Plans for urban development provide information for developers to act on, and without such information available, effects of plans would be highly hampered (Hopkins, 2001). The basic reason for the lack of publication information might probably be the absence of legal guarantee for public participation. Actually, before the Urban and Rural Planning Law taking effective in 2008, public participation and supervision were not required by law in China. The lack of public participation and supervision in the planning process to disseminate information has, unsurprisingly, resulted in the prevalence of illegal and informal constructions outside the UCBs.

The second factor is the limitation of the traditional land use prediction method. According to the Standard for Classification of Urban Land and for Planning of Constructional Land promulgated by the Ministry of Construction, the size of UCBs is based on the population scale of a city (State Construction Commission, 1980; Ministry of Construction, 1991). In Beijing, the predicted population scales in all periods of the CMPs have been much smaller than the realized ones. For example, in the 1983 CMP, the municipal population (including the permanent population and the floating population with the residence over half a year) was predicted to be 10 million by 2000 (Beijing Municipal Institute of City Planning & Design, 1982), while this target was reached quickly in 1986, only three years after the CMP was approved (Beijing Municipal Bureau of Statistics, 2007). In the 1993 CMP, the municipal population was predicted to be 15 million by 2010 (Beijing Municipal Institute of City Planning & Design, 1992); however, in 2005, the actual permanent population had already gone beyond it (Beijing Municipal Bureau of Statistics, 2007). The underestimation of the population has, inevitably, resulted in the insufficiency of the planned size of the UCBs. The implication is that prediction of population is a complex task that should take into account contingencies in the socio-economic context in order for the UCBs to be more effective. In addition, the national urban development strategy to control the size of large cities might be the key to this underestimation. According to the City Planning Law, "the state keeps strict control over the size of large cities and develops rationally medium-sized cities and small cities, so as to promote a reasonable structure of productivity and population". As the capital, the scale of Beijing has always been under strict control by not only the municipal government but also the central government. For example, The Important Directives on the Construction Strategies for the Capital issued by the central government in 1980 clearly demanded that "the population of Beijing Municipality must be controlled within 10 million and the population of the central city should be controlled within 4 million". While the strict control of population might be effective in a centralized planned system, it could take little effects after the planned system was replaced by a market-oriented system. The population control that is derived from the traditional comprehensive planning approach to one plan must be replaced by contingent plans that interact with each other (Kaza and Hopkins, 2009), as evidenced by the Beijing case.

The third factor is the absence of a mechanism to monitor and adjust the UCBs. According to the basic presumption of the UCBs, enough area must be included within the UCBs to provide sufficient land to accommodate projected market demand within the prescribed planning period, with additional land to provide for choice. The inclusion of too little land may result in exorbitant increases in the cost of land and housing, legal challenges, and political pressure to prematurely extend the urban growth boundaries in the United States (Nelson and Dawkins, 2004). However, it has led to the spill of much of new urban development over the UCBs when the boundaries were difficult to revise in the context of Beijing. In Beijing and most of other Chinese cities, a land use survey with detailed spatial land use data is conducted only when there is need for a comprehensive revision of the CMP. This has largely limited the ability of the municipal government to monitor and adjust the UCBs according to the actual land use conditions. Moreover, the hierarchical urban planning approval system has also influenced the possibility of revising the UCBs in a CMP just in time. In China, a CMP is not examined and approved by the municipal government, but by the government at a higher level. Since the CMP of Beijing has to be submitted and approved by the state council, the long and complicated approval procedures during the revision of a CMP have undermined the efforts for even some slight adjustment of the UCBs in Beijing. The UCBs should provide timely information and fit the current urban development process, but the administrative procedure in China in generating and revising the UCBs in general, and in Beijing in particular, renders such concurrency ineffective.

CONCLUSION

By examining the spatial changes of urbanized land under the UCB control, this research assesses the effectiveness of UCBs in the Beijing CMPs. Some conclusions can be drawn from the assessment in the Beijing case. First, the UCBs were limited in containing urban growth. Second, the UCBs might not be large enough to accommodate all new development. In short, the present research shows that the UCBs did not successfully function as a basic spatial instrument to contain urban growth, at least in the case of Beijing.

The possible explanations of the failure of the UCBs include: First, the lack of a transparent system for urban land use planning and control led to insufficient information dissemination and thus the prevalence of illegal and informal constructions outside the UCBs. Second, the limitation of the traditional land use prediction method that is derived from the traditional comprehensive planning process resulted in the underestimation of the scale of UCBs. Third, the absence of a mechanism to monitor and adjust timely the UCBs also contributed to the spill of new constructions over the UCBs.

Since UCBs are still widely applied in the CMPs of Chinese cities, measures have to be developed to improve their implementation, including information dissemination of plans, prediction of contingencies, and timely revision of UCBs. In particular, with the promulgation of the Urban and Rural Planning Law in 2008, stricter control over the location of new urban development has been demanded. With these policy changes, whether the existing UCBs could be better managed over next 10 to 20 years remains as an interesting topic for future studies.

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