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Containing urban expansion in China: the case of Nanjing

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Rapid urban expansion often has negative social, environmental, and ecological consequences. In China, urbanization rates have increased rapidly over the past decades, commensurate with economic growth. This article evaluates how Chinese urban planning was effective in containing urban expansion. To this end, we examined discrepancies between the Land Use Master Plan (LUMP) and the actual land use developments between the years 1996 and 2014, and analyzed them in relation to demographic and land-use change. Our findings reveal that the initial aim outlined in the LUMP proved, from the start, difficult to implement and that certain targets were either not met or surpassed. Remarkable is that the rates of land used for urbanization strongly exceed those of urban population growth. Explanations are sought in a combination of decentralization, marketization and globalization. We argue that urban growth management is challenged by the shift from the centrally planned system to a more market-oriented governance system, with the slowly increasing autonomy of local governments, which creates incentives for the latter to stimulate urbanization rather than to control it.

Keywords: urbanization; Land Use Master Plan (LUMP); urban sprawl; land use change; urban planning; centralization

1. Introduction

Urban expansion, involving the conversion of agricultural land and nature to built-up area, is occurring throughout the world (Paül and Tonts 2005; Boyle and Mohamed 2007; Tian *et al.* 2017). The global percentage of people living in urban areas will increase from 54% in 2014 to 66% in 2050, with most of the growth occurring in small to medium-sized cities (i.e. less than one million inhabitants (American Association for the Advancement of Science 2016). The expansion of built-up areas has continued in most regions, even those where population has declined (Hasse and Lathrop 2003; Salvati *et al.* 2013). Such trends are at odds with ambitions to preserve agricultural land as much as possible to safeguard food production (United Nations 2014).

The dramatic expansion of urban areas has sparked scientific interest and debate for decades (Hasse and Lathrop 2003; Yue, Liu, and Fan 2013; Shu *et al.* 2017), in particular around the phenomenon of urban sprawl, referring to a type of low-density, skip- and/or scattered development (Galster *et al.* 2001; Anthony 2004). In order to mitigate the negative effects of rapid urban expansion (i.e. loss of natural open space,

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increased commuting time and transportation costs, and the deterioration of ecosystems and biodiversity, Anthony 2004; Abass, Adanu, and Agyemang 2018), growth management and urban containment policies have served as the main instruments to prevent needless expansion (Janssen-Jansen 2007; Siedentop, Fina, and Krehl 2016). However, opinions on whether decentralized or recentralized planning power is effective in containing urban expansion remain divided. Decentralization in planning is often framed as a benevolent policy guided by principles of fairness, transparency and democratization (Mualam 2018), but has, at the same time, been associated with free-rider behavior and poor law enforcement, and the consequent inability to control urban expansion (Perrin *et al.* 2018). In China, the central government has increasingly recentralized the arable land protection policy and controls urban expansion (Xu and Yeh 2009; Zhong *et al.* 2017), which supposedly increases the effectiveness of urban expansion management. And, possibly, China's top-down land-use management system—at least theoretically—allows for more effective growth management than the more democratic, bottom-up planning systems that exist in most Western countries.

In China, the need to control urban expansion is deemed urgent by the government. Since the political-economic reform in 1978, the urban population has increased from 172.5 million people in 1978 to 749.2 million in 2014, and the urban area expanded from 8,842 to 32,520 km² during 1984–2005, an increase of 260% (Lin *et al.* 2015). Commensurate with this growth, China lost over eight million hectares of arable land from 1996 to 2006 (Liu, Liu, and Qi 2015), which is equivalent to a production capacity of about 30 million tons of wheat on an annual basis. This urged the central government to a gradual reform towards improving land management policies and strengthening land management institutions. For example, the *Land Administration Law* was revised, which also involved the National Land Use Master Plan (LUMP) in which the designated use of the entire Chinese territory is planned. The delimitation of the urban growth boundary, the basic farmland protection red line and ecological protection red line is required to coordinate production-living-ecology space (Ran *et al.* 2018). This resulted in a top-down planning system that forces local plans to be in line with national plans, with the aim of stopping the uncontrollable loss of arable land and urban expansion (Wu, Xu, and Yeh 2007). On the other hand, the Chinese economic development mode relies more on urbanization and industrialization, thus creating a lock-in phase with a stable trajectory. This creates a path dependence, from which it is very hard to escape (Wu *et al.* 2018). If this trajectory cannot be changed, it seems to imply that the top-down planned land management institutional system will be incapable of controlling urban expansion.

Many studies on Chinese urban growth have focused on cities such as Beijing (Zhao, Lü, and Woltjer 2009; Zhang *et al.* 2018), Shanghai (Tian *et al.* 2017), Wuhan (Tan *et al.* 2014), and Guangzhou (Tian and Shen 2011). These studies indicate that industrialization, economic growth, and population increase are the key driving factors for urban growth. They also indicate that the Chinese planning system does not function very well in steering and controlling urban growth (Wei 2005; Zhao, Lü, and Roo 2010). The reasons for this ineffectiveness probably need to be sought in the implementation of the national growth management strategies by local governments. In this article, we investigate why, and to what extent, local implementation of the LUMP deviates from the LUMP at national level. We use the city of Nanjing as an example, as it can be considered a representative case of metropolitan areas in which a combination of rapid marketization, globalization, economic development, and national

reforms took place (Qian 2013; Chen *et al.* 2014; Wei 2015). Using these indicators distinguishes our work from geospatial analyses of urban expansion by use of remote sensing images, such as Liu *et al.* (2018), Yang *et al.* (2018). We adopt a mixed-methods approach, whereby we first retrieve the numbers about the actual developments, and then interview a range of experts about these developments. In this way, we try to answer the question whether or not land use planning under conditions of top-down planning systems can control urban expansion and find the determinants that influence the success of growth management.

The remainder of this article is organized as follows. In Section 2, we introduce the land management system in China in order to better understand how the state uses its planning system to control urban expansion. Section 3 explains the methodology and data sources. In Section 4, we present the results, and in Section 5 we try to provide an explanation for the inability of the Chinese planning system to regulate urban expansion. In Sections 6 and 7, we present the discussion and conclusion.

2. Institutional framework of land management in China

For the purpose of protecting arable land and improving land management policy, the Chinese government decrees that each tier of government has the legal responsibility to establish a *Land Use Master Plan* (LUMP) as the land administration guideline. As articulated in the *Land Administration Law*, all building activity should be in concordance with the LUMP. Until now, there have been three rounds of planning (Figure 1).

The LUMP has five-tiered hierarchical levels: central, provincial, municipal, district (or county), and township. In principle, the Ministry of Land and Resources on behalf of the state has absolute regulatory control. This national plan establishes land management objectives, in the form of directions of how the land use should be organized. The plans of the lower tiers of government translate the national plan into a regional or local context, such as arable land quantity, as well as the permitted amount of built-up land. At municipal, district/county, and township level, detailed, spatially-explicit LUMPs at parcel level have to be prepared, which need to comply with the national and provincial strategy. The lower land-administrative departments have to submit the scheme to higher government tiers for permission.

During this process, political arguments often play an important role between superior and subordinate tiers, as each jurisdictional territory has economic incentives

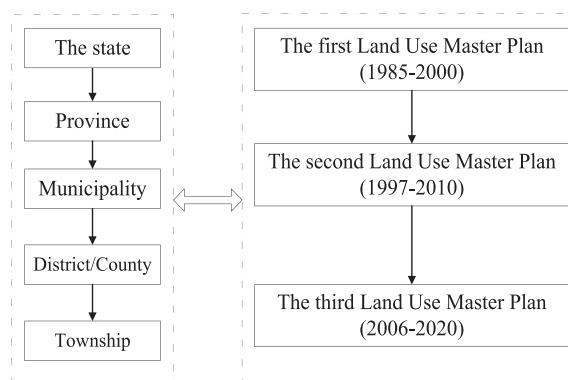


Figure 1. The Land Use Master Plan system.

to reduce protection quotas (e.g. for arable land) and increase development quotas (Wang and Shen 2016). Therewith, the established procedure is a complex and time-consuming process (Qian 2013). When the LUMP is approved by the upper-level government, it has legal validity and has become the principal guideline for land-use development. In order to guarantee the implementation of the LUMP, the central government issued certain regulations. For instance, if the newly built-up land exceeds the planned quotas by more than 15% on an annual basis, local cadres will be punished, or even dismissed (*Measures for Violating Land-use Management Regulation* issued by the Ministry of Land and Resources in 2008). In order to tackle land-use regulatory dilemmas, the central government established the State Land Supervision Bureau in 2006, an organization whose jurisdiction goes beyond provincial boundaries and regional branches.

The current system is a system in transition. Before 1978, there was a central planning system in which the central government played an important role in the market and society. This top-down decision structure, however, caused low efficiency in economic development and construction (Cao 1998). For example, land was allocated to state-owned enterprises through administrative methods, without market considerations. After the economic reform in 1978, China gradually changed from a centrally planned regime towards a 'socialist market regime'. The state decentralized its power in part to local governments, including fiscal contracts, banking systems, and land use power (Wong, Heady, and Woo 1995; Wei 2005). China's urban governance prioritizes economic growth (Wu and Zhang 2008; Zhao, Lü, and Woltjer 2009) and local governments have become more growth-oriented (Gu, Wei, and Cook 2015). Growth-oriented mayors and economic/financial bureaus can selectively choose partnerships with non-state agents to form pro-growth coalitions, and tend to view planning as an instrument of growth rather than control (Wei 2005; Qian 2013).

3. Study area and methods

3.1. Study area

Nanjing has a history of over 2,400 years and was the capital of 10 dynasties. Currently, it is the capital of Jiangsu Province. It covers a large area (about 6,587 km²; Figure 2a) and encompasses multiple districts and counties. Administrative boundaries within the municipality were adjusted in 2000, 2002, and 2013 in order to reduce management fragmentation and conflicts. Here, we use the administrative districts at the beginning of 2013, namely 11 districts and 2 counties. The core city center includes the Xuanwu, Baixia, Qinhuai, Jianye, Gulou, Xiaguan districts. The suburb districts include Pukou, Qixia, Yuhuatai, Jiangning, Liuhe. The two counties are Lishui and Gaochun (Figure 2b and c).

The area has experienced high rates of urban land expansion and population growth due to increasing industrialization and urbanization. In 2014, the built-up land increased from 93,920 ha (in 1996) to 162,525 ha, while the registered population increased from 5.3 million to 6.5 million. The GDP was 882 billion RMB and the industrial structure of primary, secondary and tertiary industry was the ratio of 2.4:41.1:56.5 in 2014, meaning services and industry are the most productive activities. The six districts in the core center account for 37.4% of the population and 33.7% of the GDP (Nanjing Statistical Bureau 2015).

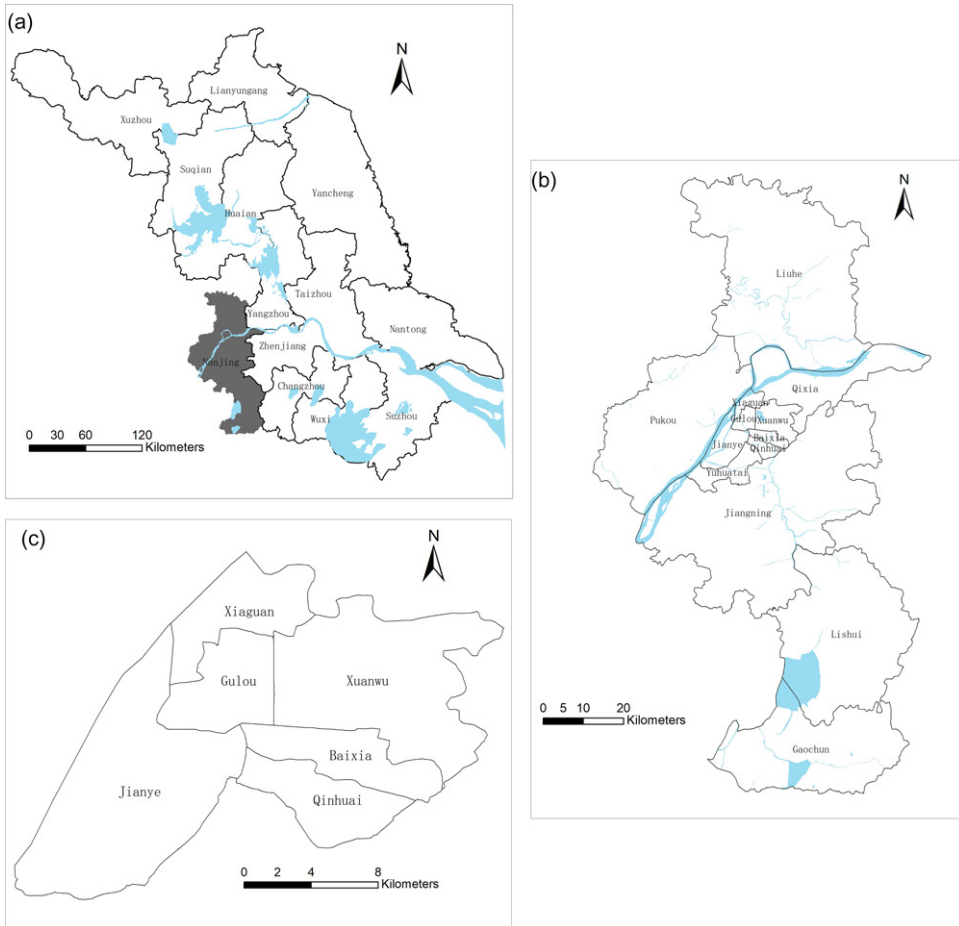


Figure 2. (a) The location of Nanjing. (b) The districts and counties. (c) The city center.

The revision of the LUMP is a complicated and time-consuming process. The lower-level governments generally want to reduce preservation quotas, increase development quotas and often bargain with the upper-level government, which involves numerous revisions. Nanjing is no exception. The LUMP (1997–2010) in Nanjing was prepared in December 1997, and was finally approved by the Ministry of Land and Resources in October 1999. According to this plan, the built-up area could increase up to 100,935 ha in 2000, and up to 101,186 ha in 2010. However, only two years after its approval, the LUMP (1997–2010) was already obsolete. While the plan stated that the arable land should be strictly conserved, and that any future urban expansion was toward the north and concentrated in the central districts, but all kinds of development zones were constructed and new towns were developed in the suburb districts. Then, Nanjing began to prepare the LUMPb (2006–2020) in 2005, finished the draft in December 2010, and the plan was officially approved in July 2012, almost seven years later. Similar to the LUMP (1997–2010), the LUMP (2006–2020) also aimed to contain urban expansion, preserve arable land, strengthen the preservation of ecological areas, and coordinate the dilemma between land use and socioeconomic development. Furthermore, the plan emphasized the importance of control of urban expansion,

economical and intensive land use due to massive population migration, as well as economic growth. Also, the spatial land-use quotas in each district were redistributed in order to satisfy the municipal overall development in the future. For example, the Nanjing government wanted to develop satellite towns, sub-commercial centers, and built industrial zones in suburb districts, which were distributed by more development quotas in the LUMP (2006–2020). Furthermore, the plan stressed the importance of the use of land quota reservations for major projects, public infrastructure, and facilities, while also aiming at land consolidation and the utilization of vacant land, as well as building an ecological network. Also, the plan revision paid more attention to advice from experts and the public. But in the end, the rapid urban growth and restructuring were beyond the expectation of urban planners and government officials, which heavily challenged the effectiveness of land use planning on urban expansion.

3.2. Methods

3.2.1. The quantitative analysis

We chose (changes in) population, density, density gradients, and built-up area between 1996 and 2014 to measure urban expansion¹. Therewith, this study covers the second LUMP (1997–2010) and the third LUMP (2006–2020). The change in population was calculated using the number of residents registered in the municipalities, obtained from the Nanjing Statistics Bureau. To compute density, the population numbers were divided by (a) total area, (b) central districts area, (c) suburb districts area, and (d) the counties' area. A density gradient based on a monocentric assumption shows the variation from the city center, which is a traditional sprawl/expansion indicator (Couch and Karecha 2006; Kline *et al.* 2014; Jiao 2015). A decline in population and density in the city center signifies the moving of inhabitants to the suburbs or rural areas, which is a clear manifestation of expansion. We examined the expansion of built-up land (including urban settlements and industry/mining sites, rural settlements and transportation land) and the loss of agricultural land, using land use survey data from the Jiangsu Institute of Land Surveying and Planning, which obtained the data from remote sensing image analysis and field investigation correction. In addition, we compared the actual land use with that in the municipal LUMP to assess whether the newly urbanized land complied with the original land-use allocation in the plan (Yue, Liu, and Fan 2013).

3.2.2. The qualitative analysis

We conducted semistructured interviews with government officials and experts in order to understand the process of urban expansion and arable land loss. Interviewees were confronted with the results of the quantitative analysis and asked to reflect on them. We selected 23 people for face-to-face interviews, of which 18 accepted the invitation (Table 1), among them were three academic experts in the field of land use planning. Furthermore, we used policy documents and governmental work reports to further explain our findings. Hereto we obtained policy documents and governmental work reports from the central and local governments, including *Development zones' land-use evaluation in Nanjing (2014)*, *The Nanjing Master Plan (1991–2010)*, *The Emergency Notice of Regulation and Rectification on Land Market Order*, and *The Notice of Promoting Real Estate Market Sustainable Development*.

Table 1. Interviews on land management and planning.

Department	Number	Date
Nanjing Bureau of State Land Supervision	1	2015.11
Land and Resources of Jiangsu Province	1	2015.12
Jiangsu Institute of Land Surveying and Planning	2	2015.04
Nanjing Municipal Land and Resources Bureau	2	2015.05
Qixia District Land and Resources Bureau	1	2015.11
Xinbei District Land and Resources Bureau	2	2015.12
Suqian Municipal Land and Resources Bureau	3	2015.10
Sucheng District Land and Resources Bureau	3	2015.10
Nanjing University	1	2014.12
Nanjing Institute of Geography and Limnology, CAS	1	2015.06
Nanjing Agricultural University	1	2015.06

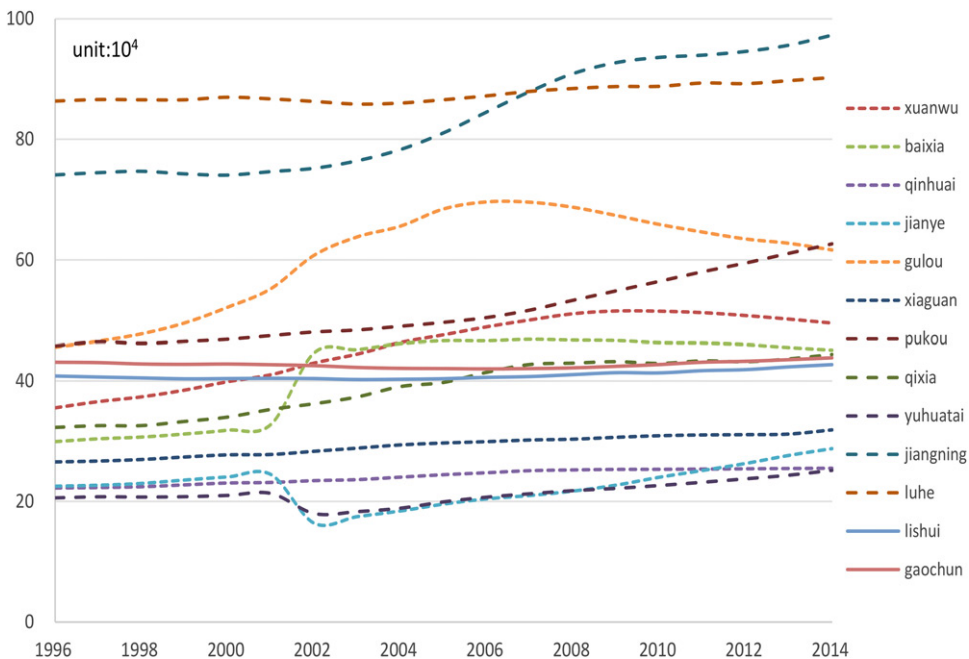


Figure 3. Population in Nanjing districts and counties. Central districts are displayed with fine dashes, suburb districts with coarse dashes, and counties as solid lines.

4. Results

4.1. Population growth and density changes

The population in Nanjing increased gradually from 5.25 million in 1996 to 6.49 million in 2014, with an annual growth rate of 1.2%. The population growth rates varied among the different city districts (Figure 3). The biggest population growth rate was Baixia district (50.6%) during 1996–2014; the lowest was Gaochun county (1.7%). The population in the central districts Xuanwu, Baixia, and Gulou declined in 2010, 2009, and 2007, respectively. The population in each suburb district increased during the study period. Before 2009, the districts in the city center attracted more

population, which experienced a higher annual average growth rate, up to 2.3% (1996–2001), 2.5% (2001–2008). These numbers exceed the annual average growth rate for the entire city (1.0%, 1.8%, respectively) and those of the other two regions. The situation changed gradually after 2008, as the city center experienced a decrease in population.

The population density at municipal level increased from 8.0 person/ha in 1996 to 9.9 person/ha in 2014 (Table 2). The population density showed strong spatial variability, with a clear gradient from high densities in the center towards low densities in the suburbs and counties. This gradient strongly increased up to 2008, but in 2014, a small decline could be observed (Table 2). During this last period, the suburb districts with relatively lower housing prices and higher air quality began to attract more people (Shao *et al.* 2018). However, population was still concentrated in the city center, with a high population density due to excellent resources (e.g. education, medical services), convenient transportation facilities, and jobs (Zeng *et al.* 2016).

The population density was calculated by dividing the grouped districts' population numbers by the grouped districts' areas. The population percentage was calculated by dividing the grouped districts' population by the total population in Nanjing. Districts were grouped in three categories: central, suburb and counties.

Table 2. The population density and percentage during the period unit: person/ha.

	1996		2001		2008		2014	
Nanjing city	8.0		8.4		9.5		9.9	
Central districts	70.0	34.7%	78.5	37.0%	93.6	39.0%	93.1	37.4%
Suburb districts	5.8	49.3%	5.9	48.0%	6.7	47.6%	7.2	49.3%
Counties	4.5	16.0%	4.5	15.0%	4.5	13.3%	4.7	13.3%

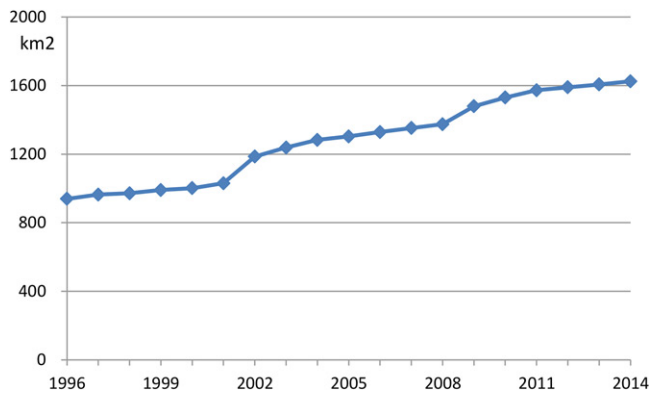


Figure 4. Built-up land between 1996 and 2014.

Table 3. Growth rates of population and built-up land from 1996–2014.

	Population	Built-up land
Nanjing city	23.5%	73.0%
Central districts	32.9%	33.6%
Suburb districts	23.4%	83.0%
Counties	3.1%	71.8%

Note: Calculated by dividing population increase (1996–2014) by population in 1996, and by dividing built-up land increase (1996–2014) by built-up land in 1996.

Table 4. The area and annual increases of built-up land unit: ha.

	1996–2001	2001–2008	2008–2014	1996–2014
Nanjing city	9,092 (1.9%)	34,471 (4.2%)	25,042 (2.8%)	68,605 (3.1%)
Central districts	662 (0.8%)	1,784 (1.5%)	2,765 (2.4%)	5,211 (1.6%)
Suburb districts	6,962 (2.1%)	26,397 (4.7%)	19,320 (3.1%)	52,679 (3.4%)
Counties	1,468 (1.9%)	6,291 (4.8%)	2,957 (2.1%)	10,715 (3.1%)

Note: Calculated as in Zheng, Zhang, and Zang 2007.

4.2. Land use change

4.2.1. Expansion of built-up land between 1996 and 2014

Built-up land strongly increased between 1996 and 2014 (Figure 4), from 14.3% of the total Nanjing area in 1996 to 24.7% in 2014. This shows that the growth of built-up land exceeds that of population growth (Table 3). This phenomenon is even stronger in the suburbs, which suggests that the newly built-up land was mainly created for industrial development, infrastructure, and uses other than residential.

4.2.2. Temporal and spatial variability of growth

From 1996 to 2001, urban expansion happened relatively slowly, with an annual expansion rate of 1.9% (Table 4). The built-up area in the central districts increased relatively slowly as a result of limited development space. However, due to development zones, new sub-centers and towns construction, and large numbers of people moving into the city (Chen *et al.* 2014), large amounts of land were needed after 2001 and the amount of built-up land increased by 34,471 ha (Table 4). The annual growth rate in the 2001–2008 period was 4.2%. The core city district experienced slower expansion than the suburb districts. The built-up land in core districts expanded by 1,784 ha (1.5%), compared with 26,397 ha (4.7%) in suburb districts and 6,291 ha (4.8%) in the counties, which spread out from the core urban areas and expanded into agricultural land.

4.2.3. Agricultural land use change

Nanjing experienced a loss in arable land of 72,357 ha during the study period, which comes down to an annual shrinkage of 4,020 ha. It is worth mentioning, though, that there was a dramatic decrease around 2002 (Figure 5), partly as a result of built-up land

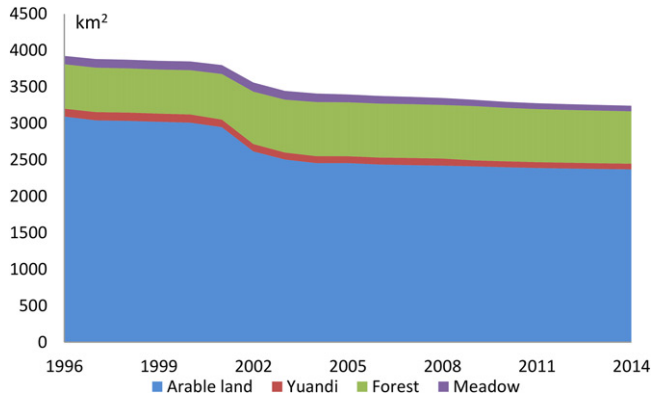


Figure 5. Agricultural land use change between 1996 and 2014. Yuandi (in Chinese, including orchards, vineyards, and plantations).

Table 5. Losses in arable land unit: ha.

	1996–2001	2001–2008	2008–2014	1996–2014
Nanjing city	14,503	52,768	5,086	72,357
Central districts	840	38	655	1,533
Suburb districts	12,056	39,695	7,390	59,141
Counties	1,607	13,035	–2,959	11,683

Table 6. Comparison between actuality and plan (2006–2020) unit: ha.

	2010		Discrepancy
	Planning	Actuality	
Arable land	241,604	239,912	–1,692 (–0.7%)
Total built-up land	138,359	153,064	14,705 (10.6%)
Urban-rural built-up land	124,665	135,695	11,030 (8.8%)
Urban settlements and industry/mining site	71,662	77,992	6,330 (8.8%)
Rural settlements	53,003	57,703	4,700 (8.9%)
Land used for transportation	13,694	17,369	3,675 (27.0%)

expansion, but also of an increase in forest land cover, which is likely to be related to the implementation of the Grain for Green programme (*The Notice of Returning Arable Land to Forests* issued by the State Council in 2003). Most of the loss in arable land happened in the suburb districts, where such land was still available: a loss of 59,141 ha, compared to a loss of 1,534 ha in the core urban districts (Table 5).

4.3. Comparison of planning and actual development

In order to determine the degree of compliance between the LUMP and actual land use change, we selected indicators in the plan in order to compare planned areas and actual areas (Table 6). The most important discrepancies were as follows: The target of total built-up land in LUMP (2006–2020) was 138,359 ha in 2010. However, this

was exceeded by 14,705 ha, i.e. by 10.6%, which means that more than planned areas of arable land, forest, meadows, and yuandi became converted.

4.4. Interviews and document study

Our interviewees were confronted with the here-presented numbers of urbanization, and asked to reflect upon them. Below we interpret and summarize how interviewees explained the observed trends and developments. We used policy documents in order to further explain and support the things that were said during the interviews.

First, the main driver of urbanization in Nanjing is, as anywhere in the world, the income gap between those active in the primary sector (generally rural inhabitants) and those active in the secondary and tertiary sectors (generally urban inhabitants). This leads to massive migration of rural population to cities to find a job in industries or services. This combination of urban population growth and economic growth leads to a high demand for houses, infrastructure, offices, and factories and a commensurate increase in land and real-estate prices. This development can almost be regarded as a 'force of nature', which is unstoppable and from many humanitarian perspectives even desirable.

However, urbanization can be controlled in spatial terms, by adopting policies that stimulate compact, high-density growth. This is what the national government prefers, since it prevents the needless consumption of productive agricultural land. However, the results in Table 3 show that the area of built-up land expanded much faster than the population, implying sprawl rather than compact growth. This is because lower-level governments have different concerns than the national government. From our interviews, the following drivers and mechanisms were given as explanations:

- The local government issued a **deliberate polycentric development plan**. Drawing from concepts of new towns and satellite towns, a concept was proposed called 'a city proper' (Zhu Cheng), which resulted in 3 new sub-centers (Xing Shi Qu), 7 new cities (Xing Cheng), 13 major towns (Zhong Dian Zhen), and some regular towns (Yiban Xiang Zhen)' (*Nanjing Master Plan (1991–2010)* revised version). This means that new centers and cities were developed, and that migration to towns instead of cities was also stimulated. Although this is a meaningful approach to prevent congestion and other large-city problems (e.g. slum-formation), it has resulted in low-density growth. One official said: "We know that it is a good idea to adopt a polycentric development strategy and build new towns to avoid a too dense population in the city center. However, we built so many sub-centers and satellite towns... For example, the area where Xianlin university town has been developed should have been used for ecological land reservation." Thus, apart from the fact that polycentric development is generally less dense than monocentric development, there also seems to have been a lack of coordination that has contributed to urban sprawl.
- The frequently changing local leadership results in a **fragmented spatial configuration**. The Nanjing government changed mayors five times from 1999 to 2014, and each new mayor had their own vision on urbanization development strategies and construction. This succession of ideas not only caused uncertainties and difficulties when developing the LUMP, but also led the municipality in an unidentifiable direction. The municipality changed the view on its spatial development frequently, e.g. starting from an industrial to a modern city and

ending with an image of the city as an international green metropolis (*The 9th, 10th, 11th, and 12th five-year plan for Nanjing economic and social development*). The priority of urban development also changed from Pukou New Town to Hexi New Town, and next to Jiangbei New District. As a planner said: “I am really confused by the urban development direction. We just changed the plan in order to satisfy the mayor, but the plan will be required to be changed again when the other mayor comes”.

- The strongly increased land prices turned out to be a lucrative economic model for municipalities to earn money by **leasing land to property developers**. As an official put it: “Nanjing also experienced a booming real estate market and leased much land to satisfy developers’ requirements and to reap land lease revenues”. Another said that “The booming real estate market encourages us to lease more land for developers or mortgage land in banks to get money for urban construction”. Not only do the land leases provide immediate income for the municipalities, but also the taxes that can be earned from real estate provide a secure source of income. Although municipality officials are supposed to conform to the LUMP, the financial incentive to change the designation from rural to a residential or development zone, is very strong and difficult to resist. This is further illustrated by the fact that, although a large number of rural houses were demolished based on the policy of Land-area Balance Mechanism Between the Urban and Rural Settlements in 2004, land used for rural settlements did not decrease but, instead, also continued to grow. According to a local official “The leaders in the primary-level organization have weak land use management ideology, farmers often have weak land use ideology, which give many troubles to supervise farmers’ building activities.” As a result, the arable land ended up to be less than the goal (Table 6).
- Another way for municipalities to secure economic growth was to **create large development zones** in order to attract capital and increase jurisdictional GDP (Table 7). This often did not happen primarily for the sake of incurring land leases, but to promote economic activity and employment. As an official stated: “We do know that leasing land against lower or even zero prices violates the central policies and distorts the land market and management. However, we have no choice, since other surrounding cities also do it like this. We don’t want to lose these enterprises to our neighbours.” In order to attract capital, local governments expropriated land in order to build industrial parks, high-tech parks and economic development zones (Table 7), which are often located at the periphery, and encroach on arable land. Analysis from documents of the Nanjing Statistical Bureau revealed that foreign direct investments increased to 3.3 billion dollars and many Fortune Global 500 firms, such as Siemens, Ford, and Fiat, have built branches in Nanjing. One interviewee explained: “The mayor or other leaders in the [local] government prefer to attract foreign businesses and investment and built megaprojects, even sometimes the location and/or quantity violate the plan, and the enterprises even encroach on the basic arable land. We should find ways to tackle problems. We often suffer much pressure.”
- Because of the global financial crisis in 2008, the Chinese national government decided to revitalize the economy through **large investments to stimulate domestic demand** (known as the ‘four trillion plan’ in China). One interviewee stated that “Nanjing was, like other cities, increasing investments in order to get

Table 7. National and Provincial Development Zones in Nanjing.

Development zone	Year of establishment	Planned area (ha)
National level		
Jiangning Economic and Technological Development Zone	1992	3847
Nanjing High-tech Development Zone	1988	1650
Nanjing Economic and Technological Development Zone	1992	1137
Nanjing Free Trade Zone	2012	503
Provincial level		
Jiangsu Gaochun Economic Development Zone	1995	673.4
Jiangsu Lishui Economic Development Zone	1993	1155.9
Nanjing Eco-technological Economic Development Zone	2012	1019
Nanjing Baixia High-tech Industrial Park	2001	114
Nanjing Chemical Industry Park	2001	1200
Nanjing Binjiang Economic Development Zone	2003	557.2
Nanjing Luhe Economic Development Zone	1993	1000
Nanjing Pukou Economic Development Zone	1993	1000
Nanjing Qixia Economic Development Zone	1992	731.8
Nanjing Yuhua Economic Development Zone	2000	468

Data source: Development zones' land-use evaluation in Nanjing in 2014.

out of the economic crisis. This accelerated infrastructure construction and real estate development.” Unfortunately, the plan was not very effective, as the annual growth rate decreased to 1.1% between 2011 and 2014. Meanwhile, the strong expansion of built-up land was an accidental side-effect.

Thus, it may be clear that the LUMP failed in terms of containing urbanization and protecting farmland. Although violating the LUMP involves financial and sometimes even personal penalties, the incentives for doing so are clearly stronger than those for complying with it. The combination of the above mechanisms caused unreasonable and redundant construction, and induced a real estate bubble, which severely affected sustainable growth. As a reaction, the central government successively strengthened its control in land markets and real estate investment, gradually changing its economic development pattern, especially after the new session of the Party Central Committee in 2013. Also, the protection of arable land has been prioritized in the Land Administration Law, making use of new technology, such as by linking the official assessment with satellite images in illegal land use inspection.

5. Analysis

In this section, we will evaluate the presented findings and confront them with existing literature in order to discuss whether or not growth management in China can contain urban expansion better due to its top-down governance regime. Our quantitative data on population and density changes, land-use changes, and the comparison with the LUMP suggest that the LUMP only had a limited effect on controlling urban expansion. An obvious reason is the growing number of people living in the city and the huge demand for land for development. However, studying the numbers presented above, population growth can only be partly held responsible for the strong expansion

of built-up land. Other mechanisms also play a role, whereby local governments seem to be driven by other incentives than the wish to comply with national directives for e.g. arable land preservation. There are several possible underlying reasons that lie at the heart of the weak power of the LUMP. The distinction between these factors is, of course, an analytical one. In reality, these factors are interrelated and they interact.

5.1. Decentralization

Decentralization is one of the most significant factors in battling the effect of the LUMP (Xu and Yeh 2009; Qian 2013). The political contexts change constantly and the power of the state is often reshuffled (Lin *et al.* 2015). The result is that local governments have increased discretion to implement central policies, which are usually beneficial to their own jurisdictions (Qian and Weingas 1996). Next to that, decentralization gives local governments more economic autonomy, as well as administrative and fiscal powers. Yet, municipalities are not simply loyal agents of the central states, but can be seen as territorial authorities with their own objectives and incentives. In this sense, decentralization has led to fragmentation of management and policies, resulting in a weak central governing capacity (Edin 2003). When governance structures become fragmented, they tend to have little power to control such complicated spatial processes as urban expansion (Carruthers 2003; Greasley, John, and Wolman 2011).

The importance of local economic appearance in the official evaluation system encouraged the local cadres to pursue GDP growth, leading them to become virtual CEOs of ‘urban development corporations’ in China (Chien 2008). The coalition among the municipal-district-town governments often provided municipal governments with relatively little control over illegal land-use. Although developments at the town-village level (for example, township enterprises) were qualified as being illegal, they still contributed to built-up land expansion. Furthermore, the promotion of one official means a lost opportunity for another. The pursuit of promotions, and thus more power, stimulates local leaders to build iconic projects and infrastructure schemes in order to boost local economy.

5.2. Marketization

The budgetary fiscal income and expenditure of local governments was severely imbalanced after the tax-sharing system in 1994 (Lin and Yi 2011). Fiscal reform provided the incentive and made it imperative for localities to perform their tasks of consolidation in order to gain control over urban resources such as land (Wu *et al.* 2007). Local governments acted as an executive agent of the state in order to manage and provide land to developers in commerce, industry and real estate (Ding and Lichtenberg 2011). They often seized the chances to capitalize land, especially after the urban land-leasing revolution in 2002. Land-leasing revenue represents a big amount of extra-budgetary revenue (Lin and Yi 2011). The land-leasing income of Nanjing e.g. increased from 6.6 billion RMB in 2002 to 38.6 billion in 2007, 42.3 billion in 2011, and 79.2 billion in 2014 (Land Leasing Market Report in Nanjing). This increased commodification of urban land inevitably caused much built-up land expansion.

As the flourishing urban land market increased land values, many enterprises and factories in the city center moved to ex-urban development zones where costs were

significantly lower. The number of real-estate projects, in turn, rose in order to satisfy this outward migration. Land speculation, however, created large quantities of idle land, due to inadequate laws and withdrawal procedures. As urban regeneration processes involved many stakeholders, high costs and complicated land property rights were the result. Therewith, urban regeneration processes were too complicated, and therefore not very successful. As a result, local governments turned even more to the expansion strategy in order to satisfy urban land demand.

5.3. Globalization

Economic globalization accelerates capital flows, which in turn accelerates inter-city competition to attract mobile external capital. In China, this competition increased after entry into the World Trade Organization (WTO) in 2001. The local government became a 'public entrepreneur' in attracting investment (Zhao, Lü, and Woltjer 2009). The main purpose of the spatially uneven open-up policy is to attract foreign direct investments (FDI) and to sell goods for export (Wei 2015). At this point, development zones became the new economic growth poles and the interface for attracting capital and export-import goods. Municipalities initiated many preferential policies, such as tax returns, financial support, better infrastructure, and more land with a lower price in order to promote economic growth.

During these years, a great deal of land was used for the construction of megaprojects, new towns and sub-business centers (Shao *et al.* 2018). The development pressure and challenges from Suzhou, Shanghai and Hangzhou, which are all located in the Yangtze River Delta, intensified the competition to attract capital (Wei 2015). Nanjing urgently wanted to improve its investment environment, urban image, and competitiveness by way of construction projects in this area. For example, Hexi New Town, with a planned land area of 94 square kilometers, was intended to be the second biggest CBD in Eastern China (Hexi New Town official website). Large-scale constructions easily and significantly contributed to GDP growth, which served as the capital for political promotion of local cadres. Local cadres in Nanjing thus gave impetus to urban constructions.

6. Discussion: Land use planning in the (de)centralization regime

Urban expansion management under the top-down land-use management system, such as China, does not show better management effectiveness than in a decentralized regime, such as the Netherlands (Hennig *et al.* 2015) or Spain (Paül and Tonts 2005). Compared to the centralized land use planning which provides a poor fit with local land needs, decentralization is supposed to make plans fit better to local needs, especially when it concerns matters of economic and administrative efficiency (Hananel 2013). Decentralization can more easily facilitate new modes of governance, such as co-governance and self-governance, which can supply public support and better innovate farmland preservation methods that often improve the effectiveness of managing urban expansion and protecting farmland (Perrin *et al.* 2018). On the other hand, decentralization has also led to multiple decision-making authorities and has increased the complexity of procedures, and local authorities' actions are not always consistent with national goals (Perrin *et al.* 2018). Local governments usually have considerable autonomy in their choice of approaches and policy instruments for land use and they

exercise considerable discretion in terms of how they implement land use planning (Feiock, Tavares, and Lubell 2008). As a result, not all local governments would like to take measures to contain growth management. Instead they often prioritize job creation and tax revenue generation in impoverished areas (Park, Park, and Lee 2010).

The general philosophy of most planning systems is based on the sustainable development approach, embedding principles of social justice, environmental protection, economic growth, etc. (Papageorgiou 2017). When land use planning shifts towards a more neoliberal orientation, implying that land use planning becomes more friendly towards investments, improves local competitiveness and prioritizes a market-supportive growth agenda, these objectives will take over the land use management agenda (Allmendinger and Haughton 2010). When enhancing the city's economic growth and competitiveness becomes the major priority of any ambitious local government, they have a strong inherent impulse to exert stringent constraints from the central government. Therewith, goals and interests can become more and more inconsistent between central and local governments. In the words of Anthony (2004, 390): "State-mandated measures need to be implemented at the local level. If at the local level there is no political support for the state-mandated measures, regardless of how significant and comprehensive those measures are, their implementation will be weak." As a result, the national government interventions and growth management strategies face more and more challenges in containing local expansion.

This phenomenon limits itself not only to China, but also in other countries whether in a centralized or decentralized regime. While China resembles more and more a federal institutionalized state, municipalities are still subordinated to the national government, meaning that their policies can be easily deprived by the central state. China is a socialist society in ideology and a federal institution is not in compliance with Chinese laws (see Qian and Weingas 1996). The institutional system supplies the central government with much recentralization power (Xu and Yeh 2009). When the central management policies fail, the central state will rearticulate a scalar relationship in order to achieve a more centrally consolidated power (Xu and Yeh 2009; Zhong *et al.* 2017). The cycle of 'centralization-gap failure-centralization' can make land use management stricter in the top-down centralized land-use regime. This encourages local governments to have more economically and intensively used land and take measures to activate the stock of construction land in future.

Following the ideological and attitude changes from the central government, local cadres' behaviors can change under the influence from top-down policy and institutional changes. Currently, the central government increasingly strengthens and recentralizes the state power in land management. For example, urban growth boundary delineation, permanent basic farmland delineation, the accountability system for land-use violation implementation, GIS and remote sensing technology adoption etc. have significant influence on local land use behavior and urban expansion management. China is also currently implementing a 'revolution' in order to adapt to a domestic socioeconomic environment, which can tackle local development dilemmas, to some extent, and change the underlying mechanism of urban expansion. This includes the performance assessment of officials (which will hardly focus on GDP and may alleviate intergovernmental competition and local development pressure), as well as the re-division of responsibilities and revenue between central and local government (which is expected to balance expenditure and incomes for local governments). But, how these measures can be successfully implemented is a question full of uncertainties. The

priority of economic development is still rooted in most local cadres' mind, which need time for local governments to change their economically oriented ideas and extensive economic development style. Urbanization in China, like in other developing countries, may be expected to continue in the forthcoming years, representing uncertainty for urban expansion management in the future.

We used Nanjing, which is a representative of Chinese cities at the forefront of globalization, national reforms and economic development (Qian 2013; Chen *et al.* 2014; Wei 2015), to study the effectiveness of growth management within a centrally planned regime. The results show that it is urgent to explore new governance modes of urban expansion. The quantitative data will be subject to errors, but in order for this error to undermine the credibility of our findings, it needs to concern a systematic overestimation of satellite-image-derived urbanization rates. We have no reason to believe that this is the case, since urban features are typically easy to distinguish. Regarding population data, these are census-based and may again be prone to some degree of error. But here as well, we have no reason to assume these errors to be large and systematic. Finally, our selection of interviewees may have led to a biased view of the underlying reasons for the mismatch between LUMP and actual land use. However, since the interviewer only reported reasons that were mentioned by at least two respondents, we are confident that we have tackled the most important and prominent reasons for the mismatch.

7. Concluding remarks

Although the land management and planning systems remained largely unchanged, new land regulations and laws to restrict local land-use behavior have been enacted and implemented. However, the central government still lacks effective instruments and strategies to enforce local compliance. This study evaluated the ineffectiveness of growth management strategies of the local government in Nanjing. We focused on population growth, density gradients, land-use changes between 1996 and 2014, and their compliance with the Land Use Master Plan (LUMP). The results show that the population density in the central districts (93 person/ha) is far higher than in the suburb districts (7 person/ha) and counties (5 person/ha). Urban expansion is not featured by population-dominated expansion in Nanjing, which is in contrast to America's population-dominated expansion (Ewing, Pendall, and Chen 2002; Woo and Guldmann 2011). The different characteristics of urban expansion also show that the land-use urbanization rate far exceeds that of population growth and that the expansion of built-up areas and the loss of arable land are considerable. This means that urban expansion in Nanjing is featured by built-up land expansion, including development zones, new towns and university towns, roads etc. The Nanjing case reveals explanations as to why the local governments act as they do, and shows that this is the result of the combination of decentralization, marketization, globalization and population growth. The conclusion is therefore: Growth management in China does not seem to contain urban expansion better, with its centrally organized land-use management system, than any other system, although comparisons are always difficult to make due to the inability to control for other determining factors such as population growth.

Containing low-density development and urban expansion is necessary for preserving open space, representing a strategy that is often agreed upon by local officials (Kline *et al.* 2014). However, facing greater competition between local governments,

land can be one of the assets, which is often used by local governments to attract investors and firms. Therefore, local governments would rather lose control over the urbanization process than lose capital and jobs. In particular, when local officials realize that they can also gain substantial land leasing income and/or tax revenue, which can be invested again in local construction and enhance economic growth, the land-driven development appears to strongly encourage local governments to plan more land for development and therewith stimulates further urban expansion. Thus, if anti-expansion strategies were to be successful, they should especially be oriented to reduce local dependence on land finance (Liu *et al.* 2018). Although the central government has taken some measures to encourage and force local plans' development control, the decentralization process stimulates the growing local ambitions for economic growth. This results in a fragmented form of governance arrangement between the local and central government and makes the central government control capacity weak. In fact, it seems almost impossible for central and local government to bridge this gap in containing urban expansion due to different interests. This shows, again, how difficult it is to manage urban expansion via growth management. In fact, growth management strategies require additional arrangements in terms of law and regulations, fiscal and financial arrangements, as well as the political willingness to limit urban expansion. Future research on new modes of governance in urban expansion should still be given considerable attention.

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Note

1. The base period for the second LUMP was 1996, and the latest data for the study was the year 2014.

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