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An Introduction and Comparative Study of the Implementation Approaches of Beijing's Green Belts

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Abstract: During China's rapid urbanization, its megacities are facing the greatest challenge of urban growth control of both population and built-up area. As one of the most important measures of urban containment, Green Belt has been widely used worldwide for many years. Beijing's Green Belts have been in their implementation for nearly three decades, during which different implementation approaches were used. The article looks into the evolution of Beijing's Green Belts policies and the existing implementation approaches, in which, the government, rural collectives and property developers cooperate in different ways. The aim of the article is to provide China's megacities with experience and lessons of urban containment policy implementation. In-depth interview, document research, remote sensing and GIS analysis are used for summarizing the detailed processes of different implementation approaches, as well as their strengths and problems. Four approaches involved include 'government direct participation – property developer nonintervention', 'government direct participation – property developer intervention', 'government nonparticipation – property developer intervention' and 'government indirect participation – property developer intervention'. Typical areas in the unit of the township are selected to analyze and compare the effectiveness of Green Belts policy under different implementation approaches. The conclusion is that the implementation approach of 'government direct participation - property developer nonintervention' results in the greatest effectiveness of physical environmental plan implementation, but requires large amounts of financial expenditure, and thus cannot be widely used. The approaches of 'property developer intervention' suit market-oriented economy better, and thus are more widely used, but they have also left some unsolved problems caused by market failure such as the under-supply of public goods. Suggestions for

planning policy improvement lie in how to guide these four approaches respectively to achieve the multiple goals more effectively during Beijing's Green Belts implementation.

Keywords: Green Belts; Beijing; implementation approaches; urban containment policy

1. Introduction

In 2014, the State Council of China published *Notice on Adjusting the Standard of Urban Size Classification*, in which the word 'Mega-city' first appeared officially in a China's government document. This demonstrates that some Chinese cities have entered a new development era, which is different from the way of traditional large cities. As China's representatives of global competition, these mega cities are also facing great challenges of spatial development strategy, the provision for efficient infrastructure, intensive land development and the establishment of competent planning and management institutions. In a word, the emerging mega-cities in China are confronted with the difficulty of how to develop in a more sustainable way under the tremendous pressure of population and built-up land expansion.

During their rapid urbanization, western countries invented various forms of urban containment policies, among which Green Belt and Urban Growth Boundary are the most famous and widely used two. From then on, it has been required that these theories should be localized to solve the problems in fast growing Asian cities, where the pressure also comes from village renovation due to the high rural population density. Some researchers have talked about the conflicts and practices of Green Belt policies in Asian cities' urban-rural fringe, like Hong Kong, Seoul and Beijing (J. Kim, 1990; Bo-sin Tang et al, 2005; Y. Jun & J. X. Zhou, 2007). This article is a deeper look at how Beijing's Green Belt plan is implemented under different approaches, as well as their results and problems.

2. The Policies and Implementation Approaches of Beijing's Green Belts

2.1. Beijing's Green Belts Policies and Implementation

The concept of green belts in Beijing first appeared in the city master plan that came into effect in 1958, but the concrete Green Belts region wasn't designated and the policies for implementation were not officially promulgated until 1986. The current range of Beijing's Green Belts includes two rings (Fig. 1). The inner ring (light green part) is located between the central city and the urban fringe groups, while the outer (dark green part) lies outwards to the suburbs. The out boundary of the Green Belts is the 1-km buffer outside of the 6th ring road of Beijing, which, to some extent, marks the dividing line of urban and rural areas. According to the city's master plan, The inner ring of Green Belts, with an area of about 240 km², is mainly composed of public green spaces due to its proximity to urban residents, while the outer ring, with a total area of 1061 km², is primarily composed of ecological landscapes and farmlands.

Figure 1. Diagram of Beijing’s Green Belts Location (by the author).

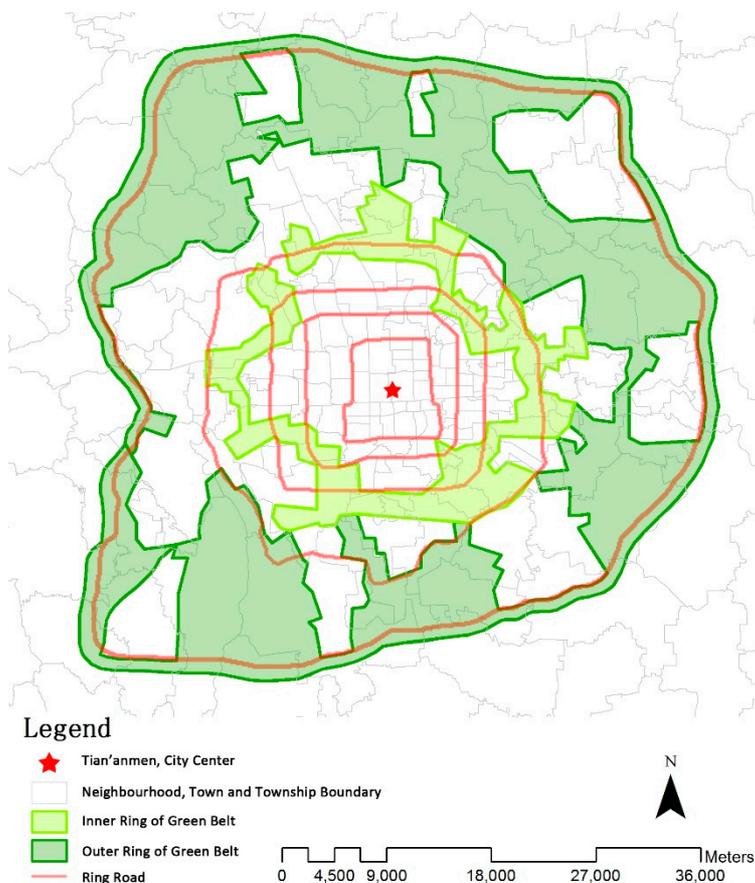


Table 1. Chronological Beijing’s Green Belts Major Policies.

The Year of Enactment	Official Document Code	Main Funding Source	Measure
1986	Capital Planning Committee [1986]2	1 Township and Village Enterprises 2 Nursery Garden	Guidance
1994	Beijing Government [1994]7	1 Township Enterprises 2. Real estate development 3. Commercial projects, like sports fields and recreational facilities	Market Forces and Regulation
2000	Beijing Government Office [2000]20	1. Real estate development 2 Subsidies 3 Loan from financial institution 4 Commercial projects, like sports fields and recreational facilities 5 Green Belts Industrial Land	Subsidies, Market Forces and Regulations
2008	Beijing Government [2008]17	1 Subsidies 2 Green Belts Industrial Land	Subsidies, Market Forces and Regulations

For the past three decades, several official documents were issued to guide the realization of green belts. Different from its birthplace, the United Kingdom, lands within Beijing's green belts are not directly purchased by the state, and most of them remain rural-collectively owned before the implementation starts. The proposed way of realizing green belts is to make the full use of the market mechanism, but the main funding sources changed over time (Table 1).

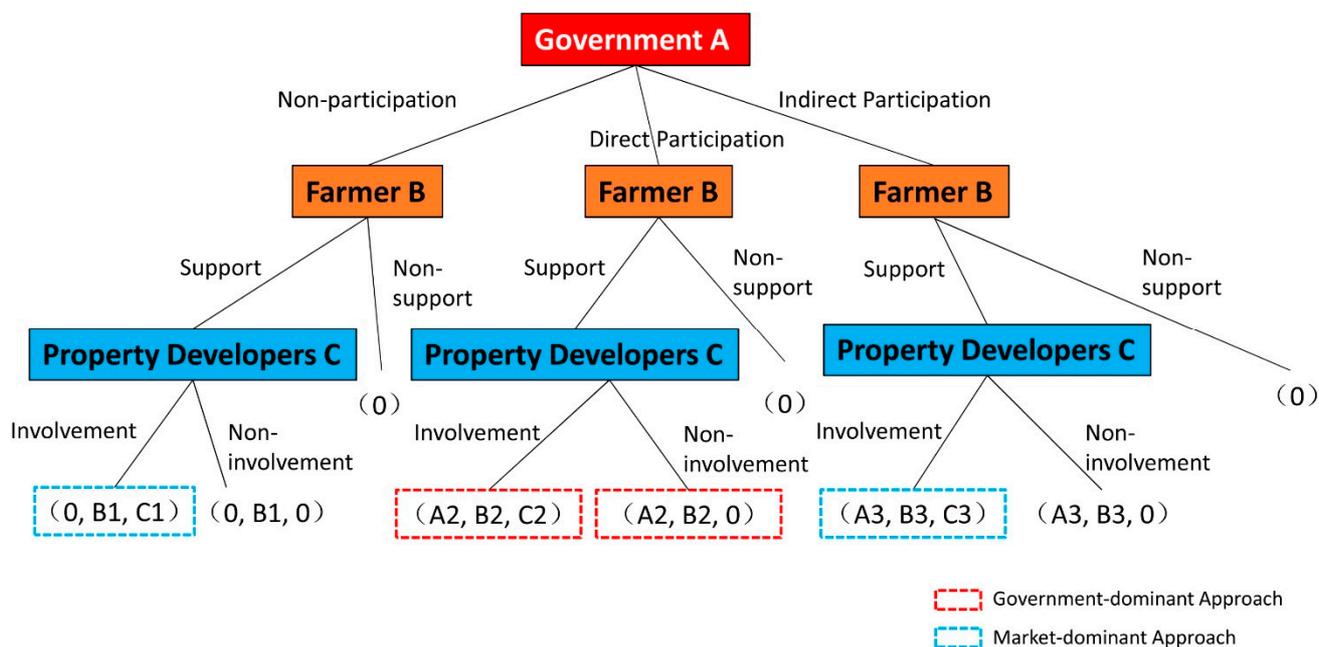
There has been quite a number of researches that look into Beijing's Green Belts policies and implementation. Most of them are unfolded in two ways: 'typical area analysis-problem induction-suggestion proposal' (Tan Q., 2008; Yang X. P., 2009; Lv H. H. et al, 2013; Zeng R. Z. & Wang L. S., 2014) and 'index selection-data analysis-policy evaluation' (Y. Jun & J. X. Zhou, 2007; Han H. Y. et al, 2009; Sun X. P., 2012). The former is based on survey data and the latter is based on remote sensing data. Based on the above researches, some agreements have been made: first, since 2000 the effectiveness of urban growth control has emerged, and built-up area grows more slowly within Green Belts boundary than outside area; second, in recent years, the vegetation-covered area in the inner ring has been increasing steadily, but the outer ring has become the area where built-up area expands rapidly; third, the implementation of the inner ring has been almost finished, while that of the outer ring is still in early stage. Generally speaking, in the macro level, the existing researches have done a good job in the evaluation of the green belt implementation, but there still lacks a structural analysis. For example, they haven't gone more depth into the questions, like whether there is a spatial differentiation of the implementation results and what the effect factors are. The article is devoted to answering these two questions.

2.2. Implementation Approach

The land use pattern and property right's distribution are complex in urban fringes, and the redevelopment process involves many agents. Bryant C. R. et al (1982) described the development process in fringe zones as an agent-based market model. Therefore, according to the participation ways and the results of the game, planning implementation approaches can be effectively classified. In Zeng R. Z. & Wang L. S.'s research (2014), land use and development way of Beijing's urban fringe can be summarized as 4 approaches based on game theory (Fig.2). In the context of Beijing's Green Belts implementation, these approaches correspond to four specific development ways (Table 2).

The essential difference of these implementation approaches lies in the financial sources of village demolition, primary land development and re-afforestation. For land banking, funds come from land-transferring income after land consolidation. For the area driven by large urban projects, like the Olympic Game venues and newly-built airport, most of the funds come from government fiscal expenditure. For the area where townships autonomously cooperate with the property developers, the funds completely rely on the land leases within the area, which means the intention for a company's corporation plays an important role. For the area with higher-level project settlement, the funds partly come from municipal and district government financial expenditure, and the rest rely on the market.

Figure 2. Agent-based Game Analysis of the Development Process in Urban Fringe Zones.



Source: Reference 4, pp.26

Table 2. Implementation Approaches and Development Ways of Beijing’s Green Belts and Their Surrounding Areas.

Implementation Approach	Specific Development Way	Typical Area
government direct participation – property developer nonintervention	Large Urban Project (e.g. the Olympic Games)	WL*
government direct participation – property developer intervention	Land Banking	CGZ
government nonparticipation – property developer intervention	Townships’ Autonomous Cooperation with the Property Developers	DS
government indirect participation – property developer intervention	Higher-level Project Settlement	HZH

* The abbreviation of township names are used in the table, e.g. Township Wali is expressed as WL for short. The same below.

Generally speaking, when the government dominates the development process, the planning goals will be well achieved, but also, they may carry the heavy burden from fiscal expenditure. On the contrary, the more the development process relies on the market, the more problems may appear in the late stage of implementation, such as the under-supply of public goods and the vacancy of social equity. Therefore, the government is facing the trade-off between financial pressures and the achievement of planning goals. At the same time, not all the towns and townships have the autonomy to choose the implementation approach, which actually depends on external conditions. For land banking, a good location with a high land price is a prerequisite, which can balance the high costs during land

consolidation and primary development in the urban fringe. For large municipal projects and higher-level project settlement, the contingency for major decision-making in urban development always exists.

Then a question comes whether the approach affects implementation results. If so, to what extent and in which aspect, it does. In the following part of the case study, the article will try to answer this question by analyzing typical areas.

3. A Case Study of Beijing’s Green Belts Implementation

3.1. Methodology and Data

The research is unfolded quantitatively and qualitatively. In the quantitative part, with ENVI 4.8 and ArcGIS 10, Landsat data are processed to find the spatial differentiation of Green Belt implementation results among towns and townships in the municipal level. In the qualitative part, sample areas, which represent various implementation approaches, are selected to make a comparison. The research is to see how approaches affect results in the routine ‘value-goal-approach (measure)-result’ planning policy evaluation framework.

In the remote sensing and GIS analysis part, original data are downloaded from USGS (Website: <http://earthexplorer.usgs.gov/>) with their information shown in Table 3. Here 2003 is selected as the time node when the current city master plan hadn’t come into operation, or the non-policy period¹, and 2014 is selected as the present. 2004-2014 can be regarded as an effective implementation period for the current master plan.

Table 3. Remote Sensing Data Description.

Data ID	Date of Collection	Longitude (° E)	Latitude (° N)	Cloudage (%)	Sensor	Accuracy
LC81230322014279LGN00	2014-10-06	116.72	40.33	1.06	Landsat 8 OLI_TIRS	30*30m
LT51230322003121BJC00	2003-05-01	116.70	40.44	0.0	Landsat 4-5 TM	30*30m

3.2. Overall Analysis and Sample Selection

Concrete steps for analysis are as follows:

Step 1: In ENVI, the Support Vector Machine is used as a supervised classification method to classify Landsat data roughly into five land use types² (Fig 3): water (blue), vegetation-covered area (green), built-up land (purple) areas paved with rigid material like airport and plaza (light purple) and bare land (yellow).

Step 2: In ArcGIS 10, these five land use types are reclassified and combined into two categories: built-up area and unbuilt-up area (Fig 4), in which blue, green and yellow pixels are incorporated into the former and purple and light purple pixels into the latter.

Step 3: The two green belts rings are subdivided into towns and townships as the basic units to figure out the change of unbuilt-up area proportions. Use the function of Zonal Histogram of Spatial Analyst

¹ Beijing’s current plan came into effect in 2004, named *Beijing City Master Plan (2004-2020)*, in which the boundaries of two rings of Green Belts are designated.

² The classification overall accuracy of 2003 is 95.20% and that of 2014 is 94.97%.

Tools to count the numbers of pixels which represent different land use types, and calculate the proportions.

The results clearly show the spatial difference of planning implementation results among towns and townships (Fig 5). Here the results mean during the implementation period of the current city master plan how the amounts of unbuilt-up land have changed. Due to the fact that the difference does not present an obvious spatial pattern, it can be concluded that location is not the only major effect factor. However, generally speaking, the implementation results of the northern part are better than those of the southern part.

Then four townships, as the representatives of the each implementation approach, are selected to do in-depth study (See Table 1 for the corresponding relation). Figure 6 demonstrates their locations in the city and their land use plans formulated according to *Beijing City Master Plan (2004-2020)*. Although the green belt occupies only some parts of these administrative units, the land use plans for townships are presented as a whole because in the process of implementation townships are taken as the smallest administrative units. The plans manifest that in the long term the original townships are intended to be urbanized areas, public green spaces and a small amount of farmlands far from the central city.

Figure 3. Land Use Classification Results of 2003 and 2014 (by the author).

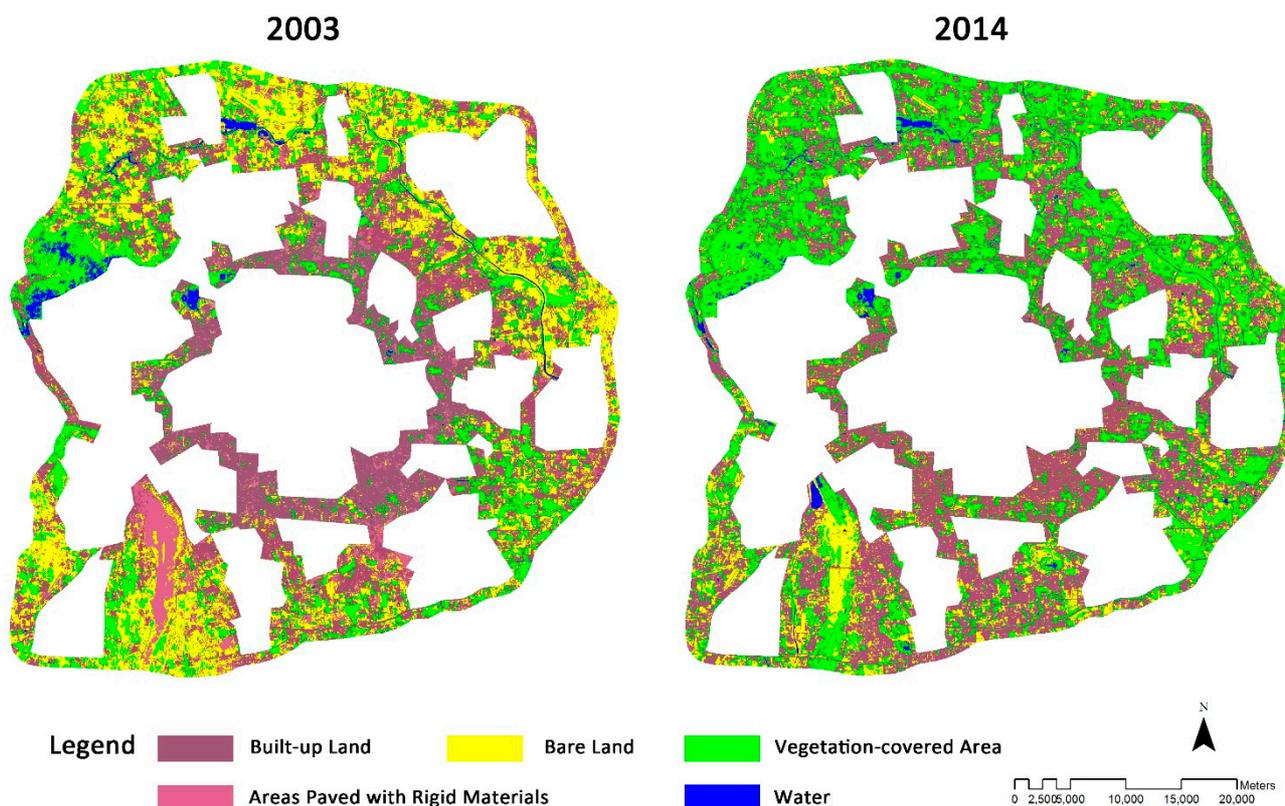


Figure 4. Built-up Land and Unbuilt-up Land within the Two Rings of Green Belts (by the author).

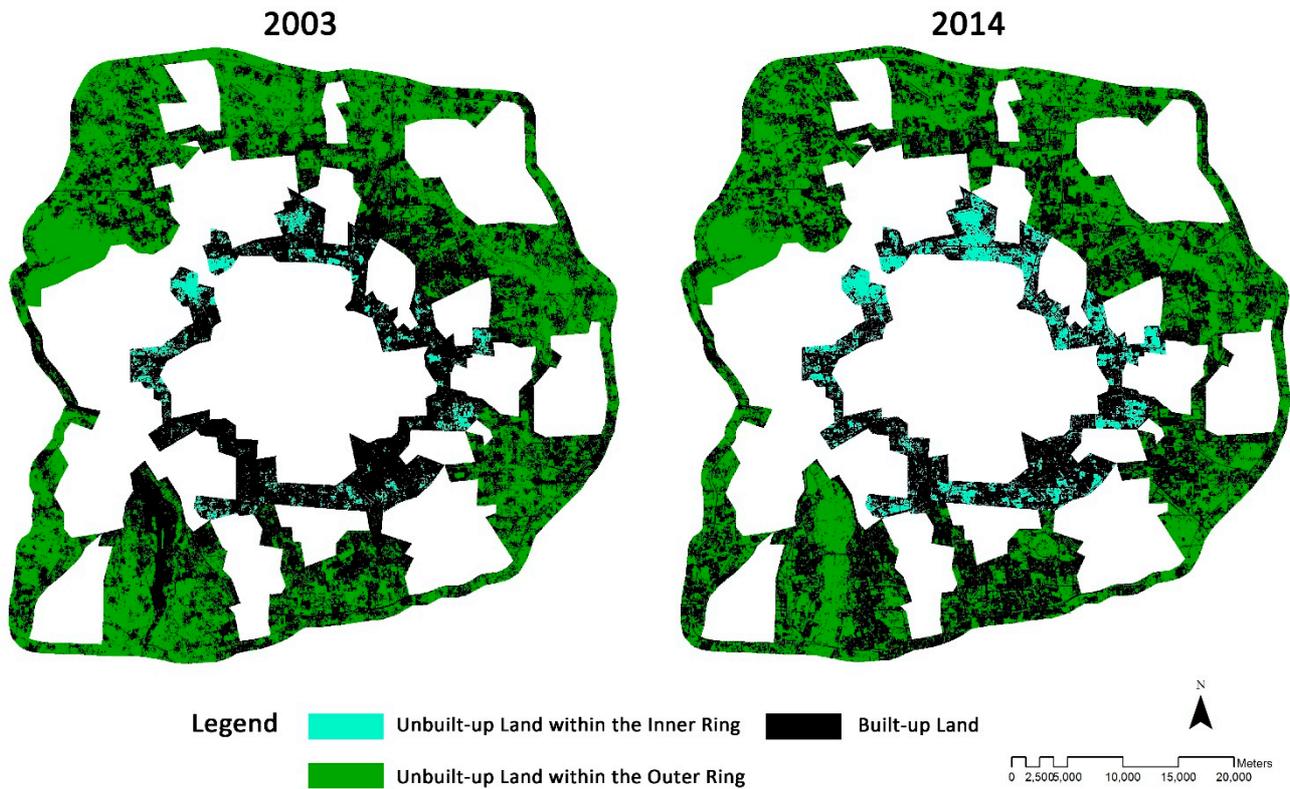


Figure 5. The Proportion of Unbuilt-up Area in Towns and Townships (by the author).

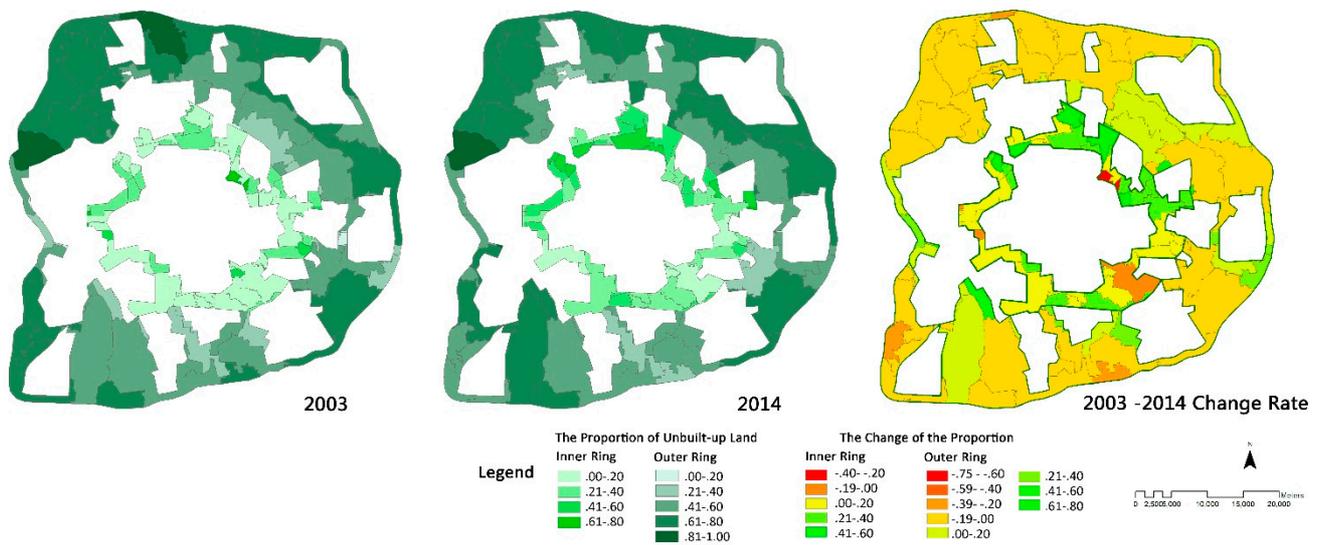
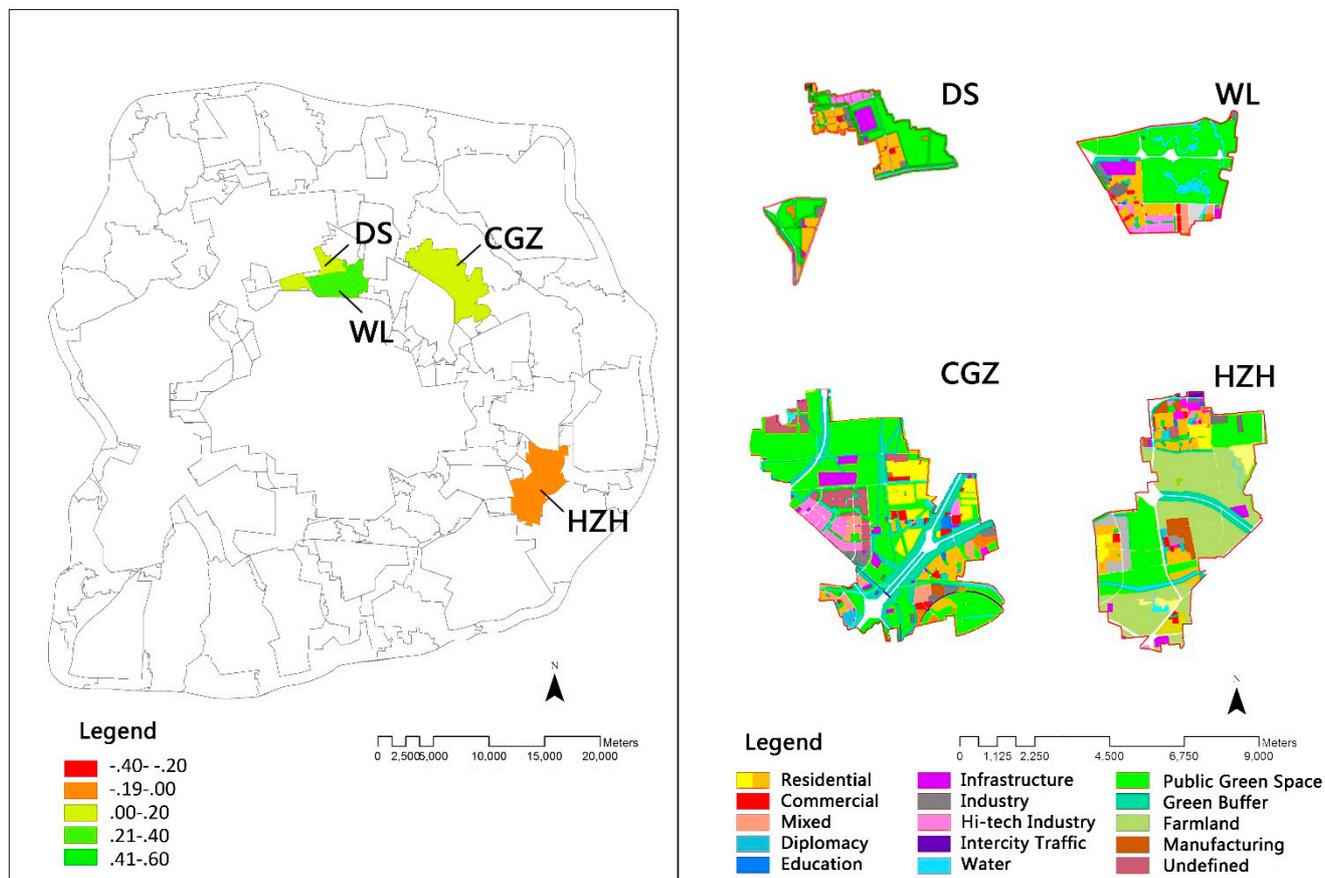


Figure 6. (a) the locations of selected sample areas. (b) Land use plans of selected sample areas.



3.3. Comparative Study

3.3.1 Context

John Friedman (1995) proposed three contextual elements when doing a comparative study, including state or regional elements, making-decision environment and governance style³. Due to their close geographical distance, with similar culture under a unified governance system, the contextual difference only lies in the following two aspects:

The first is economy, or, to be more specific, the economic activities, industries and property prices. An old saying existed for hundreds of years in ancient Beijing city that ‘East rich, West noble, South poor, and North humble’, which manifested a rigidly hierarchical urban structure in the periods of Chinese feudal emperors. Therefore, the eastern and western parts of the city develop better than the other two directions as a continuation of history. In the modern times, some large urban events have successfully driven the economic growth in the northern part, such as the Asian Games and Capital International Airport expansion, which leaves the southern part less developed where land prices are relatively low and economic activities in formal sectors grow comparatively slowly.

³ State or regional elements consist of economy and technology, history and traditions, and political organization. Making-decision environment refers to the quantity and quality of stakeholders, the attitudes of opponents, and the power of private enterprises etc. Governance style involves governmental structure, planning procedures, scope of planning and science and technology capacity of planning.

The second is the quantity and quality of stakeholders. According to Bryant C. R. (1982), the development process in urban fringe under the market mechanism can be abstracted into an agent-based model with many stakeholders. Here, for the green belt implementation, government, farmers and property developers are the three direct stakeholders, and farmers must support to make the development process feasible. Under China's current circumstance, the determining factor of farmers support is the compensation for demolition. Interviews with relative stakeholders reflect that farmers may hold completely different positions in front of different approaches. When faced with large urban projects, farmers actively cooperate with the government and they may have a sense of pride in their contribution to the city development and improvement. Under the other three approaches, the price negotiation will be complicated and require a few rounds, and the negotiation price for land banking is the highest among the three. This means the bottom lines of stakeholders vary in different situation.

3.3.2 Process and results

Figure 7 displays the durations of the green belt implementation in these four townships. Together with Figure 6, it can be found that it takes several years for the implementation process in a township, and generally speaking, the earlier it starts the better the implementation results are. For those townships whose implementations are on the agenda but the action delays, farmers tend to expand their residential houses and built-up lands to ask for higher compensation payments for demolishment, which finally gives rise to the reduction of public open green spaces or farmland.

Figure 8 shows the land use changes in these four townships from the beginning of green belt implementation to the present. So far, except for WL and DS, there are still some villages to be resettled in the other two townships. Land use changes in WL are significant, and the plan has been completely realized and original rural lands have been divided into urban parks and urbanized areas. DS, located next to WL, has also finished the planning implementation with original villages being converted to modern real estates (blue frame). Compared with the two sample townships in the inner ring, the pace of planning implementation in the other two townships is much slower. CGZ, where land banking is used, a serious problem leaves that within the proposed built-up area (red frame) villages can be demolished smoothly because it is possible for the sale incomes of redeveloped lands to cover the high costs of land consolidation, but within the supposed green belts area there lacks impetus for demolishment and afforestation. In HZH, the situation became even worse, and a large amount of original farmlands are occupied to build rural factories (yellow), which gives rise to the increase of total built-up land.

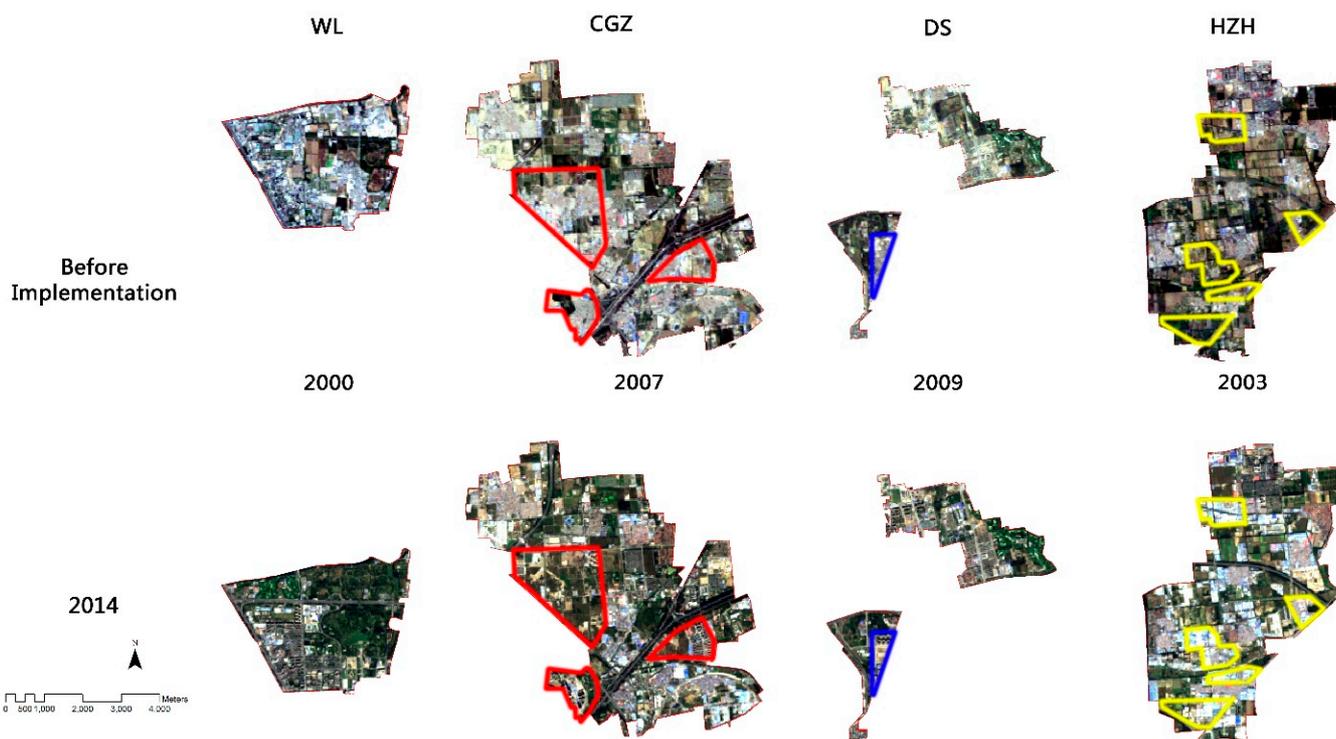
The four sample townships cannot represent all the implementation areas, and the location factor of these samples hasn't been sufficiently talked about, but to some extent, they can reflect the effectiveness and problems under different approaches. Both the government-dominated (WL) and market-oriented (DS) approaches can be successful, although the paths are completely different. Another reason behind this result may be the two samples located in the inner ring, which is closer to the central city, and thus is more attractive to capital. For the other two samples, where market power is not strong enough, problems are more obvious. In CGZ, only the villages within future built-up areas can be effectively demolished, and those within public open spaces are still untouched. This reflects the unsustainability for the current land banking mechanism during the green belt implementation, which also makes the

development of villages in green belts into the dilemma. On one hand, they are situated in designated green belts and cannot develop residences and factories due to strict growth restriction. On the other hand, there is no capital and mechanism to resettle and urbanize these villagers. In HZH, the implementation has not started yet, and therefore the approach of a higher-level project settlement as a way of indirect government intervention is actually a kind of government aid for the area where market forces are weak. One problem in this approach is that it usually takes several years for a large project to go through the complicated official process of ‘proposal-site location-planning approval-design-build’, which somewhat delays the implementation schedule.

Figure 7. Durations of Green Belts Implementation in the 4 Sample Township.



Figure 8. Land Use Changes of the 4 Sample Townships.



3.4. Discussion

Since each approach has its scope of application, advantages and problems. There should be a discussion on how to improve them. For the approach of ‘government direct participation – property developer nonintervention’, large urban projects do not emerge consistently, and thus it makes little sense for reference. For the approach of ‘government direct participation – property developer intervention’, land banking mechanism must be operated in a more holistic, long-term and meticulous way, to prevent the irrational phases and steps of implementation which may lead to the situation that the profits of redevelopment are carved up at the very beginning with the provision for public goods never being touched. For the approach of ‘government nonparticipation – property developer intervention’, the choice of reliable cooperator is the key to smooth progress during which large-scale state-owned enterprises could be good selection objects. In the example of DS, Tsinghua University is the cooperator who provided the initial capital for village demolition and land development. For the approach of ‘government indirect participation – property developer intervention’, the speeding-up of approval process, during which the strict control on the building and renovation of rural settlements can be done to reduce the difficulty in latter implementation, and thus improving the results.

4. Conclusions

The plan and implementation of Beijing’s green belts is significant for the China’s fast-growing mega-city to develop in a sustainable way. For the past three decades, the green belts have been implemented in different approaches from highly government-dominated to pure market-dominated, and the leading policies also changed over time. Four approaches can be summarized according to agent-based game analysis of the three key participants, including government, farmers and property developers.

By the use of remote sensing technology in ENVI 4.8 and spatial analysis in ArcGIS 10, the article reveals the spatial differentiation of green belts implementation results and talks about how approaches affect results. Generally speaking, the implementation results of the inner ring of the green belt are better than the outer ring, and the northern part is better than the southern one. It is found implementation approach is not randomly selected but, to a large extent, based on the contexts of the area. The approach of ‘government direct participation - property developer nonintervention’, like WL where the 2008 Beijing Olympic Games were held, results in the greatest effectiveness of physical environmental plan implementation, but it also requires large amounts of financial expenditure, and thus cannot be widely used. The approach of ‘government nonparticipation – property developer intervention’ suits market-oriented economy best, and thus is most widely used, but it may also leave many unsolved problems caused by market failure such as capital chain rupture and the under-supply of public goods. This deficiency is also reflected in land banking as an approach of ‘government direct participation – property developer intervention’. Compared with the above three, the approach of ‘government indirect participation – property developer intervention’ is more like a makeshift for the area where market forces are weak and fiscal transfer is impossible. The long term of complicated official process is the main challenge of built-up land control and green belt implementation in this approach.

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Conflict of Interest

The authors declare no conflict of interest.

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