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URBAN REGIONAL STRUCTURES TRANSFORMATION AND SUSTAINABLE DEVELOPMENT: CASE STUDY OF NANJING MEGALOPOLIS

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ABSTRACTS: Since 1978, many changes have happened on the background of urban regional structure in China, such as the economy system restructuring, the social transforming including the population flow accelerating and social demand diversifying and individualizing, the political and economic systems reforms, the rise of the real estate market and the changing relationship between human and nature. From the macroscopic view, these changes make the national urban system to be a newer pattern with a widening gap among the cities in spite of the rising of the cities as a whole. At the same, the urban land use structures are changing with both the trends of intensification and diversification, and the trends of the regional diversification and the economic integration. Besides, urban structures with multiple centers are emerging in several metropolitan areas in China. These changes and trends mentioned above are confirmed by a case study of Nanjing City, a growing metropolitan area in east China. The case study also points out some problems in urban regional structure reforming, especially the poor social and ecological considerations. We should pay more attention to some ideas like balance of intensification and decentralization, development of suburban centers and a reasonable mixing of the functional activities to develop a sustainable urban regional structure.

KEY WORDS: urban regional structure; Nanjing megalopolis; sustainable development

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An urban region refers to an area within the direct incidence of urban activities, usually includes the central city and its suburban areas. The structure of urban regions (urban regional structure) is the characteristics of distribution and constitution of various urban functions. By the macroscopic point of view, urban regional structure means the cities as a whole, named urban agglomeration or urban system, which is consisted with neighboring cities with influences to each other. By the medium or microcosmic point of view, it means the spatial projections of locations and relationships of various physical objects in an urban region. Both of the regional structures always exist while cities are coming into being or developing, and each as the result of the other to some extent. This paper is a study on these two levels of regional structures of cities, discussing the various patterns, the characteristics and trends, leading the cities to develop in a way more economical, effectual and impartial.

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1 BACKGROUND FACTORS OF URBAN REGIONAL STRUCTURE

Here we'll discuss the restructuring of the economic and social factors in urban regional development, and what have been happening on the background of urban regional structure in China since 1978.

1.1 Economy System Restructuring

Restructuring of the products will make the original spatial patterns of the economic activities change, such as the land uses, locations and structures. It will then affect the spatial structures of the urban functions, and lead to the spatial restructuring of the national or regional production in an open system. Rise of the Sun Belt in the United States is a case of spatial restructuring of national development caused by development of the information industry. In another case, rise of the Zhujiang River delta in China is caused by the export-oriented product structure there. Such cases are also common in global extension while the economic activities becoming more regionalized and internationalized.

1.2 Population and Social Transforming

Since 1978, China's population has been growing with lower birth rate and death rate. The population flow accelerated, and the social demand has been diversified and individualized. There is a new pattern of life coming into being in China.

1.3 Reforms in Political and Economic Systems

Chinese government paid more attention to adjustment of the economic development, regarding it as a major function of the government. The control of the micro-economy by means of plans in the past has now turned into the adjustment of the macro-economy by means of policies on financing, taxing and banking, etc. Reforming and adjusting of the economic system is now remarkably affecting the urban structures.

1.4 Rise of the Real Estate Market

In the late 1980's, after decades of winter, the market of real estate was established and re-rose in China when the terms of land exchange in China's constitution and other laws were modified. Since then, the investors mainly as the government and the collectivities have now been diversified; the sources of funs mainly as the financial bankrolls have now been more private; and instead of free allocation, the housing policy has now been more interrelated with the markets while renting and purchasing being the major means of housing.

1.5 Changing Relationship Between Human and Nature

In an urban area, human is the dominating element in the relationship between itself and nature. We have to reevaluate the developing model and the living pattern with negative effects on the natural environment as the urban area expanding. It's one of the major topics in sustainable urban development to harmonize the relations between the development of urban regional structure and the balance of natural environment.

2 MACROSCOPIC URBAN REGIONAL STRUCTURE: NEW PATTERNS AND EVALUATIONS

After 1978, as relations among cities or regions expanded and complicated, there has been a macroscopic regional restructuring in China. To review this geographical process of spatial reformation in China, these two factors below were studied: industrial restructuring of cities with different rank of size, changing status of the cities in national urban system.

Through a comparative study on urban centrality of 50 Chinese cities in 1978 – 1994, we find that there are 10 cities with average centrality above zero, most of them are opened coastal cities. On average, centrality of these 10 cities rose from 2.1 in 1978 to 4.0 in 1994(Fig. 1). The fact indicates that the traditional geographical urban structure hasn't been changed yet through 20 years of opening and reforming. The gap

between the eastern coast and the inland is widening as the coastal belt of urban agglomerations from Dalian to Guangzhou emerged, which is intensifying the Core-Periphery map of China's urban system. Also, the gaps among the cities in both core area and periphery area are widening, for example, the centrality of Dalian rose from −1.37 in 1978 to 1.53 in 1990, while the centrality of Fuzhou rose from −1.87 to −1.28 only. Another case is shown in Fig. 1, the centrality of Xi'an and Kunming indicates the similar gap in the inland.

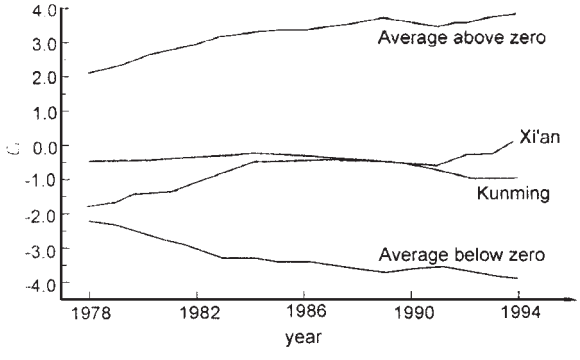

Fig. 1 Variation of urban centrality in China ①

Why did the gaps widen in spite of the rising of the cities as a whole? First, cities well developed as Suzhou and Xi'an could easily perform the restructuring of economy and urban functions and establish an economy system based on service sector. Secondary, the well developed cities as Guangzhou, Wuhan and Dalian are usually geographically well located and as regional or national transportation centers, and is competitive to get investment for faster development. The widening gap between core area and periphery area in economy development, functions and scales of cities in China leads to the unsustainable development of society and resource. It's an essential task to seek for an urban regional structure with social equity and a balance of economic development, resource exploiting and environmental preservation, especially when we encounter the critical problems of resource exhaustion and environmental deterioration, and when the gaps between core area and peripheries in the standard of consumption and the quality of living are widening.

3 URBAN LAND USE STRUCTURE DYNAMICS

Urban land use structure means the locations and relations of various urban functions. The dynamic of urban land use structure includes two basic proceedings in urban growth—the expansion of the functional sections, replacing and restructuring of different functional sections.

3.1 Intensification

When the urban areas grow, various functional activities are located and expand along lines with least resistance in terms of transportation, technology and natural condition. Urban land uses usually concentrate along the transportation corridors or jump to the intersects on the upsurge stages, or otherwise expand just near the original constructed areas. In any case, not only in the proceedings of growth, the trends of intensification of land uses exist in replacing of functions and intensifying of the functional structures.

Under the planned economic system before 1978, urban land use was less intensified in China, land of various functions were highly mixed up and lack of economical consideration. But it needs arduous efforts to perform an advantageous for restructuring because of poor utilities and a large number of funds needed in reconstruction even after 1978. Not until the early 1990's did cities in China begin to pay more attention to the construction of CBD in the cities, such as Waitan central business district in Shanghai and the district centered on Sidalin Square in Dalian.

3.2 Diversification

As the urban areas expanding, various functions of land use spatially diversified. In traditional models of urban land use, there're rings of different land uses

① $C_i = P_i + I_i + S_i$; C_i, the centrality of city (i); P_i, the centrality of city (i) valuated by its gross national product; I_i, the centrality of city (i) valuated by its total income of communication service; S_i, the centrality of city (i) valuated by its non-agricultural population.

from the center to fringes as in turn, commercial, residential and industrial. Main reason for the diversification is that land prices in urban areas varies from the center to the fringe — higher near the center and lower as getting closer to the fringe. The diversification of land use based on prices make the urban structure more reasonable and economical.

In China, the market of land has not been established until 1988. The functional rings in urban areas formed mainly because of the urban growth in different time, but not the land prices. Usually, urban land use structures in China were less diversified, and there're medleys of multiple functions in urban areas, such as commercial and residential mashes in inner city, and industrial and residential aggregations dispersing in fringes. The pattern of urban land use structure in China reflects the industrial construction-based urban planning policy under the planed economic system, regarding the cities as an integrated unit of social-economic activities. It led to a pattern of land use unit based on economic unit that providing occupations, housing, and even social welfare; accordingly the units were composed of multiple functions of land use. This kind of aggregation could to some extent cut down the commuting, resource consumption, environmental pollution and pressure on utility providing; but would lead to an uneconomical and motley land use pattern in the urban area as a whole and an unsatisfying habitation environment.

After the establishment of real estate market, functions of land use have been diversifying more remarkably. In the inner city, industrial activities have been mostly peeled off, and the commercial and residential activities have been mostly spatially segregated leading to the formation of CBD and the consolidation of traditional commercial centers. The economic units-based land use units have been mostly broken, urban planning policy have been considering more upon economy in land use and the quality of living environment.

3.3 Formation of Multiple Centers

When an urban area expands to a particular scale, the land uses do not evolve a single core, but at several nods or focal points. In most cases, formation of multi- centered structure was close related with the suburbanization. When the activities expanded and dispersed farther away from the main center, cost of the services provided by the main center rises; when the service price exceeds a certain level, a new sub service center emerges.

Suburbanization is now yet a new term in China, and there are few cities with trends of decentralizing. Why so dissimilar are the Chinese cities and the cities in western countries? First, there's a difference in stages of economic development, and there's only a small number of families being economically able to be suburbanized and have little affect on the urban structures. Secondly, transportation facilities are poor provided and private vehicles ownership is lower as a whole in China. Thirdly, affected by the traditional cultures, the Chinese families — even the wealthy ones mostly like to live in the inner city. Fourthly, there're fewer relations between migrating and the living cycles of Chinese (ZHOU, 1996). In any event, the formation of multiple centers in the bigger cities will be an inevitable trend and necessary process when we seek for a less polluted, well-facilitated social-ecological environment which is beneficial to harmonious development of nature, factitious environment and social production.

3.4 Regional Diversification and Integration of Economy

These two processes of regional diversification and integration always exist at the same time in the urbanizing economic space. An urban space highly gathered with various economic activities has been always producing newer types of economic activities to meet the social demand that is always diversifying. The diversifying activities will be integrated, because to seek for maximum profit they have to pull together and cooperate with the others while competing with each other and repelling the others. The integrating of these two trends is reflected in the geographical space as multiple kinds of economic activities being located and

re-located in the urban area on the basis of their thresholds of service area and abilities of paying for the land. It led to the spatial classification of the economic activities on the one hand, and the chronicle restructuring of the activities on the other hand, such as the replacing of industrial activities with services in the inner city.

4 A CASE STUDY ON NANJING MEGALOPOLIS

4. 1 The Regional Structure of Nanjing Megalopolis

As a historical capital city, Nanjing is an important center in the Changjiang River Delta. The urban area of Nanjing megalopolis has been growing rapidly (Table 1). By 1990, it has expanded in an area of 136. 76 km^2, and had a population over 817 000.

Table 1 Total land use of Nanjing in 1920 – 1990

	Total land use (km^2)	Average annual growth (%)
1920	11. 89	
1930	23. 69	2. 29
1940	31. 20	0. 80
1950	55. 93	1. 80
1960	67. 91	0. 60
1970	116. 18	0. 20
1980	123. 74	0. 90
1990	136. 76	2. 00

Source: Nanjing Bureau of Urban Planning.

Fig. 2 shows the land use of Nanjing in 1990. It shows us a case of classical Concentric Zone Model of land use structure.

4. 1. 1 Central district

The area around the commercial center (Gulou – Xinjiekou) within a radius of 3. 0km is the central district of Nanjing. Its main functions of land uses are commercial, governmental and residential. The population density is 9338 persons per square kilometer.

4. 1. 2 Transitional ring

The ring about 3 – 5km wide around the central district is filled up with various functions of land use, mainly the residential and industrial activities, and public facilities as green space and educational institutions. The population density in this ring is 1200 persons per square kilometer.

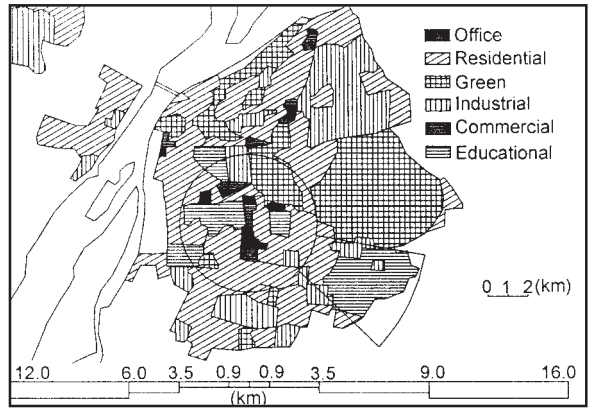

Fig. 2 Land use of Nanjing (1990)

4. 1. 3 Peripheral ring

The ring of urban land with a width about 7km around the transitional ring is mainly of the industrial uses. There're educational zones at the eastern and northwestern parts, and industrial zones and residential zones or towns at the outer parts, such as the Jiangning Development Park in the south of Nanjing. The population density is 4510 persons per square kilometer.

4. 2 Dynamics of Land Uses and Functional Structure

In the decades of 1950 – 1985, the total land use of Nanjing urban area grew slowly with an average annual growth rate of below 0. 8%, just as the economy growth in this period. In recent years of 1986 – 1990, the total land use grew more rapidly with an average annual rate of 2. 0%, at the same time, the economy grew with a faster average rate of 14. 7%, while it was 11. 2% in 1978 – 1985. Fig. 3 shows the structures of land use of Nanjing in 1950 and 1985:

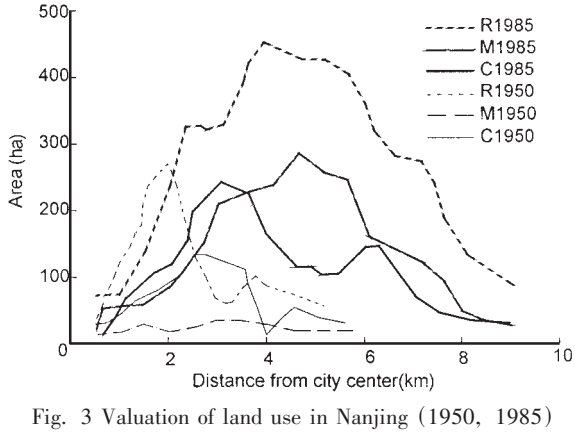

Fig. 3 Valuation of land use in Nanjing (1950, 1985)

R: residential, C: commercial, M: manufacturing

4. 2. 1 Industrial space

Industrial space grew slowly in the inner city (0 – 2km) as a whole, with an expansion of 60ha in the past 30 years. There were mainly electric, textile and food manufactories servicing the local needs (BOWDEN, 1971). Some industrial units will probably exist for a long time, even will grow while there's a decline of industrial space in the inner city as a whole. In the ring 3 – 4km from the center, industrial space grew rapidly in 1963 – 1985, and declined after 1985. There was a remarkable growth in the area 6km away from the center after 1985 because of the out moving of industrial units from the inner city and the emerging of peripheral industrial parks which attracted a large number of industrial units.

The evolution of industrial functions indicates that the expansion of industrial space is a generator for urban growth, and that the out moving of industrial land uses from the inner city is a historical trend.

4. 2. 2 Residential space

As shown in Fig. 3, in 1950 and 1985, residential uses gathered in the rings of 1. 7 – 2. 0km and 4km away from the center, that was nearly as same as the industrial space. It reflects the decisive effects of the economic unit-led land allocation system in structural changing. It's remarkable that the residential space gathered in the ring 4 – 4. 5km away from the center in 1985. The main reason for this phenomenon is the out moving of industrial units and the relative out growing of the transitional ring.

4. 2. 3 Commercial space

There are two facts in the commercial land uses changes. (1) The commercial center moved from the ring 2. 5km away from the center in 1950 to the ring 3. 5km away from the center in 1985, which has a same trend as the residential space. (2) A multiple-center structure developed; the sub-centers were located in the ring 6. 5km away from the spatial center of urban area near the newly developed residential ring. After 1990, the commercial center moves on to the area between Gulou and Xinjiekou as the reconstruction continuous and the commercial functions are intensified in this area. A central business district (CBD) is coming into being in the area of 1 – 1. 5km wide around Xinjiekou, Gulou and Zhongshandonglu. Spots in the ring 6. 5km away from the center as Xiaguan, Maigaoqiao and Weigang will be the sub-centers and growth poles partly sharing the functions of the central district.

4. 3 Problems and Suggestions

There are some problems in the restructuring of urban space in Nanjing for a sustainable development.

(1) There's a harmful trend in urban development that seek for intensification and expanding, and paying more attention to construction and development but less on preservation, more to economic benefits but lesser to cultural values. This kind of development without environmental and social improvement is not a sustainable way of development. There should be a turn with the economical based principles for urban development, and the right principle for sustainable development should be based on a balance of natural, social and economical benefits.

(2) Social problems emerged when the residents moved out from a classic social area, such as inconvenient job seeking, commuting and education service, and even the declining of living qualities because of the poor facilities in newly developed areas. So it's important to reevaluate the policies for restructuring of urban space and the traditional physical planning, considering more about the social and environmental changes in the process.

There are some ideas we should pay more attention to developing a good, or a rational and sustainable urban regional structure:

(1) Balance of intensification and decentralization. The process of decentralizing needs a transportation system of multiple means of traffics. But, in the structure of traffics in Nanjing, bicycles and walking share a major proportion, as 3 by public service, 7 by bicycles and 6 by walking. The present structure of transportation evidently limits the commuting area expanding and the process of decentralizing. So it's important to keep a reasonable population and a satisfying living environment in the core area in the process of reconstructing to cut down the commuting traffics and enhance the economic growth of the inner city.

(2) Development of sub-centers. It's important to develop several sub-centers for local service at spots on the main transportation corridors with a reasonable distance to the CBD, such as Xiaguan, Maigaoqiao and Weigang. The distance, scales, and positions are essential factors for the sub-centers to avoid the possible declining in the future when the urban daily system extends.

(3) Diversifying and mixing of the functional activities. In common, it's reasonable to keep a mixing of multiple functions in a certain area. In CBD, it's beneficial to keep commercial functions as a proportion of 60%, and some light manufacturing and residential functions to meet the needs of CBD itself, and it's also beneficial to enhance the stability and flourish of the CBD, and develop a nice human environment.

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