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Estimate the Rationality of Spatial Structure of Beibu Gulf (Guangxi) Economic Zone and Analyze the Agglomeration Trend

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Abstract

On Aug. 10th, 2006, Beihai hosts the First City Cooperation Summit of Beibu Gulf (Guangxi) Economic Zone. It discusses and approves the *"4+2" City Cooperation Framework Agreement of Beibu Gulf (Guangxi) Economic Zone*. Along with the formation of Beibu Gulf (Guangxi) economic zone, its spatial structure will inevitably turn into an export-oriented spatial structure. The new characteristics of regional economic spatial structure rely in: forming a "pole-axis" spatial pattern showing initial city leveled system; the network system and the "pole-axis" system without perfect "driving axis"; with lots of spatial units. In future, the Beibu Gulf (Guangxi) economic zone will undoubtedly become a new important place of population and industrial spatial agglomeration.

Keywords: Beibu Gulf (Guangxi) economic zone, Spatial structure, Agglomeration, Diffusion

1. Present spatial structure of Beibu Gulf (Guangxi) economic zone

1.1 The outline of city Urban hierarchical systems comes into being

Regional Urban hierarchical systems are still an absence. The order of levels is imperfect. Presently three levels come into being. The first level is the largest city Nanning, being the capital and the central city of Guangxi, and also the economic and cultural center of the Beibu Gulf (Guangxi) economic zone, which is irreplaceable. The second level includes Qinzhou, Beihai, and Fangchenggang. As the front port cities in Beibu Gulf, the three cities possess great regional advantages, what are also important nodes of China-ASEAN Free Trade Area. The third level is Zuolin and Chongzuo, considering the transportation and logistics, and the effects of Beibu Gulf (Guangxi) economic zone.

1.2 The spatial structure of "pole-axis" system

In Beibu Gulf (Guangxi) economic zone, the central city is Nanning. Taking Nanning as the starting point, connect every node city in line in the region heading toward southwest, south, and southeast. By comparing the spatial changes (in Table 1) of GDP per capita in successive two years, 2006 and 2007, we find that the GDP per capita in the southwest and southeast axes is declining, while the GDP per capita in the south axis is rising. In Fangchenggang and Beihai, the GDP per capita is even higher than that in the central city Nanning. That is a thoughtful phenomenon. It proves the ports, due to their sea channels, in the south axis possess regional advantages over Chongzuo and Yulin where there is land as barriers.

1.3 The extensiveness of axes of "pole-axis" spatial structure system needs to be strengthened

The formation of "pole-axis" system's spatial pattern has two tendencies, namely spatial agglomeration and spatial diffusion. The spatial agglomeration and spatial diffusion of regional economy have to rely on the transportation line, energy-supply line, and telecommunication line in axes of "pole-axis" system. The infrastructure turns into the "axes" that is capable of agglomeration and diffusion.

(1) The fluency of land transportation net in the region needs to be improved

The fluency of land transportation net in Beibu Gulf (Guangxi) economic zone needs to be improved. It does not realize a fluent transportation between cities. In most cities, the logistics has to depend on roads in cities. Highways can not connect all cities, and the land transportation circular net is imperfect in the region. The land international road is too single and the highway is too short, not mention the railway.

(2) The spatial agglomeration of seaside port cities in the region needs to be improved

Qinzhou, Beihai, and Fangchenggang are important port cities in Beibu bay, and also important channels for extensive Beibu Gulfeconomic cooperation. Whether Guangxi occupies a position in China-ASEAN Free Trade Area or not, the

sea lines toward the south are vital.

Qinzhou, Beihai, and Fangchenggang, as the land nodes at the end of axes of "pole-axis" spatial structure, and also the starting points of sea lines, do not possess strong infrastructure and can not catch up with the regional economic development. Without realizing an organic combination of reasonable industrial structure and regional infrastructure, and generating enormous spatial agglomeration effects, we can not establish the optimal spatial structure of the "pole-axis" system, what will further affect the overall regional economic development.

2. The specialized analysis on cities, the units of Beibu Gulf regional spatial structure

2.1 The spatial node and driving axis

Beibu Gulfnow has five radiate pole-axes starting from Nanning. The pole-axes connecting the core cities form the spatial net system in scale. The spatial node cities at the axes of "pole-axis" system firstly generate the agglomeration effect. Social economic factors centers on the "pole". Meanwhile, the "axes" (infrastructure) connecting nodes impose strong economic attraction and cohesion on neighbor regions. It may form "driving axes" for economic development.

The "driving axes" for Beibu Gulf(Guangxi) economic zone include three classes. The first-class has three axes, namely Nanning → Fangchenggang, Nanning → Qinzhou, Nanning → Beihai; the second- class has one axis, namely Nanning → Yulin; the third-class has one axis, namely Nanning → Chongzuo.

2.2 The specialized spatial agglomeration units under new conditions

Along with the fast industrialization of Beibu Gulf (Guangxi) economic zone, industrial activities tend to agglomerate toward specific spaces, including industrial development zone, labor-intensive machining enterprises, seaside city machining, and manufacturing industry band.

(1) Industrial development zone

In 2007, the industrial development zones in Beibu Gulf (Guangxi) economic zone, mainly Nanning, Beihai, Qinzhou, and Fangchenggang, realize the gross industrial output value 52.05 billion RMB, rising 46.8%, and the industrial value-added 16.63 billion RMB, increasing 35.0%. The contribution rate of value-added to regional industry reaches 47.1%, pulling a rise of 14.5%. The rise of gross industrial output value and value-added is respectively 10.4% and 8.5% higher than the industry in the whole zone. The GDP of the industrial development zones account for 8.84% of the total GDP of Guangxi. The industrial zones (development zones) have already turned into places with more enterprises. The most enterprise-intensive regions chiefly include Nanning, Beihai, and Qinzhou.

(2) Seaside city machining and manufacturing industrial cluster

In Beibu Gulf (Guangxi) economic zone, the seaside city machining and manufacturing industrial cluster mainly centers on Beihai, Qinzhou, and Fangchenggang. In 2007, cities in Beibu Gulf(Guangxi) economic zone realize large-sized industrial value-added, 38.587 billion RMB, increasing 30.5%, 4% faster than the average increase of the zone. Its contribution rate to the large-sized industrial growth reaches 29.5%, pulling an industrial rise of 7.9%. Here, the large-sized enterprises whose contribute rates to gross industrial output value exceed 1% are Guangxi Wanxin Steel Co. Ltd., Guangxi Dongyou Bitumen Co. Ltd., Ocean Food & Oil Industrial (Fangchenggang) Co. Ltd., and Beihai Galaxy High- Tech Industrial Stock Co. Ltd. These enterprises realize gross industrial output value 14.1 billion RMB, increasing 73.1%. The contribution rate to large-sized industrial growth is 4.9%, pulling an industrial rise of 1.8%.

Take Beihai, and Fangchenggang for example. In 2007, the large-sized industry realizes accumulatd output value 18.417 billion RMB in Beihai, increasing 39% than last year, realizing the industrial value-added 5.935 billion RMB, increasing 37.08% than last year. In Fangchenggang, the large-sized industrial enterprises realize gross industrial output value 16.097 billion RMB, increasing 64.9%, accounting for 87.6% of the city's large-sized industrial output value, pulling a large-sized industrial output value rise of 55.6%.

Beihai, Qinzhou, and Fangchenggang locate the south of Beibu Gulf (Guangxi) economic zone. The distance between them is short. However, due to the market guidance and regional cooperation, the three cities form special micro spatial structures respectively in their regions. In recent years, the industrial clusters in the three cities achieve the agglomeration to a great degree. Many industries are developing into complex economy instead of resource economy, such as the high-tech telecommunicating equipment, computer and electronic equipment manufacturing, medicine production, electronic machine and equipment manufacturing in Beihai, the petrochemical, paper making, energy, grain and oil machining, and metallurgy industry in Qinzhou, the edible crop oil processing, sugar refining, steel, and feed processing in Fangchenggang. All these industries make best use of the regional advantage of seaside, occupying a relatively large share in market.

The location of Beihai, Qinzhou, and Fangchenggang determines their outward spatial extension. They will actively meet the inland industrial transfer. Whether the construction of port infrastructure and logistics base can satisfy the seaside industrial development is the key. Beihai, Qinzhou, and Fangchenggang, as the terminals of land roads in Beibu

Gulf(Guangxi) economic zone and also the starting points of sea lines, have irreplaceable effects as "driving axes" in space.

3. The rationality evaluation of the spatial agglomeration in Beibu Gulf (Guangxi) economic zone and the agglomeration trend

3.1 The people-land relationship in Beibu Gulf (Guangxi) economic zone

The Beibu Gulf (Guangxi) economic zone has the land area of 42,5000 square kilometers, the maritime space of 129,3000 square kilometers. Till late 2005, the population reaches 12.3 million, occupying 25% of the municipality's total population. The gross production value is 120.53 billion RMB, accounting for 29.6% of the municipality's gross production value. Considering the development of transportation, logistics, and ocean industry, in June, 2006, Guangxi Zhuang Autonomous Region takes the transportation and logistics of Yulin and Chongzuo into the programming and construction of economic zone, forming a "4+2" pattern. The land area of economic zone becomes 72,700 square kilometers, occupying 30.7% of the municipality's land area. In late 2005, the population in the economic zone reaches 20.53 million, accounting for 42% of the municipality's total population. The gross production value reaches 171.27 billion RMB, accounting for 42% of the municipality's gross production value. The land area of the economic zone is 0.76% of the national land. The population of the economic zone is about 1.57% of China's population. And the GDP of the economic zone is about 0.93% of national GDP. These numbers illustrate that the uprising economic zone has great potentials with wider development spaces.

It is well-known that plain and basin are right for economic development and city construction due to the favorable climate. Guangxi locates in the southeast edge of Yunan-Guizhou Plateau, sloping from northwest to southeast geologically. It is surrounded by hilly lands and looks like a basin. Therefore, it is also named as "Guangxi basin". The landform of Beibu Gulf(Guangxi) economic zone is various, including plain, basin, hills, shallow sea, and beach. The Beibu Gulf (Guangxi) economic zone, centering on Nanning, Beihai, Qinzhou, and Fangchenggang, includes Nanning basin, Qinzhou plain, Hepu plain, and Bobai plain. Therefore, the Beibu Gulf (Guangxi) economic zone is the most appropriate lands for developing agriculture, industry, and city construction in Guangxi and even in China. In addition, Beibu Gulf (Guangxi) economic zone includes amounts of ocean areas, with the shallow area of 6,488 square kilometers, the beach area of 1005 square kilometers, and the ocean breed aquatics area of 614 square kilometers. So, the legal confiscation of farmland by non-agricultural construction in Beibu Gulf (Guangxi) economic zone can be complemented by developing beaches.

In the perspective of population agglomeration, Beibu Gulf (Guangxi) economic zone will become an important population and industry agglomeration region in China. At present, the population density in Guangxi is far less than that in the developed region, such as the Peal River Delta in south China. In Guangdong province, Guangzhou and Shenzhen have largest populations. In 2005, the population density in the two cities is respectively 1227 people per square kilometer, and 4239 people per square kilometer. Even for Huizhou (332 people per square kilometer), Zhuhai (839 people per square kilometer), and Zhanjiang (536 people per square kilometer), the population density is higher than the average of Guangxi. In 2005, the population density of Guangxi is 208 people per square kilometer. Along with the improving industrial agglomeration in Beibu Gulf (Guangxi) economic zone, more and more people will rush into cities. Therefore, the Baibu bay (Guangxi) economic zone will become a national agglomeration center in China.

3.2 Analyze on industrial agglomeration and spatial diffusion in Beibu Gulf (Guangxi) economic zone

In economic development, the dots on the "driving axis" mentioned above are cities, which can agglomerate most social economic factors and form industrial cluster band. The "driving axis" connecting cities has strong attractive effects and cohesion on neighbor regions. Social economic equipments exert a diffusing effect on neighbor regions by products, services, networks, and technologies. The material and non-material factors, including the diffusing industries, technologies, and information, can impact neighbor regions and generate new productivity, forming new industrial cluster band.

Since 1995, the economic space of Guangxi keeps in enlarging. The rise of population is far slower than the expansion of economic space. In 1995, the total investments in Guangxi are 38.295 billion RMB. In 2006, the number is 224.657 billion RMB, being 5.86 times of 1995. In 2006, the total investments of cities in Beibu Gulf (Guangxi) economic zone are 64.991 billion RMB, accounting for 28.93% of total investments of Guangxi. Till late 2006, the population of Beibu Gulf (Guangxi) economic zone is 6.114 million, being 13.03% of the total population of Guangxi.

The investments of cities at the "driving axis" are far less than that of cities in China's developed regions. The economic capacity of these cities is not close to the limit. And the contribution rate of the city cluster to national accumulation is lower than that in China's developed regions. In the future, for a long period, Beibu Gulf (Guangxi) economic zone is the main space for industrial and population agglomeration.

For the city cluster of Beibu Gulf (Guangxi) economic zone, the proportion of non-agricultural population is relatively larger, but the proportion of non-agricultural industries to GDP is relatively smaller, what will directly affect the

industrial agglomeration, and will exert negative effects on the formation of "sub-driving axis". In other words, only when a greater agglomeration happens in the first "driving axis" and amounts of people and economic unit center towards the "driving axis", forming an intensive industrial band, can it poses the "sub-driving axis", forming the spatial structural system signaled by the "pole-axis" network.

In Beibu Gulf (Guangxi) the foremost city Nanning realizes the GDP 62.461 billion RMB in 2006, accounting for 12.94% of the GDP of Guangxi. The social fixed assets investments of Nanning value 34.812 billion RMB, being 15.5% of Guangxi's total social fixed assets investments 224.567 billion RMB. The contribution of Nanning to Guangxi is relatively lower. For Beihai, Qinzhou, and Fangchenggang in Beibu Gulf (Guangxi) economic zone, the proportion of non-agricultural population to the total population of the city is respectively 49.16%, 16.01%, and 28.23%. These data show that the city cluster in Beibu Gulf (Guangxi) economic zone has a lower degree of industrial agglomeration, lower social contribution rate, and higher proportion of non-agricultural population, what can also serve as motives for future industrial agglomeration in Beibu Gulf (Guangxi) economic zone.

To evaluate the degree of spatial diffusion and population and industrial agglomeration in one region, we must know whether there are interconnecting city areas in the region. According to the definition of index system advanced by Xuwei Hu, Yixing Zhou, and Chaolin Gu, the basic regional unit for interconnecting city area in statistic is county. For each county in one region, if the population $\geq$ 200,000 people, the proportion of non-agricultural industries to GDP $\geq$ 75%, and the proportion of non-agricultural labor power to total social labor power $\geq$ 60%, all these counties are neighbors in the region and have interconnections, this region will be named as the interconnecting city area.

In Beibu Gulf (Guangxi) economic zone, all main cities include 22 counties and towns totally. These counties and towns have irreplaceable effects on regional economy, what are also key factors for the uprising of Beibu Gulf (Guangxi) economic zone. At present, among all 22 towns and counties, none of them achieves those indexes mentioned above. Only the county Binyang and Luchuan, the populations and proportions of non-agricultural industries to GDP are close to or reach the standards. For other counties and towns, the indexes are still at a lower level.

Beibu Gulf (Guangxi) economic zone only takes the first step. Its city scale is small. And the capability of collecting wealth is weak. According to experiences of developed countries in world, an inevitable and objective fact is that people move toward seaside and large city cluster. In future, cities in Beibu Gulf (Guangxi) economic zone will extend toward the city cluster and city economic band. Guangxi must insist on giving priority to the development of interconnecting city band. And the precondition is to expand the county economic space. Beibu Gulf (Guangxi) economic zone will definitely turn into a new important place for population and industrial spatial agglomeration in China.

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Table 1. The changes of GDP per capita in the pole-axes centered on Nanning in 2006 and 2007

Pole-axis	Changes of GDP per capita RMB per capita
The southwest pole-axis from Nanning.	Nanning (11057, 13071) Chongzuo (6566, 8366)
The south pole-axis from Nanning	Nanning (11057, 13071) Qinzhou (6000, 7107) Fangchenggang (11872, 14764) Beihai (12225, 13252)
The southeast pole-axis from Nannign	Nanning (11057, 13071) Yulin (5998, 6908)

Data source: Guangxi Statistical Yearbook 2006, Guangxi Statistical Yearbook 2007.

Table 2. Main industrial development zones and the industries in Beibu Gulf(Guangxi) economic zone

Industrial zone (development zone)	Grade	Main industries
Nanning high-tech industrial development zone	National	Biology engineering and medicine, electromechanical Integration, electronic information, auto parts, modern agriculture
Nanning economy & technology development zone	National	Chemical, auto parts, aluminum processing, sugar refining, biology engineering, electron,
Nanning overseas investment zone	Municipal	Medicine, machine production, tissue paper, agricultural by-product processing, food production
Nanning seaside economic corridor development zone	Municipal	Biology medicine, machine, modern logistics, color metal Feed, medicine, building materials, machine processing, real estate
Nanning Dashatian economic development zone	Municipal	Real estate, scientific research & education, commercial catering, new urban industry
Nanning Xianhu economic development zone	Municipal	Biology medicine, food processing
Nanning Liujing industrial zone	Municipal	Electron, medicine, food safety, textile, building materials, paper making, aquatic product processing
Beihai industrial zone	Municipal	Electronic information, biology medicine, new materials, energy-saving and environment protection, subtropical agriculture
Beihai high-tech industrial zone	Municipal	
Beihai overseas investment development zone	Municipal	Chemical, marine product processing, environment protection
Beihai export & machining zone	National	Electronic information, precise machine, biology medicine, import-export goods transportation
Qinzhou economic development zone	Municipal	Petrochemical, energy, grain and oil processing, phosphor chemical, biology medicine, color metal, bitumen processing
Qinzhou Hedong industrial zone	Municipal	Agricultural and marine product deep-processing, textile clothing, biology engineering, electronic processing

Data source: http://www.gxjmw.gov.cn/

Table 3. The total population and population density in Beibu Gulf(Guangxi) economic zone

City	Total population (10,000 people)	Land area (square kilometer)	Population density (people per square kilometer)
Nanning	671.89	22112	304
Beihai	152.06	3337	456
Fangchenggang	82.21	6181	133
Qinzhou	348.56	10843	321
Yulin	609.31	12838	475
Chongzuo	233.20	17351	134

Data source: Calculated from China Statistical Yearbook 2007. (This table is based on data of all cities.)

Table 4. The investment/population conditions of cities in Beibu Gulfin 2006

City	Regional GDP(10,000 RMB)	Total social investment (10,000 RMB)	City's total population (10,000 people)	Non-agricultural population in city (10,000 people)
Nanning	6246072	3481191	254.86	130.81
Beihai	1226169	635333	56.92	27.98
Qinzhou	1223859	831814	124.85	19.99
Fangchenggang	823038	529696	49.13	13.87
Yulin	1401258	877511	91.31	21.21
Chongzuo	434008	143559	34.33	8.83
Total	11354404	6499104	611.4	217.08

Data source: Guangxi Statistical Yearbook 2007. (The table is based on data of municipal districts.)

Table 5. The proportion of population/industry of counties and towns in Beibu Gulf(Guangxi) economic zone

City	County/town	Population (10,000 people)	Proportion of non-agricultural industries to GDP (%)	Proportion of non-agricultural labor power to total social labor power (%)
Nanning	Wuming county	66.1	59.5%	25.08%
	Long'an county	37.8	59.12%	0
	Mashan county	51.4	65.53%	44.1%
	Shanglin county	47.4	54.75%	8.89%
Beihai	Binyang county	100.7	73.84%	30.23%
	Heng county	113.7	64.2%	27.54%
	Hepu county	95.1	65.15%	38.23%
Fangchenggang	Shangsi county	21.5	62.46%	28.27%
	Dongxing town	11.6	71.88%	40.83%
Qinzhou	Lingshan county	141.1	63.07%	27.27%
	Pubei county	82.7	61.6%	42.99%
Yulin	Rong county	76	66.57%	45.34%
	Luchuan county	93.5	75.4%	47.10%
	Bobai county	156.2	53.97%	41.86%
Chongzuo	Xingye county	69.6	52.24%	49.2%
	Fusui county	42.7	59.69%	25.65%
	Ningming county	40.6	60.05%	17.25%
	Longzhou county	27.2	63.32%	20.23%
	Daxin county	36.2	68.62%	16.48%
	Tiandeng county	41.5	63.76%	46.47%

Data source: Edited from Guangxi Statistical Yearbook 2007.