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Research on the City Population Carrying Capacity Based on Possibility-Satisfiability Method —Take Urban Areas in Southern Jiangsu as an Example

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Abstract: A region's modernization construction refers to the modernization in economy, resources, environments and human. The construction of urban district in Southern Jiangsu is the leading in the country. However, its land resources are very limited. From the view points of land resources, water and power resources, transportation and environment sanitation, economy and physical constitution security, this paper uses Possibility-Satisfiability Model to analyze these indicators to get urban district in Southern Jiangsu population carrying capacity in 2020 under the condition of single-factor and multi-factors. And finally, it gives some advices about population like the warning system about the bearing capacity of the regional population.

Keyword: Urban district in Southern Jiangsu; Modernization construction; The population carrying capacity; Possibility-Satisfiability Model

INTRODUCTION

A region' modernization is reflected by human modernization. It is related to the economic, resources, the guarantee of population quality and environment of the area. With the development of new urbanization, that the implement of policies and measures in favor of the local economic development and the reinforcement of the fiscal transfer payment to the citizenization of agricultural transfer of population will cause the population of the area change. However, modernization needs to examine real GDP per capita, Total industrial labor productivity, invention patent ownership per 10,000 persons, pension institutions bed possession per 1000 elderly people and doctors per 1000 persons and so on (The Planning Office in Jiangsu Development & Reform Commission,2013,& the plan of the new type urbanization and the integrated development in urban and rural regions in Jiangsu Province (2014-2020)). But when the population reaches a certain level and little had altered in economic resources and environment change, it will cause the decline of modern indicators, and finally lead to the local economic downturn. Therefore, it is important and necessary for the sustainability of the overall economic development, environmental protection and resources of Urban District in Southern Jiangsu to predict the corresponding population bearing capacity so as to make policies even more apposite according to the current situation of economy, resources and environment in urban district in Southern Jiangsu and the requirement of modernization index.

The measurement of the carrying capacity of urban population are generally used the land resource carrying capacity, ecological footprint (Wackernagel& Rees (1997), Wang & Lin(2005)) and energy value analysis(Odum(1996), Wang & Chen (2007)). But these methods are generally applicable to the area with strong sealing and low openness. Another kind of complex indicator system method needs more data.

Consequently, the reliability is poor when data for the region are sparse. However, The Possibility-Satisfiability (P-S) method set possible function and satisfaction function according to the possibility degree and the satisfaction degree that the goal of the system realizes, and then use a certain merging technology to integrate into the possibility—satisfaction degree, and it can be

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viewed as the determination basis of the optimal state of the system relative to the design goals (Zhang at el.2009). And the urban population carrying capacity is determined together by the possibility degree that the local natural resources continuous supply and the satisfaction degree that the people are satisfied with the real life level. Therefore, the P-S method is more suitable for the analysis of the population carrying capacity of urban district in Southern Jiangsu.

In China, A number of researchers are thinking of using the P-S method to analyze the problem about the population carrying capacity. For example, Wei at el (2013) measures the population carrying capacity of Hefei City by means of the P-S method from the perspective of urban water supply, public transport and urban medical treatment. Tong (2011) uses some indicators representing resources of beijing like natural resources, urban infrastructure, economic resources, social resources and social entironment to analyze the population bearing capacity of Beijing City by the P-S method. In this paper, the indicators of measuring the population carrying capacity of urban district in Southern Jiangsu mainly use economic factor, energy factor, land factor, transportation facilities, guarantee of the population quality and environment factor, etc.

1. Research on the population carrying capacity of urban district in Southern Jiangsu

1.1 Analysis on the population status of the city proper of all cities belonging to Southern Jiangsu

Urban areas in the South of Jiangsu include all downtown areas of Nanjing City, Suzhou city, Wuxi City, Changzhou City and Zhenjiang City, their status quo of the population are as shown in Figure 1.

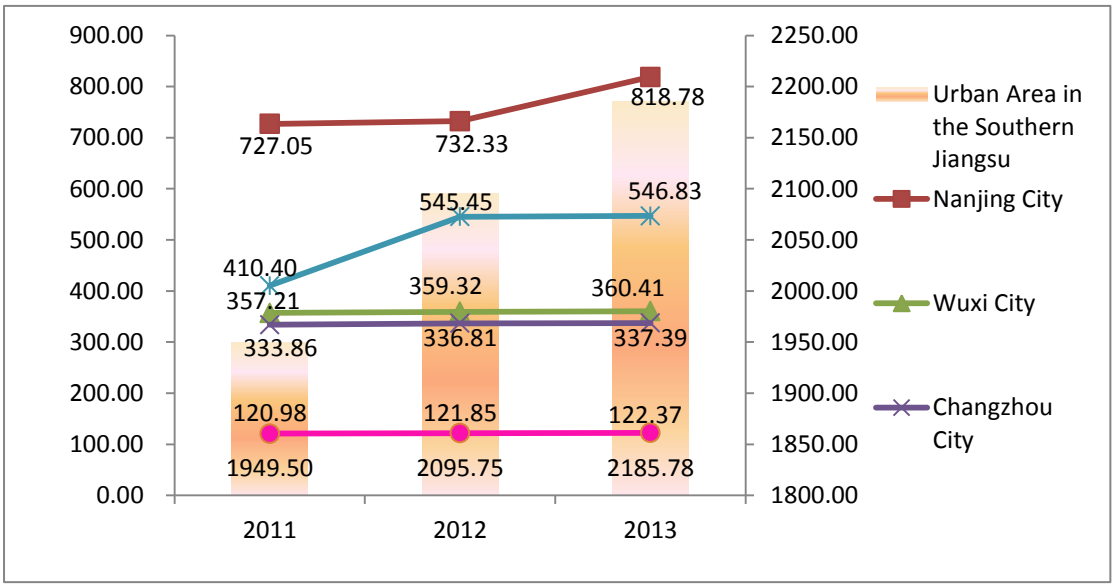

Figure 1 The distribution diagram of urban resident population in the Southern Jiangsu

As indicated in Figure 1, the number of resident population of urban areas in the South of Jiangsu rose from 19495 thousand people in 2011 to 21858 thousand people, its average annual growth is 5.89%, chiefly because the downtown area of Suzhou City increased by 15.43%, that of Nanjing City had an increase of 6.12%, and the others had smaller changes. In addition, for the city proper in Southern Jiangsu, its population increased by 7.5% in 2012 compared with that in 2011 because Wujiang County was incorporated into the city of Suzhou, and then the population of the city proper in Suzhou increased by 32.91%. However, its resident population

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had little change in 2013 compared to that in 2012. The number of resident population in Nanjing urban area rose from 7270.5 thousand people in 2011 to 8188 thousand people in 2013, which its resident population had a little change in 2012 compared to that in 2011, but the population in 2013 increased by 11.8% compared with that in 2013 because Lishui County and Gaochun County were incorporated into Nanjing City.

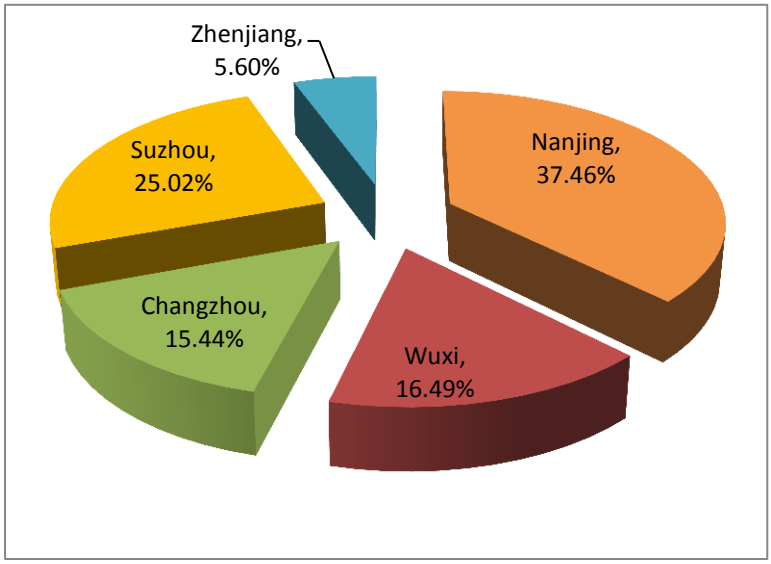

Figure 2 The distribution Chart of urban resident population in Southern Jiangsu in 2013

As illustrated in Figure 2, in the resident population of urban district in Southern Jiangsu, that of Nanjing City accouted for 37.46%, that of Suzhou City accounts for 25.02%, that of Wuxi City was about 1% higher than that of Changzhou City, and that of Zhenjiang was the least, 5.6%.

1.2 Analysis on the factors affecting the economic, resources, population quality and environment of the population carrying capacity of urban areas in Southern Jiangsu

1.2.1 Economic factors: analysis on the current situation of the regional GDP and GDP per capita of urban areas in Southern Jiangsu

This paper uses GDP deflator that is based on the year 2000 from World Bank website to calculate the real GDP of urban area of the South of Jiangsu. The result is shown in Figure 3. The average annual growth rate of the real GDP of urban areas in Southern Jiangsu during 2004 to 2013 was about 12.28%, of which the average growth rate was 9.78% during the 11th Five-Year plan, and its average annual growth rate was 13.42% in the first three years of the 12th Five-Year plan.

Overall, in the first three years of the 12th Five-Year plan, the economic growth is higher than the 11th Five-Year plan. However, the total GDP of urban areas in Southern Jiangsu has reached a higher level. Therefore, it is harder to keep higher speed of growth. Accordingly, to ensure the speed of the economic development needs to make adjust the current industrial structure and the layout of urban construction and grasp that the existing resources in the end can carry the number of population.

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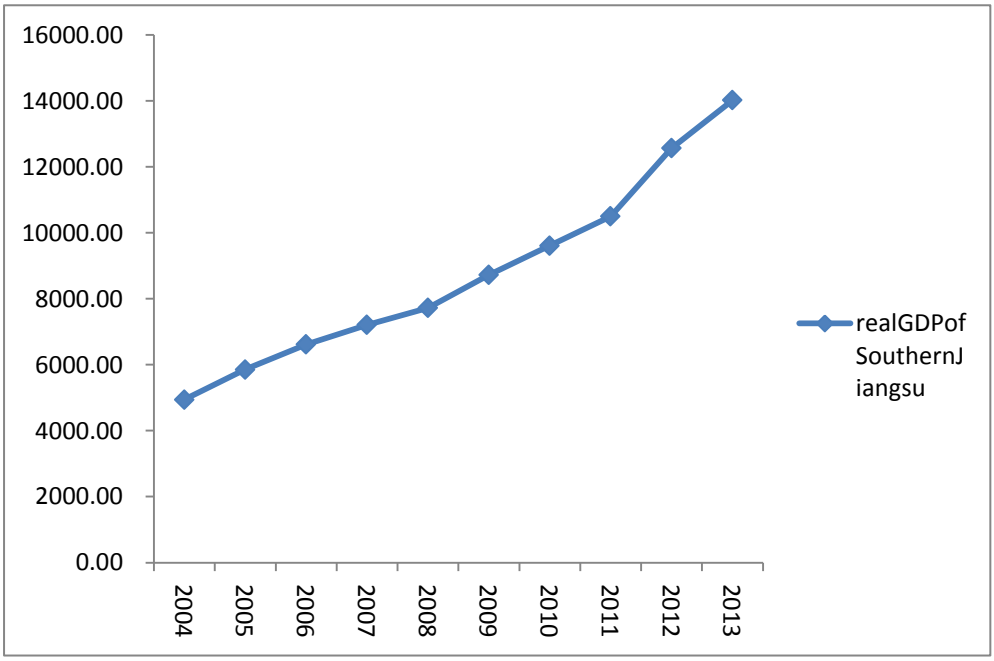

Figure 3 The Trend Chart of Real GDP of Southern Jiangsu

In the first 3 years of the 12th Five-Year plan, the growth rate of the real GDP per capita for urban resident population in Southern Jiangsu was 9.15%, its real GDP per capita increased from 53.9 thousand RMB to 64.2 thousand RMB. However, its growth rate in 2013 was 4% lower than that in 2012. It shows that the growth rate of the real GDP per capita is in slowdown. Therefore, its nominal GDP per capita to achieve the lowest satisfaction sets 135 thousand RMB; its nominal GDP to achieve the highest satisfaction sets 230 thousand RMB

It is reported by Xinhuanet, General secretary Xi Jinping put forward a goal that GDP and income per capita of urban and rural residents will double by 2010, and in pursuing completing the building of a moderately prosperous society in all respects that will benefit more than a billion people. Consequently, whether it is the real GDP or the nominal GDP, for urban area of Southern Jiangsu, it will achieve this requirement for GDP in the realization of the modernization construction according to the predicted results. Moreover, the goal that is mentioned in the construction task of modernization construction demonstration area planning for South Area of Jiangsu Province published in 2013 and its index system of modernization construction is that GDP per capita will reach 180 thousand RMB. However, only the GDP per capita of urban area will be above the value, all cities in Southern Jiangsu can realize this goal. Therefore, the city proper in Southern Jiangsu needs to take a series of measures about its sustainable development to realize the maximum of benefits of unit economic resources and unit environment and finally, meet the requirement of modernization construction.

1.2.2 Land resources such as urban construction area factors: Analysis on the current situation of urban construction area and data per capita of urban areas in Southern Jiangsu

A region's urban construction needs to expand the area of urban construction to accommodate the influx of population and economic construction when one city has just begun to develop. But when its economy develops to a certain stage, it needs to

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improve the connotation construction rather than constantly reduce the area of arable land to expand the urban area to enhance the attractiveness of the city. Therefore, urban construction area per capita is regulated by the related departments in some rules.

The average annual growth rate of area of land used for urban construction was 5.81% in Southern Jiangsu during 2003 and 2012. What's more, the annual growth rate was 6.23% since the 11th Five-Year plan. Consequently, the growth rate in 2012 was 7.06% higher than that in 2011.

In addition, its construction land area per capita of resident population is 79.2 square meters in 2011 and 78.87 square meters in 2011.

1.2.3 Energy factor: analysis on the current situation of water supply capacity and living water per capita of urban areas in Southern Jiangsu

Water resources are rich in urban area of the South of Jiangsu, but its pollution is more serious, so it is very important for protection of water supply for residents to purify water and fight against the pollution. Its water supply capacity, total water supply and water consumption during 2005 and 2013 are shown in Figure 4. Its water supply capacity is much higher than total water supply. Moreover, water consumption only accounted for 28.15% to 20.11% of the water supply capacity and basically reached the double water supply capacity.

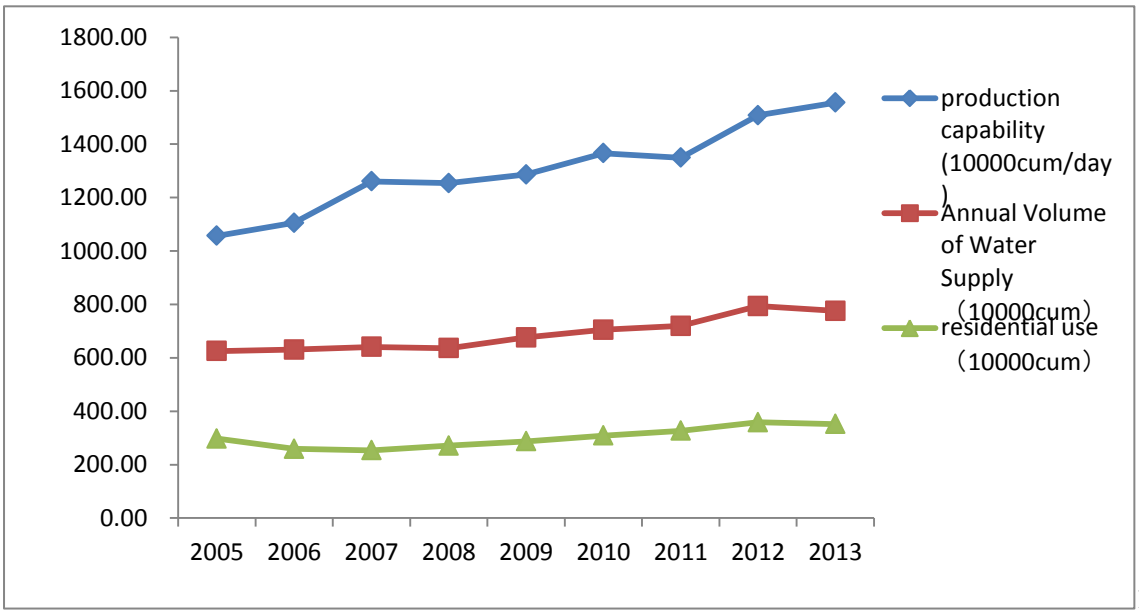

Figure 4 The Chart of Volume of Annual Water Supply of Southern Jiangsu during 2005 and 2013

The daily water consumption per capita of the urban resident population went down from 167.51 liters in 2011 to 160.99 liters in 2013 because the residents' consciousness of water saving is strengthening, the slowdown of economic growth also affect some residents' consumption capacity, and some residents with the low consumption capacity that was from the foreign population led to a decline in the daily living water consumption per capita.

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1.2.4 Energy factor: analysis on the current situation of the social electricity consumption and the living electricity consumption per capita of urban areas in Southern Jiangsu

It is shown in Figure 5, in the process of realizing modernization in South of Jiangsu, its electricity consumption will gradually increase. It is calculated that the average annual growth rate of electricity consumption in urban areas was 10.5% including those data that incorporated the counties into urban areas from 2005 to 2013. The average growth rate was 8.15% during the 11th Five-Year Plan and that in the first three years of the 12th Five-Year Plan was 15.11%. in addition, the electric power consumption of residents is also growing fast, its average growth rate was 11.78%, it was 12.53% during the 11th Five-Year Plan and that in the first three years of the 12th Five-Year Plan was 15.44%.

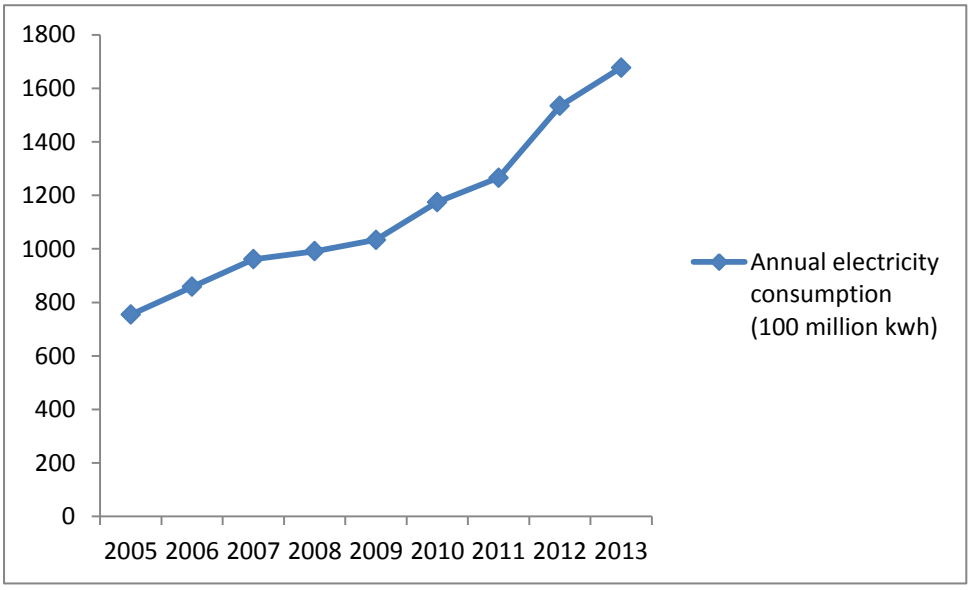

Figure 5 The Chart of Annual Electricity Consumption of Southern Jiangsu during 2005 and 2013

What's more, in the first three years of the 12th Five-Year, the electricity consumption of urban residents per capita increased from 698.62 kwh per person in 2011 to 830.37 kilowatt hours per person in 2013. The living electricity consumption per person in 2012 increased by 10.52% with compared to that in 2011, and the living electricity consumption per person in 2013 increased by 7.55% in comparison to that in 2012. The data shows that the economy of South of Jiangsu slowed down to a certain extent that led to a decline in living electricity consumption per capita in 2013. Of course, there are electricity consumptions per capita of some urban areas such as Wuxi in the increase.

1.2.5 Traffic facilities factors: analysis on the current situation of area of paved road and area of paved road per capita of urban areas in Southern Jiangsu

Road construction reflects the economic development of a region because a good public transportation system is conducive to transport local products to those places that demand them and reduce the loss rate of products on the road, it is beneficial to communicate and cooperate with the outside world, and it is helpful to attract the attention from the floating population.

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It is illustrated in Figure 6, the area of paved road of urban areas in the South of Jiangsu was 326800.7 thousand square meters in 2013, and has increased by 5.25 times during 1999 and 2013. Its average annual growth was 19.5% in the 10th Five-Year plan period, 5.64% in the 11th Five-Year plan period and 8.97% in the first three years of the 12th Five-Year plan period. These data demonstrate that urban area in Southern Jiangsu has carried on the large scale urban infrastructure construction during the 10th Five-Year plan.

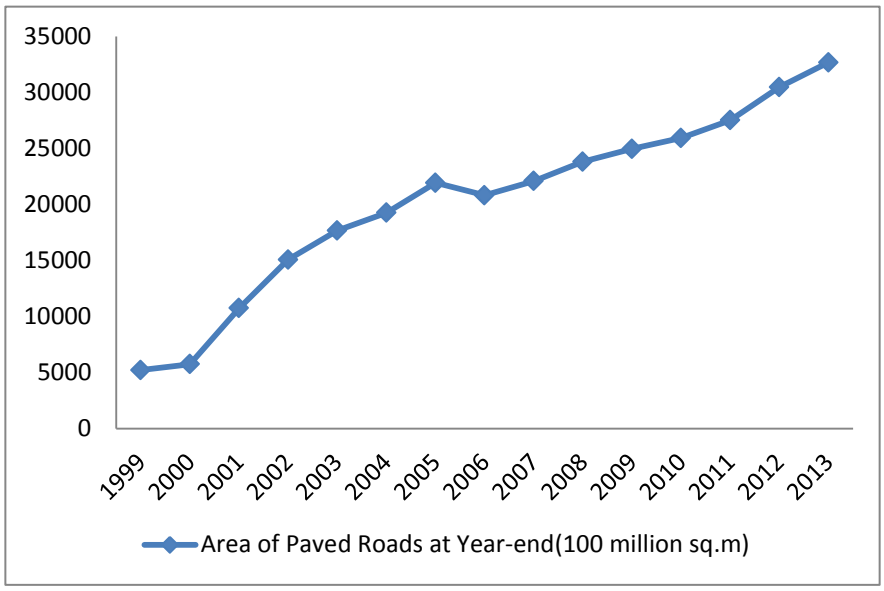

Figure 6 The Chart of Area of Paved Roads at Year-end of Southern Jiangsu during 1999 and 2013

Its area of paved road of urban areas per capita reached 14.95 square meters per person in 2013 and the average annual growth rate was 2.91% during 2011 and 2013.

1.2.6 Environmental factors: analysis on the current situation of area of parks and green land and area per capita of urban areas in Southern Jiangsu

A Good green environment is conducive to protect the local ecological environment, improve the living quality and health level of the residents, promote the development of ecological industry and enhance the residents' modernization level and promote the local economic development.

It is shown in Figure 6, for urban areas for the South of Jiangsu, the average annual growth rate of area of parks and green land was 12.16% during 1999 and 2013, 21.73% in the 10th Five-Year plan period, 5.76% in the 11th Five-Year plan period and 6.34% in the first three years of the 12th Five-Year plan period. These data illustrates that construction of urban area in Southern Jiangsu has entered into the connotation construction.

For the urban residents, the area of parks and green land per capita increased from 9.13 square meters in 2011 to 9.21 square meters in 2013.

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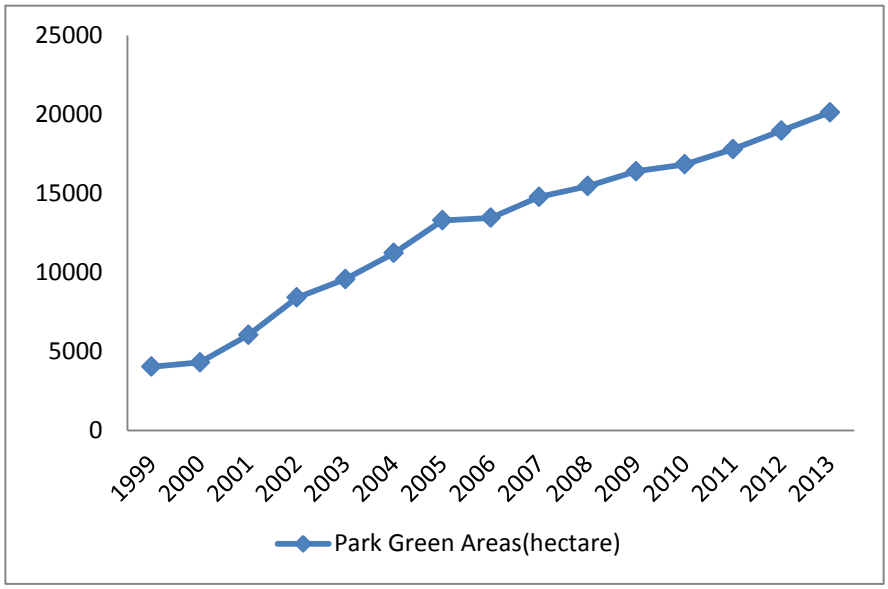

Figure 7 The Chart of Annual Park Green Areas of Southern Jiangsu during 1999 and 2013

1.2.7 Environmental health factors: analysis on current situation of the volume of garbage disposal and the value per capita of urban areas in Southern Jiangsu

The historical data of the volume of garbage disposal during 2004 and 2013 is shown in Figure 8. Its average annual growth rate was 5.85% in that period, 4.68% in the 11th Five-Year plan period, 7.77% in the first three years of the 12th Five-Year plan period.

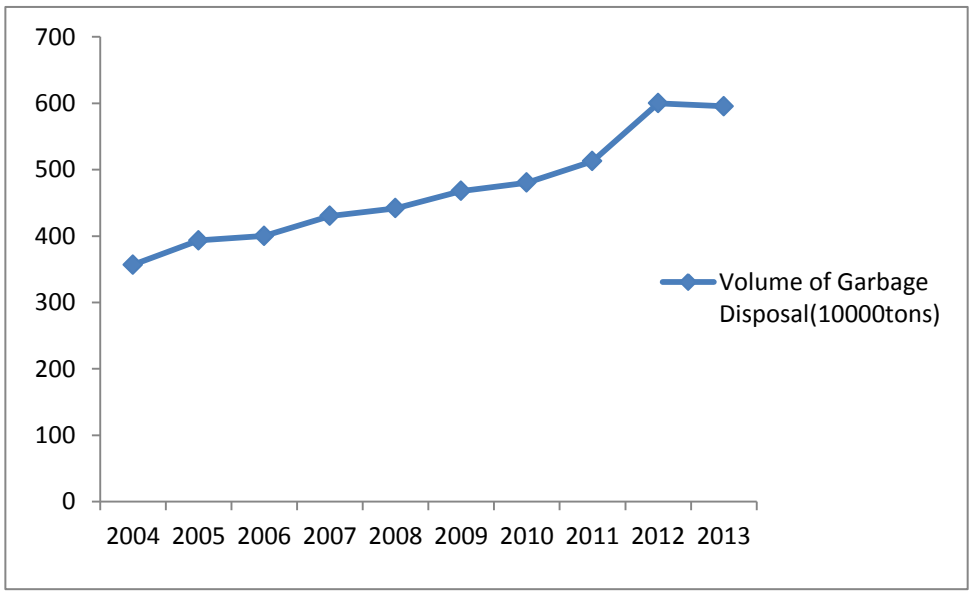

Figure 8 The Chart of Volume of Garbage Disposal of Southern Jiangsu during 2004 and 2013

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The volume of garbage disposal per capita for urban residents rose from 0.72 kg in 2011 to 0.75 kg in 2013. Its average annual growth was 1.78%. However, the volume per capita was 1.115 kg in 2006 in Janpan, the developed country.

1.2.8 Factors of health quality of social development: analysis on the current status of the number of beds in health institutions, the number of practicing (assistant) physicians and the values per capita of urban areas in Southern Jiangsu

A good medical environment and the professional skill of the doctors and nurses will improve the residents' health and advance the level of social development. The results are to be favorable to promote the occupation spirit of the residents engaged in all walks to reach a high level of modernization.

The data of health care Institutions and licensed (assistant) doctors of Southern Jiangsu during 2005 and 2013 are illustrated in Figure 9. The number of beds in health institutions grew at an annual 7.97% in that period. The rate was 5.65% during the 11th Five-Year plan, 13.88% during the first three years of the 12th Five-Year plan. The number of practicing (assistant) physicians rose at the speed of an annual 6.42% from 2005 to 2013. The rate was 3.61% in the 11th Five-Year plan period, 10.78% in the first three years of the 12th Five-Year plan period. Whether the number of beds in health institutions or the number of practicing (assistant) physicians, the data in the 12th Five-Year plan was above one times higher than that in the 11th Five-Year plan. It shows that the improvement of the healthy quality of population for urban areas in Southern Jiangsu has been in the transition period.

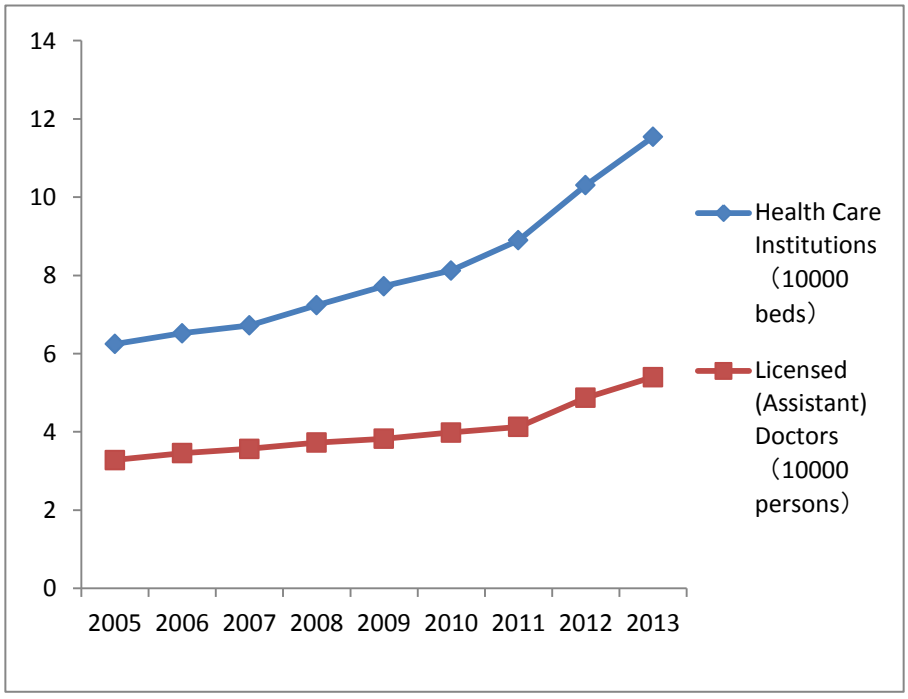

Figure 9 The Chart of Health Care Institutions and Licensed (Assistant) Doctors of Southern Jiangsu during 2005 and 2013

During 2011 and 2013, among urban residents, the number of beds in health institutions per 1000 persons had an increase of 7.5% every year, the number of practicing (assistant) physicians per 1000 persons had an increase of 8.02% every year. In 2013, the

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number of beds in health institutions per 1000 persons in the South of Jiangsu was comparatively low than that the North of Jiangsu and the Middle Area of Jiangsu Province. Meanwhile, the number of practicing (assistant) physicians per 1000 persons in the South of Jiangsu was comparatively higher than that the North of Jiangsu but lower than that in the Middle Area of Jiangsu Province.

1.3 Indicators and their Assignment Based on P-S Method for Southern Jiangsu

Based on the modernization index and the results of analysis about Economic development, Land resources, Energy, Traffic facilities, Environmental health, and health quality of social development, the indicators and their assignment based on P-S Method for Southern Jiangsu are shown in table 1.

Table 1 Indicators and their Assignment Based on P-S Method for Southern Jiangsu

Index Name	Property	Low Value	High Value
Economic aggregate GDP(billion yuan)	Possibility	34071.7	68219.42
GDP per capita (ten thousand yuan)	Satisfiability	13.5	23
Water resources (10000 tons/day)	Possibility	447.69	622.88
Water resources per capita (litre/day)	Satisfiability	170	220
the electric power consumption of residents (million kilowatts)	Possibility	255.39	413.95
electricity consumption of urban residents Per capita (Gigawatts)	Satisfiability	1000	1600
area of land used for urban construction (square kilometers)	Possibility	2176.69	2735.71
area of land used for urban construction per capita (square meters)	Satisfiability	83	95
area of parks and green land (hectare)	Possibility	26490.602	36799.67
area of parks and green land per capita (square meters)	Satisfiability	10.3	14
area of paved road (square kilometers)	Possibility	42716.42	52477.05
area of paved road per capita (square meters)	Satisfiability	17	19
volume of garbage disposal (10 000 tons)	Possibility	2.0065139	2.89
volume of garbage disposal per capita (kilograms /day)	Satisfiability	0.8	1.05
the number of beds in health institutions (10000 beds)	Possibility	15.7	25.51
the number of beds in health institutions per 1000 persons (beds)	Satisfiability	6.72	8.76
licensed (assistant) doctors(10000 persons)	Possibility	6.92	11.21
licensed (assistant) doctors per 1000 persons (persons)	Satisfiability	2.95	4

1.4 Analysis on the Population Bearing Capacity of Urban Areas in Southern Jiangsu Based on P-S method of single indicator of the Modernization Index

The meaning of the P-S method is expounded as follows according to documented data.

possibility and satisfiability：if a goal can be achieved, its possibility is the biggest, denoted by p(≤)=1; if a goal cannot be achieved, denoted by p(≥ r_B)=0; if the value of the possibility that a goal can be achieved is uncertain，denoted by p∈[0,1]. And

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it can be expressed by three-broken-line function in equation 1. Also ，if the satisfiability for attaining a goal is denoted by q, full satisfaction is denoted by q($\leq S_A$)=1, totally dissatisfaction is denoted by q($\geq S_B$)=0 and it can be expressed by three-broken-line function.

$$p(r)=\begin{cases}1 & r \leq r_A \\ \dfrac{r-r_B}{r_A-r_B} & r_A < r < r_B \\ 0 & r \geq r_B\end{cases} \qquad (1)$$

1) the mathematical definition of the possibility-satisfiability

Suppose

$r = a * s,\ \forall r,s,a \in R$（set of real numbers）

Then

p(r) and q(s) are three-broken lines, their weak merger solutions are expressed in equation 2:

$$w(a)=\begin{cases}0 & \text{solution} \leq 0 \\ \dfrac{-r_B + as_B}{(r_A-r_B)-a(s_A-s_B)} & 0<\text{solution}<1 \\ 1 & \text{solution} \geq 1\end{cases} \qquad (2)$$

The population bearing capacity of urban districts in Southern Jiangsu is computed by using the equation above and data in table 1 and the results are shown in table2.

Table 2 the Population Bearing Capacity of Urban Areas in Southern Jiangsu

Based on different P- S degree of single indicator (10000 persons)

Index	**0.9**	**0.8**	**0.7**	**0.6**	**0.5**	**0.4**
GDP	2594.22	2655.92	2710.46	2759.01	2802.50	2841.68
Water resource	2658.34	2681.82	2704.04	2725.08	2745.05	2764.02
electric power consumption of residents	2558.92	2563.41	2567.44	2571.08	2574.38	2577.40
area of land used for urban construction	2651.53	2679.74	2707.15	2733.82	2759.78	2785.04
area of parks and green land	2579.34	2586.27	2592.75	2598.83	2604.54	2609.91
area of paved road	2540.26	2567.16	2593.44	2619.14	2644.26	2668.84
volume of garbage disposal	2539.23	2568.48	2596.07	2622.12	2646.76	2670.11
the number of beds in health institutions	2409.16	2477.83	2542.69	2604.03	2662.14	2717.27
licensed (assistant) doctors	2405.56	2461.39	2513.63	2562.61	2608.63	2651.96

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As illustrated in table 2, different indicators like economy, resources, the population quality and environment factors have different effect on the population bearing capacity based on different P-S degrees. For example, when the P-S degree is 0.6, for different index like GDP, Water resource, electric power consumption of residents, area of land used for urban construction, area of parks and green land, area of paved road, volume of garbage disposal, the number of beds in health institutions and licensed (assistant) doctors, their population bearing capacities are respectively 2759.01, 2725.08, 2571.08, 2733.82, 2598.83, 2619.14, 2622.12, 2604.03 and 2562.61 (ten thousand persons). Expanding those data, the P-S (0-1) diagram of population bearing capacity of urban area in Southern Jiangsu is gotten in Figure 10. it shows that the indicator "electric power consumption of residents" is the main limiting factors; licensed (assistant) doctors and area of parks and green land are the second limiting factors; the number of beds in health institutions, area of paved road and the volume of garbage disposal are the third limiting factors; next, area of land used for urban construction and water resources are the limiting factors in sequence; and GDP is the last limiting factors.

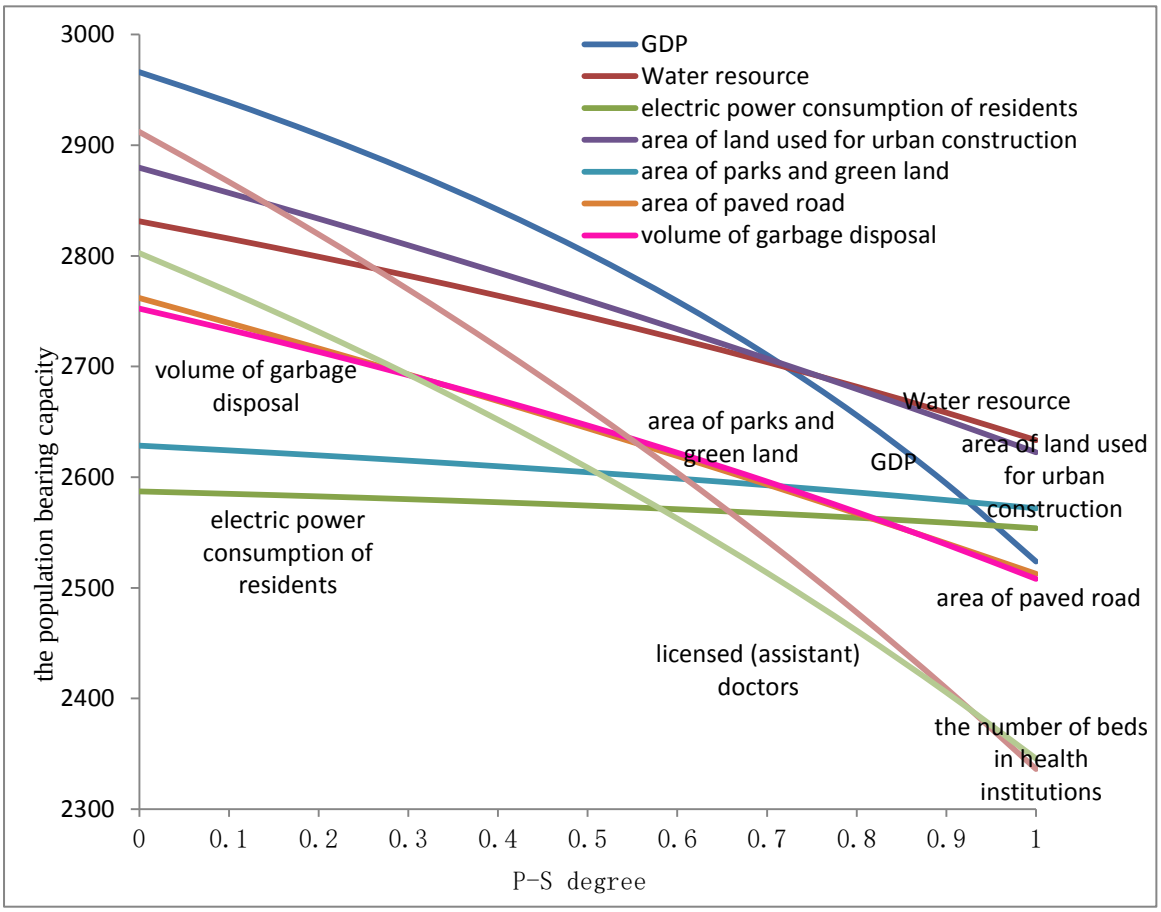

Figure 10 the relationship diagram between the P-S degree and the population bearing capacity of urban areas in Southern Jiangsu

However, as exhibited in Figure 10, the population carrying capacities of different indicators based on the same P-S degree had intersection points. For example, when the P-S degree equals 0.7, the population bearing capacity of area of land used for urban construction that is 2707 ten thousand persons is more than that of water resources that is 2704 ten thousand persons. However, when the P-S degree is set as 0.8, the former population carrying capacity that is 2680 ten thousand persons is less than that of the

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latter that is 2682 ten thousand persons. Therefore, GDP had an intersection with area of land used for urban construction and water resources when the P-S degree is between 0.7 and 0.8. Moreover, area of land used for urban construction had an intersection with volume of garbage disposal when the P-S degree is between 0.3 and 0.4.

Therefore, the identification of element a_{ij} of judgement matrix in Analytic Hierarchy Process (AHP) is confirmed by impact of different index on the population carrying capacity and expert scoring method.

The above results demonstrate that, to promote the sustainable development of the population of urban areas in Southern Jiangsu, its urban area needs to improve the power supply capability and water quality, increase the number of the licensed (assistant) doctors and enlarge area of green land in order to raise the residents' living level, improve their healthy quality and living environment. However, it should not expand the area of urban construction.

1.5 Analysis on the Population Bearing Capacity of multi indicators of Urban Areas in Southern Jiangsu Based on P-S method

The analysis of the population bearing capacity of multi indicators of urban area in Southern Jiangsu Based on P-S method adopts three scenario s as follows.

The first scenario is to evaluate the population bearing capacity of urban areas in Southern Jiangsu under the condition of different P-S degree when all indicator factors are simultaneously satisfied. For example, when the P-S degree is set as 0.6, its population bearing capacity is 25626.1 thousand persons.

The second scenario is to evaluate its average population bearing capacity of the same weight of indicators under the condition of different P-S degree. For example, when the P-S degree is 0.6, its population bearing capacity is 26439.7 thousand persons.

The third scenario is to evaluate its weighted average population bearing capacity of different indicator factors under the condition of different P-S degree. However, the weights of indicators are determined by AHP when the eigenvalue λ is 9.79. what's more, the value of element of judgement matrix in AHP is confirmed by the sequence of the limiting factors above, the significance of impact of indicators on the population carrying capacity and expert scoring method.

As exhibited in table 3, the total population bearing capacity of urban areas in Southern Jiangsu is 26174.1 thousand persons by 2020 when the P-S degree equals 0.6.

Table 3 the Population Bearing Capacity of multi indicators of urban areas in Southern Jiangsu

Conditions	**P-S degree**					
	0.9	**0.8**	**0.7**	**0.6**	**0.5**	**0.4**
Simultaneously satisfying	2405.565	2461.392	22513.629	2562.611	2574.385	2577.397
Equal weight	2548.507	2582.448	2614.186	2643.97	2672.006	2698.469
Proportional compensation	2527.923	2559.567	2589.335	2617.413	2643.962	2669.122

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Overall, the population carrying capacity of urban areas in Southern Jiangsu is between 25626.1 thousand persons and 26439.7 thousand persons in 2020 when the P-S degree equals 0.6.

These results shows that when the related departments in Southern Jiangsu are going to measure and survey the population living in urban areas, they should consider the number of the potential population after the state issued two-child policy for one family, the speed of inflow and emigration of the foreign population in order to control the number of population living in urban areas, the age distribution of reasonable proportion of urban population to improve the quality of urban population.

Nevertheless, the number of its urban resident population is comparatively less than its population carrying capacity that is calculated by means of the selected data and the P-S method. Therefore, the present development tasks for the Northern Jiangsu are to take effective measures, attract the foreign population to settle down, protect the local resources and environment while it develops, push forward the innovation development of ecological industry, reduce the quantities of companies that pollute the environment, save land resources, protect cultivated area, improve the rate of utilization of residential use of land and inefficient use of land in area of land used for urban construction and change the status that the value of net immigration is negative. Finally, it attains the coordinated development among the number of its population, economy, resources and environment.

1.6 Countermeasures and suggestions for urban areas in Southern Jiangsu

The area of land used for urban construction per capita of urban area in Southern Jiangsu has already been controlled in 100 square meters. However, there are some problems about waste or unequal distribution of land resources. Therefore, the related departments should count the inventory of the existing residential housing and the industrial land in low efficiency in urban area to deal with them to improve their utilization because some residents owns many house properties that were used to rent or be in Idle to wait to be sold when the housing prices rise to the prices that they want. Therefore, the related departments should levy the real estate tax according to national regulations and classify the real estate tax into certain types by the number of housing properties and family size to guide the residents or foreign buyers that possess a number of real estate resources to sell those idle houses in order to improve the actual residential land use. For example, for enterprises and institutions, they can build dormitories to provide for employees. The advantage of this approach is that it not only reduces the spatial distance between the work and the dwelling of the staffs to enhance their work enthusiasm, but also improves the land use efficiency. For those cities that have the inefficient industrial land because the upgrading or transformation of industrial structure leads to some enterprises to switch to other products or go to bankruptcy, the government departments should clean them to improve the utilization of land resources to reduce the risk of land resources. What's more, the related departments should enlarge or restore the greenbelt to improve the residential environment and increase the ring roads on traffic congestion area to enhance the urban road construction and the green environment of residents in Southern Jiangsu. However, for area of paved road per capita and area of parks and green land per capita, there is a certain distance from the requirements of modernization construction. Therefore, these cities in Southern Jiangsu should take effective measures to enhance its area of paved road per capita and area of parks and green land per capita to improve the ecological civilization construction, and strengthen the protection and improvement of the ecological environment.

For the residents' healthy quality, these urban areas in Southern Jiangsu should strengthen the sustainable construction for doctors and nurses on the basis of upgrading of the existing health infrastructure. At present, the problem about aging in this region is more serious. For this reason, these urban areas should enlarge nursing team and improve the treatment of the registered nurses by various investments from the government, social organizations and individual, strengthen the combination of treatment and

maintenance in order to link the family pension, community pension and institutional pension and medical insurance into a unified medical security system including multi-level pension and life to enhance the level of old-age security of urban area in Southern Jiangsu and reduce the risk associated with the imperfect system.

What's more, these urban areas should explore new fields like high-tech ecosystem services and new energy, and adjust the traditional industrial structure, attract the inflow of high-level talents to maintain their rapid economic development.

In addition, these urban areas should establish the early warning mechanism about the regional population carrying capacity to control the population scale for megacity or metropolis like Nanjing city and Suzhou city and strengthen the construction of small or medium-sized towns in order to evacuate the population pressure from urban areas in Southern Jiangsu.

CONCLUSION

This paper analyzes the population carrying capacity of urban area in Southern Jiangsu by using some index data representing the level of modernization like GDP, Water resource, electric power consumption of residents, area of land used for urban construction, area of parks and green land, area of paved road, volume of garbage disposal, the number of beds in health institutions and licensed (assistant) doctors based on the P-S method. The result is that its population bearing capacity is between 25626.1 thousand persons and 26439.7 thousand persons in 2020 when the P-S degree equals 0.6. Therefore, these urban areas should levy the property tax, build unit dormitories and other combination policies to raise the utilization rate of the land resources and enhance the staffs' activities for jobs, enhance urban road construction and the residents' green environment to improve the residential environments, strengthen the construction of teams about doctors and nurses and the combination of treatment and maintenance and build a unified medical security system including multi-level pension and life to improve the residents' healthy quality. And they should establish the early warning mechanism about the regional population bearing capacity to reduce the risk of the population. Moreover, they should seek for a new economic growth point to maintain their rapid developments.

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