The Population Capacity Adjustment and Optimization of Suzhou Ancient City for Social Sustainable Development

Yang Jianqiang, Yang Zihan

Abstract: At present, Suzhou Ancient City faces challenges such as an aging population, excessive population density, low population quality, and a living environment that fails to meet the demands of modern life. The population control strategies previously implemented, based on a singular goal of preserving traditional aesthetics, are no longer adequate to address the complex situation of ancient city preservation and development. In response to the existing issues of population development in Suzhou Ancient City, and based on the dual demands of preserving traditional aesthetics and enhancing social vitality, this paper focuses on the overall coordination of ancient city protection and development, population structure adjustment and optimization, and the creation of a livable environment for sustainable social development. The study proposes a population capacity adjustment and optimization plan and technical pathway from aspects such as population scale prediction, population structure guidance, population distribution regulation, residential space adjustment, and the distribution control of public service facilities. The goal is to more scientifically, reasonably, and precisely guide the population capacity management of the ancient city.

Keywords: Population Aging; Population Capacity; Social Sustainable Development; Cultural Heritage Preservation; Suzhou Ancient City

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Thanks to the population relocation policy, which focused on protecting traditional aesthetics and historical heritage and was implemented in the early 1990s, the population of Suzhou Ancient City decreased from a peak of 400,000 in the late 1970s to 252,000 in 2020. This policy has greatly alleviated the population pressure on the ancient city and effectively preserved its traditional aesthetics and spatial layout. However, at the same time, the strict protection strategy has made urban renewal difficult. Due to a lack of regular maintenance, issues such as aging infrastructure, poor environmental quality, and low living space quality have emerged. Particularly with the expansion of the city's overall framework and the development of surrounding new urban areas, the better living environment and entrepreneurial opportunities have led a large number of young and highly educated people to leave the ancient city for the new areas. As a result, the ancient city now faces problems such as an aging population, a decline in population quality, and the gathering of migrant workers. These issues indicate that the previous population control strategies, which were solely based on preserving the aesthetic features of the city, are no longer sufficient to address the complex situation of the ancient city. As the root of the city's historical culture, social development, and urban structure, the ancient city not only bears the responsibilities of heritage protection, aesthetic maintenance, and cultural transmission but also serves as a place of residence for many people, requiring it to meet the daily modern living needs of its inhabitants. As a dynamic urban heritage, the sustainable development of a historical district lies in achieving prosperity, environmental comfort, and community harmony during the protection process. Therefore, in the new era emphasizing a human-centered approach and high-quality development, it is urgent to objectively analyze and diagnose the real status of the population capacity in the ancient city. Based on the protection of the city's layout and traditional aesthetics, the development goals for a reasonable population capacity should be forecasted and established from the perspective of improving living conditions and enhancing urban vitality. Moreover, measures to optimize and adjust population distribution should be implemented at the district level to ensure the quality of living space and the social sustainable development of the ancient city.

1. Research Approach and Framework

1.1 Domestic and International Research Status

The study of population capacity originated in the 1780s. In 1789, Malthus [4] proposed in An Essay on the Principle of Population that population growth would outstrip the availability of resources, and therefore, population growth should be controlled to maintain a moderate population size. In 1949, Allan [5] formally defined population capacity as the maximum population a region can permanently support under certain technological conditions and consumption habits, without causing environmental degradation. In 1986, British economist Cannon [6] introduced the concept of "moderate population theory," elevating the issue of urban capacity to the level of theoretical research, and is considered the founding figure in urban capacity studies. As academic attention increased on the effects of environmental changes and human activities on ecological environments, research on carrying capacity shifted from simple population balance to a more complex balance and decision-making process involving ecological, economic, and social factors [7-9].

Domestic research on the population capacity of ancient cities mainly focuses on cultural heritage protection, tourism industry development, and infrastructure carrying capacity. Xiang Bingshi et al. [1], starting from the "comprehensive protection of the ancient city’s aesthetics" as a guiding principle for ancient city protection planning, argued that relocating the population from Suzhou Ancient City to keep its population around 250,000 is an important path for the city’s sustainable development. Sun Huijuan [10] conducted a study on the tourist population capacity of the Song Dynasty capital city, Kaifeng, from the perspectives of economic benefits, accommodation facilities, ecological environment, and social psychology. Zhang Zhenlong et al. [11], from the perspective of traffic supply and demand contradictions, studied the correlation between commuting population capacity and traffic congestion characteristics in Suzhou Ancient City, analyzing factors such as road network structure, land use layout, and the separation of living and working spaces. Zhang Bing et al. [12] conducted a comprehensive study on the natural environmental foundation, human ecological environment, and historical landscape environment of historical cities, emphasizing the need to pay attention to key elements in material circulation, energy flow, and information transmission. They also explored the processes of interaction between these elements and their formation and evolution as an organic unity of natural and social ecosystems.

Currently, research on the population capacity of ancient cities has primarily focused on aspects such as total population control, overall population relocation, and the protection of the ancient city's aesthetics. However, there is still a lack of comprehensive studies on how to approach the rational calculation of population capacity in ancient cities, taking into account the multidimensional goals of preserving traditional aesthetics, achieving overall coordination in the protection and development of the ancient city, creating a livable environment, promoting social sustainable development, and enhancing urban vitality.

1.2 Principles of Population Capacity Adjustment and Optimization

1.2.1 Principle of Dynamic Balance between Protection and Development

As a living heritage, the ancient city must follow the principles of "combining protection with livelihood," "contextual protection," and "unity of protection and inheritance" [13]. At the same time, the ancient city is a community inhabited by many people, and to meet the needs of modern daily life, it must continue to be built and developed. Therefore, it is essential to adopt systematic thinking, baseline thinking, flexible thinking, and refined thinking, while exploring the use of digital technologies for the protection and revitalization of historical and cultural heritage in the ancient city [14]. A combination of methods, including population density, population gross density, and relevant planning, should be employed to control the population baseline. Based on the current capacity of different land parcels in Suzhou Ancient City, population capacity should be calculated and adjusted at the micro-scale, with control and optimization measures proposed for residential space capacity, ensuring precise and refined management.

1.2.2 Principle of Population Structure Adjustment and Optimization

A rational population structure is the fundamental prerequisite for the sustainable development of the ancient city. It is essential to integrate the goals of social sustainable development into various aspects, such as material space renewal, social capital cultivation, and economic vitality enhancement, based on ecological services, landscape aesthetics, social experience, and economic stimulation [15]. This will strengthen the organic integration of historical environment protection and social-economic vitality enhancement, thereby giving the ancient city greater vitality and appeal. While retaining the original residents, the city should also attract young people and high-quality populations. Therefore, by constructing a population structure pyramid model for the current and future state of the ancient city, this study aims to identify the deficiencies in the city's population structure. On the premise of improving the quality of life and enhancing social vitality, guiding objectives and specific plans for optimizing the future population structure of the ancient city are proposed.

1.2.3 Principle of Creating a Livable Environment

A livable environment is a necessary condition for strengthening talent attraction and revitalizing industrial economic vitality. Under the premise of historical and cultural preservation in Suzhou Ancient City, the creation of livable spaces should incorporate the distinctive characteristics of Suzhou-style living, continuing the traditional spatial texture, scale, and aesthetic features of the ancient city. This can be achieved by improving the living environment, enhancing residential conditions, perfecting supporting infrastructure, and increasing employment opportunities, thereby maintaining the social structure of the ancient city and creating a model of Suzhou-style livable living spaces. To this end, different types of livable residential area samples should be selected from within the ancient city. Using these sample indicators, the capacity elements such as residential space types, population density, per capita living area, and public service facilities in different parts of the ancient city should be calculated and allocated, ensuring that the ancient city provides a good living environment and high-quality living conditions.

1.3 Technical Approach to Population Capacity Adjustment and Optimization

First, based on the principles of dynamic balance between ancient city protection and development, social sustainable population development, and the creation of a livable environment, a technical approach combining qualitative and quantitative analysis will be adopted. The approach will focus primarily on quantitative analysis and will integrate various technical methods such as Geographic Information Systems (GIS), mathematical analysis, and population modeling. Based on the multidimensional development goals of the ancient city, and utilizing population density, gross population density, and relevant planning, the population control of the ancient city will be calculated to determine a reasonable range for the total population. Three population capacity models—high, medium, and low—will be proposed, and the future population structure of the ancient city will be guided using the population pyramid model.Next, based on the evaluation of the living space quality in the ancient city's residential areas, various types of residential area sample indicators with Suzhou-style livability characteristics will be extracted. At the block scale, further research will be conducted on residential land use, population relocation numbers, per capita living area, and the adjustment of public service facilities.Finally, based on the refined calculation results for the population capacity of the ancient city, a decision-making and evaluation system for reasonable population capacity will be established. This system will address the multiple development goals of the ancient city—such as "historical aesthetic protection," "urban vitality enhancement," and "livability quality improvement." By evaluating the three population capacity models (high, medium, and low), the optimal and most reasonable population capacity plan for the sustainable development of the ancient city will be proposed, as shown in Figure 1.

2. Population Status and Problem Analysis

2.1 Analysis of the Current Population Structure

2.1.1 High Degree of Population Aging

According to the Suzhou Ancient City Control Detailed Planning (2015) (hereinafter referred to as the "Control Plan"), in terms of the population age structure, the population in the ancient district is divided as follows: 8.1% are children aged 0-14, 74.5% are adults aged 15-64, and 17.4%

are elderly people aged 65 and above. Internationally, a population where 7% or more are aged 65 and above is considered to have entered an aging society. Suzhou Ancient City far exceeds this standard, indicating that the city has fully entered an aging society. According to data from the 2010 National Census, there were 50,800 people aged 60 and above in Suzhou Ancient City, accounting for 23.41% of the total population. Since the age distribution data for Suzhou Ancient City from the 7th National Census has not yet been published, the latest data from the public security system indicates that in 2020, the population aged 60 and above accounted for 34.58%, which is also significantly higher than the 10% international standard for an aging society. Comparing the population census data from 2010 and 2020 for four typical communities in the ancient city—Changmen Community in Jinchang Street, historical districts in Pingjiang Street, Tangjiaxiang Community in Shuangta Street, and Jia'an Community in Canglang Street—reveals that the contraction trend in the population structure pyramid is more pronounced in 2020, as shown in Figure 2.

2.1.2 Low Cultural and Educational Quality of the Population

The educational level of the permanent residents in the ancient city is generally low, with more than 70% of the population having a high school education or below [16]. At the same time, among the non-local permanent residents, the proportion of individuals with a high school education or higher is significantly lower than that of the local registered residents. Moreover, most of the non-local population is engaged in lower-end industries such as commerce, services, production, and transportation.

2.1.3 High Density of Low-Income Population

According to the 2019 Gusu District Population Big Data Special Research Report, which collected 525,000 monthly income samples from workers in Suzhou, the median average salary is approximately 5,600 RMB [16]. Using the following income standards: below 5,000 RMB as low income, 5,000–12,000 RMB as middle income, and above 12,000 RMB as high income, the analysis shows that in the urban area of Suzhou (excluding Wujiang District), the total low-income population is about 3.12 million, with a low-income density of approximately 0.53 million people/km^2. Within the ancient city, the low-income residential population accounts for 52.3% of the total residential population, approximately 116,000 people, with a low-income density as high as 0.82 million people/km^2.

Overall, the population structure of the ancient city faces significant issues such as a high degree of aging, low cultural and educational quality, and a high density of low-income residents.

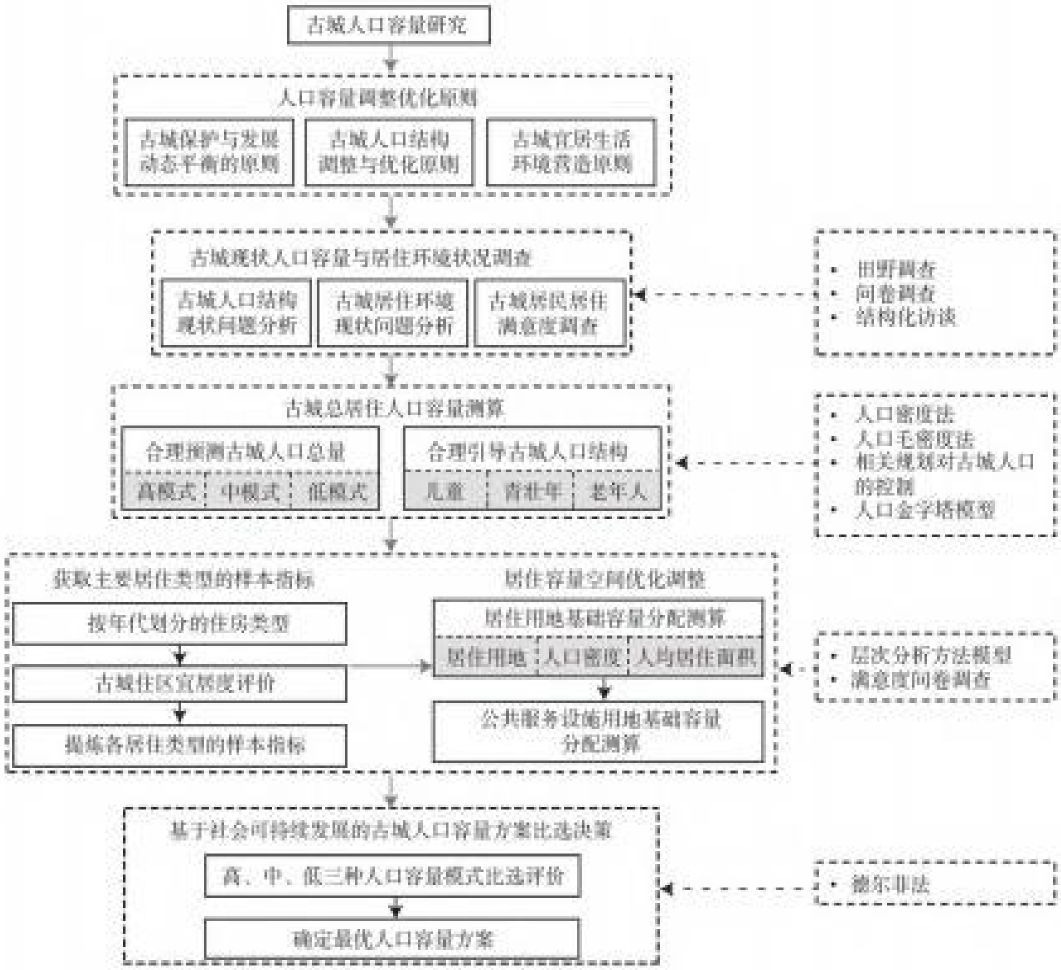

Figure 1: Research Framework

2.2 Analysis of Current Living Conditions

2.2.1 Low Per Capita Housing Area

According to the 2020 street statistics, the estimated per capita living area in the ancient city is calculated based on a total population of 252,000 people and a residential building area of 6.9 million m², resulting in a per capita living area of 27 m². This is lower than the 36.52 m² per capita residential area for urban households as reported in the China Population Census Yearbook (2020). Furthermore, 62% of the residential plots in the ancient city have a per capita living area lower than the national average.

2.2.2 High Population Density

Based on the 2020 street statistics for the ancient city, the population density is approximately 17,700 people/km², significantly higher than the citywide density of 7,700 people/km². Currently, areas such as Tangjiaxiang, Yulan, Jia'an, and Jiuxueqian communities have very high population densities, reaching 34,000 to 39,000 people/km², while communities like Dongdajie and Zhonglou have relatively lower population densities, ranging from 6,000 to 8,000 people/km². Based on the heatmap data of the ancient city for the entire day on April 1, 2021, it can be concluded that the daytime pedestrian flow is primarily concentrated in the area enclosed by "Northwest Street - Pingjiang Road - Fenghuang Street - Shiquan Street - Renmin Road," with the highest peak of heat occurring around 14:00. After 18:00, due to people finishing work, the heat distribution begins to spread across the ancient city. Overall, the heat intensity in the ancient city is higher during the daytime than at night, and after 22:00, the heat distribution becomes more evenly spread throughout the area.

2.2.3 High Proportion of Migrant Renters

According to the latest data from the Public Security Bureau, in 2020, the migrant population in the ancient city was approximately 74,500, accounting for 26.12% of the total population (including both registered and migrant residents). In five communities—Changmen, Jiuxueqian, Yangyuxiang, Wangshixiang, and Beiyuan—the migrant population exceeded 2,800 people. Among these, Changmen community had the highest migrant population, approximately 3,800 people.

These findings indicate that the living environment in the ancient city faces issues such as low per capita housing area, high population density, and a high proportion of migrant renters. See Figure

2.3 Resident Satisfaction Survey

A resident satisfaction survey was conducted in the ancient city in 2021, with a total of 602 questionnaires distributed and 594 valid responses collected. The survey revealed that residents in the ancient city generally expressed dissatisfaction with their current living conditions, particularly regarding small housing sizes, poor living quality, and unfavorable environmental conditions. Currently, many residents in the ancient city are gradually moving out. Over half of the respondents reported plans to move within the next five years. However, the advantageous location and convenient living conditions of housing in the ancient city are the most attractive factors for residents who choose to stay.

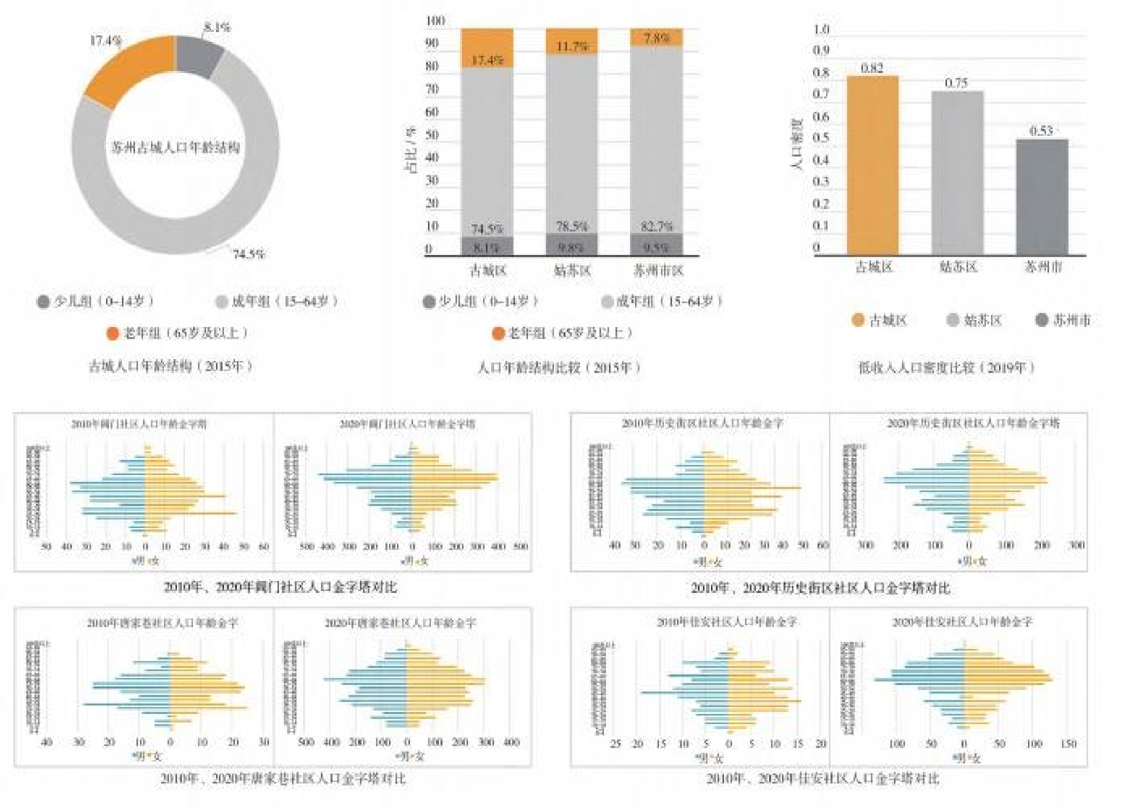

Figure 2: Analysis of Current Population Age Structure

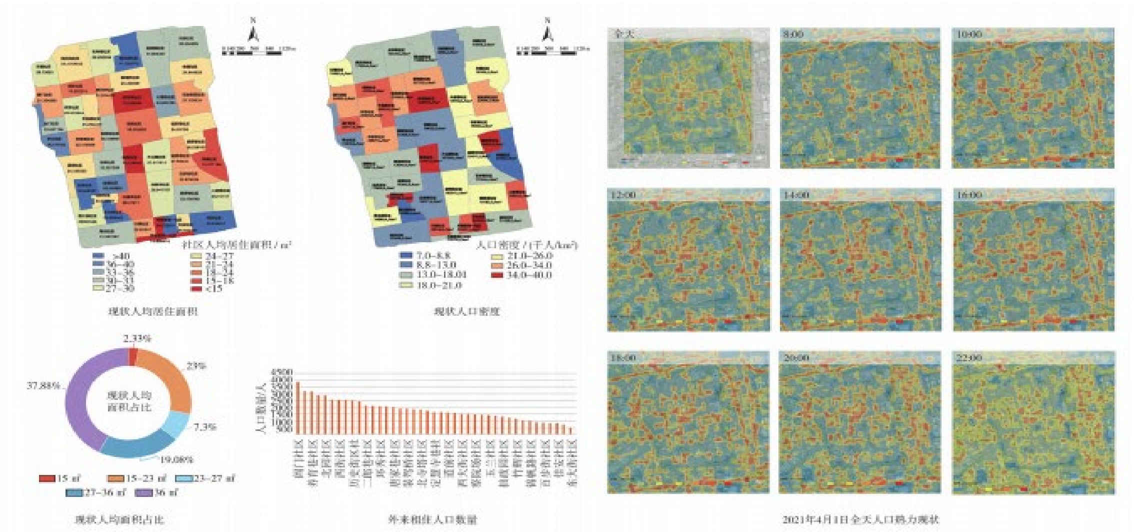

Figure 3: Analysis of Current Living Conditions, Population Density, and All-day Heatmap Distribution

3. Total Residential Population Capacity Calculation

3.1 Population Capacity Prediction for the Ancient City Based on Multiple Methods

3.1.1 Method 1: Population Density Method

Based on the urban planning construction land area of the ancient city as specified in the "Control Plan" (1414.26 hm²), and combining with the per capita construction land standard, the population scale is calculated using Formula (1). According to the "Classification of Urban and

Rural Land Use and Planning Standards for Construction Land (GB 50137, revised)" (hereinafter referred to as the "Standards"), the per capita urban construction land scale for climate zones III, IV, and V is in the range of 65.0-75.0 m² per person.

Pt = Lt / It (1)

Where:

Pt is the predicted population size at the end of the target year;

Lt is the predicted urban construction land area at the end of the target year, determined based on land development potential;

It is the recommended per capita construction land standard.The population size prediction result using this method is: 189,000 to 218,000 people.

3.1.2 Method 2: Gross Population Density Method

Gross population density refers to the number of people per unit of residential land area. According to the "Control Plan," the residential land area in Suzhou Old City is 576.67 hm². By combining the per capita residential land area indicator, the total population of the Old City can be calculated using formula (2). (The per capita residential land area standard in climate zones III, IV, and V in the "Standards" ranges from 23.0 to 36.0 m²/person.)

Pt = At / at (2)

Where:

Pt is the projected population at the end of the target year;

At is the total residential land area in the "Control Plan";

at is the per capita residential land area standard.

The population scale predicted by this method is between 160,000 and 251,000 people.

3.1.3 Method 3: Comprehensive Judgment Based on Relevant Planning

According to the "Control Plan," the population capacity of the Old City is estimated to be around 220,000 people based on the residential land area, floor area ratio, per household living area, and per household population from various planning documents. In the "Outline of the Research Report on the Guidance for the Development of Residential Population and Property Concentration Policies for the Protection and Renovation of the Old City (2021)," the population capacity is also estimated to be approximately 220,000 people, using similar factors such as residential land area, floor area ratio, per household living area, and per household population.In a comprehensive analysis that includes the supply of land resources, education facilities, agricultural markets, community public service facilities, road traffic facilities, green spaces, and sports facilities, it is concluded that under land resource constraints, the future permanent population of the Old City should ideally be between 200,000 and 220,000 people.

3.1.4 Preliminary Determination of Reasonable Population Capacity

Reasonable population capacity refers to the maximum population load, healthy and suitable population structure, and the scale and structure of residential land and supporting facilities that can be carried by the Old City to maintain the normal operation of the system, under certain natural resource and socio-economic conditions. This is based on the multidimensional goals of social sustainable development, including the protection of the traditional character of the Old City, enhancing the city's vitality, and improving livability.The total reasonable population capacity is not merely a target of total population size. To make this target practical and contextually appropriate, a more refined calculation of the Old City's population capacity must be carried out. Ultimately, the appropriate population capacity optimization and adjustment target should be

determined based on specific conditions.
Based on the population scale predictions for the Old City using the three methods above, as well as the population control measures outlined in relevant plans, a preliminary target range for the reasonable population capacity of the Old City is determined to be between 200,000 and 240,000 people. To meet the multiple objectives of preserving and continuing the traditional character of the Old City, ensuring the improvement of living space quality, and maintaining future development vitality, three population development target options are formed: 240,000, 220,000, and 200,000 people, respectively [17].
It is worth noting that the high, medium, and low population capacity options represent different degrees of population reduction compared to the current population size of 252,000. However, a reduction in population size does not necessarily imply a decline in urban vitality. Urban vitality is generated by the interaction between human activity and spatial environments, typically characterized by human aggregation and activity in space. With the construction of new cities surrounding the Old City of Suzhou, a large number of people have moved from the Old City to the new districts. However, compared to the new districts, the Old City has a higher road network density, greater functional node density, and more heterogeneity. The reasonable street scale, active interface spaces, prosperous tourism economy, and harmonious neighborhood relationships infuse the Old City with strong urban vitality [18]. Therefore, changes in population size do not necessarily reflect the density and richness of human activities. The vitality of the Old City is closely related to the organic integration of community networks, the health of the population structure, the livability of the residential environment, the road network density of urban streets, the configuration standards of urban functions, and the richness of public spaces.

3.2 Population Structure Optimization Based on the Population Pyramid Model
The population age structure pyramid of the ancient city in 2010 is a typical shrinking type, i.e., an aging type. In 2020, the population aged 60 and above in the ancient city was 73,000, accounting for 34.58%, an increase of 11.17 percentage points from the 23.41% in 2010. This indicates a further deepening of the aging trend in the ancient city. In 2020, the working-age population (aged 18–59) accounted for 55.64%, a decrease of 12.85 percentage points compared to 2010, indicating a significant shortage of labor force in the city.According to the population age structure pyramid evolved from the 2010 data, the pyramid for 2025 shows a relatively smaller proportion of people in the 35–49 age group, while the 55–59 age group has a relatively larger proportion. If no government intervention is made, the population will continue to evolve normally in the next decade, resulting in a further decline in the proportion of youth and an increase in the proportion of the elderly, as well as a gap in the middle-aged labor force.Therefore, based on the goals of social sustainable development for the ancient city, it is urgent to explore ways to improve the population structure by implementing policies that attract high-quality, young people. This includes providing good platforms for young people, middle-to-high-income groups, and talent introduction, as well as improving the living environment and service facilities in the ancient city. Policy intervention in the population structure pyramid is needed to achieve a more ideal and appropriate population structure.After research and consultation with various stakeholders, it is recommended that by 2030, the proportion of children and adolescents in the population be increased to 9%, the proportion of young and middle-aged labor force be increased to 75%, with particular emphasis on increasing the population in the 35–49 age range.

The proportion of elderly people should be reduced to 16% to correct the "shape defects" of the current population age structure pyramid. See Figure 4.

4 Adjustment of Population Capacity for the Ancient City at the Block Scale

4.1 Extraction of Residential Area Sample Indicators Based on Living Space Quality Evaluation

4.1.1 Evaluation of Residential Area Living Space Quality

Using the Analytic Hierarchy Process (AHP), a residential living space quality evaluation system was developed, including four major categories—residential environment, community services, commercial services, and transportation—as well as 17 subcategories of evaluation indicators, such as per capita residential area (Table 1). Five experts were selected to score the importance of each of the 17 indicators, and the average of their scores was used to calculate the weight (Wj) of each indicator. Based on the residential living space quality evaluation system, the ancient city was comprehensively assessed, and the evaluation results were obtained. See Figure 5.

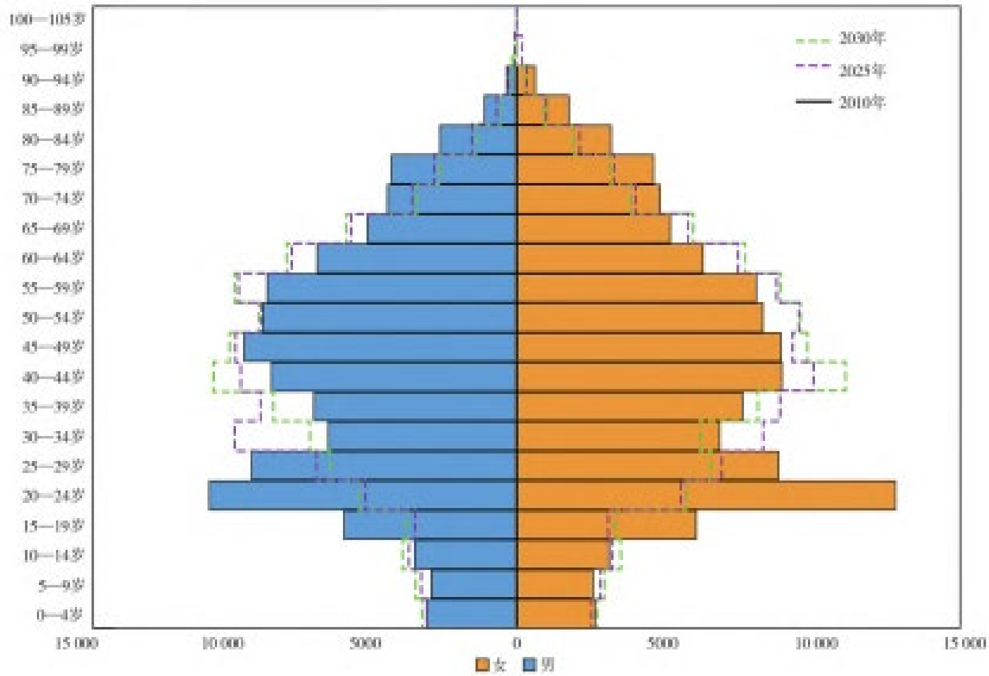

Figure 4: Population Age Structure Pyramid Model of the Ancient City in 2010 and Projected Population Age Structure Pyramid Models for 2025 and 2030.

Table 1: Residential Living Space Quality Evaluation Indicator System

一级指标 (A)	二级指标(B)		权重设定(W)
居住环境(A1)	B1	户均居住面积	0.06
	B2	居住区内部绿地率	0.12
	B3	居住区亲水性	0.05
	B4	建筑质量	0.12
	B5	建筑风貌	0.12
	B6	公共绿地开敞空间	0.08

	B7	市政基础设施供给水平	0.05
社区服务(A2)	B8	基础教育—幼儿园 300 m、小学 500 m 半径覆盖	0.03
	B9	中学 1000 m 半径覆盖	0.03
	B10	养老设施	0.02
	B11	医疗设施（综合医院 300/500 m）专科医院 300 m）	0.03
	B12	体育设施	0.05
	B13	文化设施	0.06
商业服务(A3)	B14	商业服务配套	0.05
	B15	综合市场/农贸市场	0.03
交通出行(A4)	B16	轨道站点	0.05
	B17	公交站点	0.05

4.1.2 Residential Sample Extraction

Five typical types of residential areas were selected from the ancient city: traditional residential houses, multi-story residential complexes built between 1960 and 1989, multi-story complexes built after 1990, apartment buildings built after 2000, and modern low-rise residential houses built after 2000. The top five residential areas based on the comprehensive evaluation scores for living space quality were selected as sample representatives for each residential type. Data on factors such as floor area ratio, building density, population density, per-household living area, per-household public space area, and parking ratio were extracted and analyzed. These data were used as the sample indicators for the population-residential capacity study of various residential types.

4.2 Population Capacity Calculation Based on Residential Space Adjustment

4.2.1 Basic Capacity Allocation for Residential Land

First, for plots where the per capita residential area does not meet the sample indicators, population reduction should be implemented. For areas near tourist attractions or high-traffic zones, residential capacity allocation should be appropriately reduced, while multi-story buildings with poor construction quality or those identified as unsafe should undergo overall renovation, with an appropriate increase in residential capacity. A certain proportion of talent apartments and other residential spaces should be included in the allocation. Second, adjustments should be made for plots whose land use does not align with the "Control Plan" land-use classification.Third, under the high, medium, and low population capacity models, the upper, middle, and lower limit values of the indicators for each residential type sample should be selected as reference averages during the allocation calculation (Table 2). If the per capita residential area of a plot already meets the sample indicators, improvements to the external living environment are required. Finally, the distribution of the residential population in the ancient city should be ensured to meet the requirements for improving the living environment, enhancing living quality, and preserving the traditional architectural features of the ancient city.

4.2.2 Population Density Adjustment

Based on the per capita residential area indicators extracted from the Suzhou-style livability standards, residential units with a per capita residential area below the Suzhou livability standard range will undergo population reduction. In the low, medium, and high population capacity models, population reduction will be carried out for 53,608, 41,141, and 21,285 people, respectively.

4.2.3 Per Capita Residential Area Adjustment

In the basic capacity allocation calculation for residential land in the ancient city, different levels of improvement in the per capita residential area will be achieved under the low, medium, and high population capacity models (Figure 6). In these three population capacity models, the per capita residential area will be increased from the current 27 square meters to 33 square meters, 32 square meters, and 31 square meters, respectively.

5 Population Capacity Scheme Comparison and Decision-Making for the Ancient City

5.1 Principles of Scheme Comparison

Due to the inherent contradictions and exclusions between various development goals, there is no population capacity scheme that can fully satisfy every development goal. Therefore, it is necessary to comprehensively consider the multidimensional goals of the ancient city's development, including historical and cultural heritage preservation, sustainable population development, creation of livable living environments, and enhancement of socio-economic vitality, in order to determine an appropriate population capacity development model. For the achievement of different goals, three preliminary population capacity schemes are proposed:High Capacity Model: This model has a smaller population reduction scale and a less significant reduction in aging. Therefore, it tends to involve relatively minor updates to the current urban construction of the ancient city. However, under the control of high-standard residential area sample indicators, increasing the population to enhance living quality will inevitably bring greater construction pressure. Additionally, the residential area sample indicators for this model are at the lowest level, so the improvement in livability quality is relatively low.Low Capacity Model: This model has the largest population reduction scale and can provide a more livable environment, creating better conditions for attracting high-quality, younger populations, thus significantly reducing the level of aging. At the same time, because it provides livable conditions for a smaller population, the construction pressure is lower than that of the high capacity model. However, the residential area sample indicators for this model are at the highest level, requiring stronger updates, which may lead to significant resistance and uncertainty in specific implementation.Medium Capacity Model: This model combines characteristics of both the high and low capacity models, but the results achieved in each dimension are not as pronounced as in the other two models.

5.2 Comparison Method and Results

Based on the principles of dynamic balance between the protection and development of the ancient city, population structure adjustment and optimization, and the creation of a livable environment, the Delphi Method is used to transform the multi-objective principles into comparison factors. According to the three dimensions of historical architectural preservation, urban vitality enhancement, and livability quality improvement, seven secondary indicators are extracted: construction pressure, renewal intensity, degree of population aging, population density, residential floor area ratio, per capita residential area, and per capita public service facility area. Different weights are assigned to each indicator. Since the indicators target different aspects, the values of each indicator are standardized using the min-max method. Weighted scoring and comparison evaluations are then conducted for the three population capacity schemes. See Table 3.

5.3 Determination of the Optimal Population Capacity Scheme

Based on the multi-dimensional population capacity development goals of protecting the historical and cultural resources of the ancient city, optimizing the population structure, creating a livable environment, and enhancing socio-economic vitality, the three population capacity models (high, medium, and low) were compared and scored. The schemes with a total score between 0.6 and 1, where the number of advantages outweighs the number of disadvantages, are considered to be within the reasonable range. According to the scoring results, the low-capacity model scored 0.822, which falls within the reasonable range. Therefore, it is recommended as the optimal scheme.In the low-capacity scheme, the population scale of the ancient city of Suzhou would be 200,000, with about 32,000 elderly people, around 150,000 working-age individuals, and 18,000 children and teenagers. The residential land area would be 5.8449 million square meters, with a total residential building area of 6.6047 million square meters. The average residential floor area ratio would be 1.13, and the per capita residential area would be 33 square meters.The advantages of this scheme are that it focuses on improving the livability of the ancient city and optimizing its population structure. The downside is that the population size is significantly reduced compared to the current population of the ancient city, which presents certain challenges in implementation and updating. Due to the dual complexity of the ancient city's historical space and population composition, an immediate and comprehensive population control plan will face considerable resistance. Therefore, a small-scale, incremental approach to urban renewal is required. Population control and optimization can be implemented progressively in three phases: short-term, medium-term, and long-term, based on the goals of high, medium, and low population capacity models.

Table 2: Optimization and Adjustment Indicators for High, Medium, and Low Residential Capacity

	现状	调整后		
		高容量模式	中容量模式	低容量模式
总人口规模 /万人	25.2	24	22	20
居住用地面积 /万 m^2	587.90	584.49	584.49	584.49
总居住建筑面积 /万 m^2	690.00	742.30	707.23	660.47
居住用地平均容积率	1.17	1.27	1.21	1.13
人均居住面积 / m^2	27	31	32	33

Table 3: Comparison and Evaluation of the Three Population Capacity Models

一级指标	一级权	二级指标	二级权	指标指向	高容量模式	中容量模式	低容量模式	标准化评分		
								高容量模式	中容量模式	低容量模式

	重		重							
历史风貌保护	0.33	建设压力	0.5	逆向	3	2	1	1	0.5	0
		更新强度	0.5	逆向	1	2	3	0	0.5	1
城市活力提升	0.33	老龄化程度	0.5	逆向	3	2	1	0	0.5	1
		人口密度	0.5	逆向	3	2	1	0	0.5	1
宜居品质提升	0.33	住宅容积率	0.33	逆向	3	2	1	0	0.5	1
		人均居住面积	0.33	正向	1	2	3	0	0.5	1
		人均公共服务设施面积	0.33	正向	1	2	3	0	0.5	1
最终得分								0.165	0.493	0.822

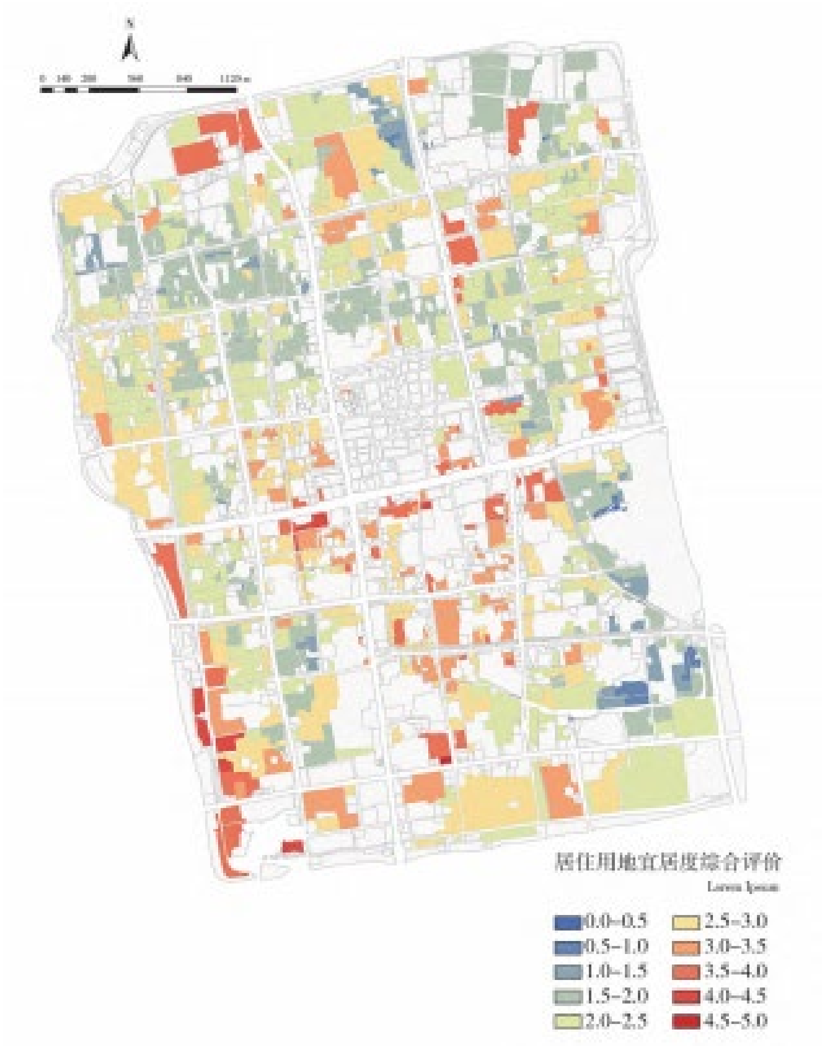

Figure 5: Comprehensive Evaluation of Residential Living Space Quality (Block Scale)

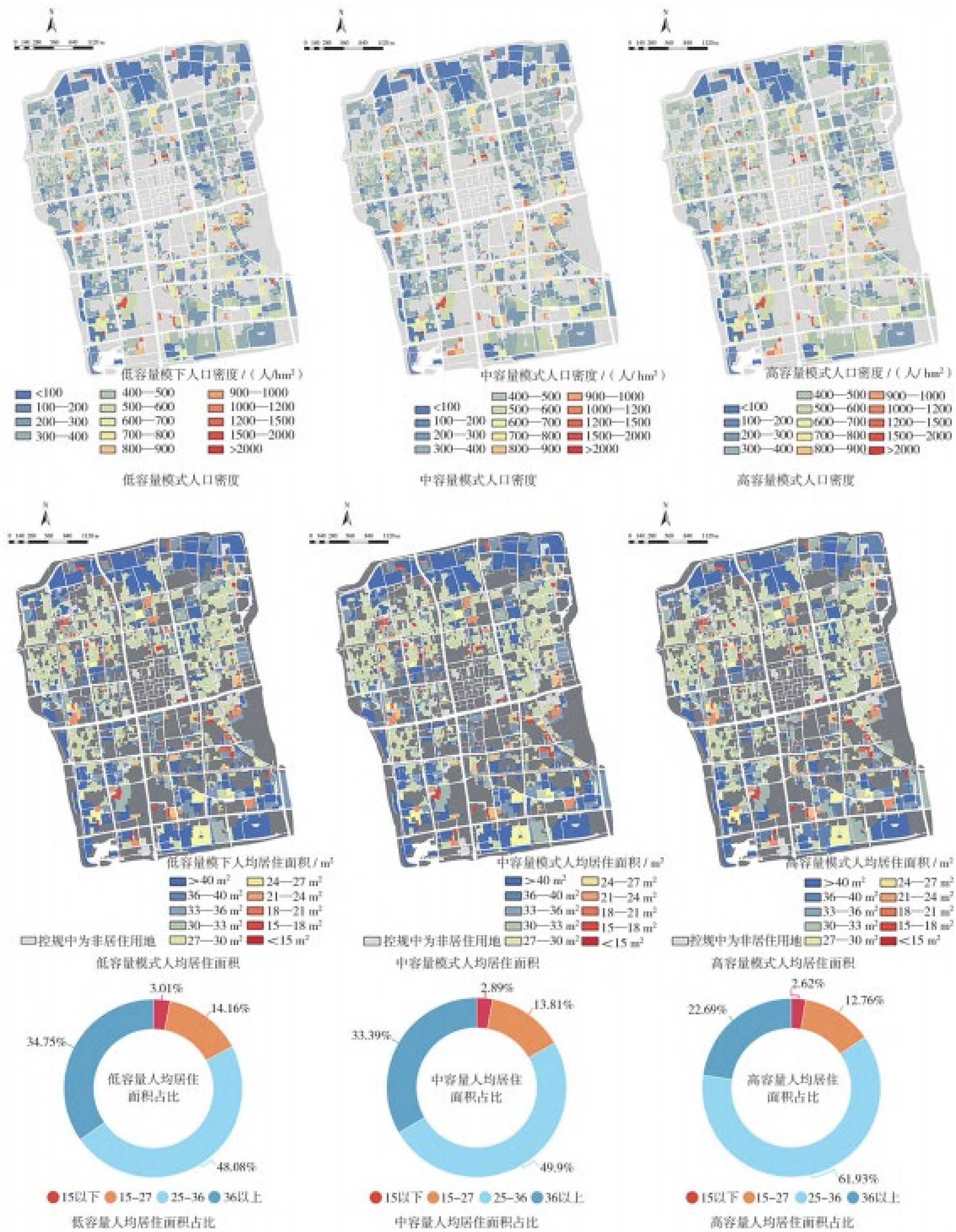

Figure 6: Population Density, Per Capita Residential Area Distribution, and Proportion under Low, Medium, and High Capacity Models

6 Conclusion

As we enter a new phase that emphasizes a people-centered approach and high-quality development, "people" have become the core element of ancient city protection and development. This paper addresses technical challenges such as the single focus and low precision of previous population capacity control targets for the ancient city. By analyzing and diagnosing the current issues related to population capacity and living environment quality, and considering the multi-dimensional goals of the ancient city's layout, traditional aesthetic preservation, improvement of living conditions, and vitality enhancement, a reasonable population capacity calculation model is developed. This model is designed to meet the needs of coordinated protection and development in the new era. Additionally, through the comparison and evaluation of high, medium, and low population capacity models, this paper proposes a population capacity adjustment and optimization plan and technical path, aiming to guide population capacity management in the ancient city in a more scientific, reasonable, and refined manner.

This research provides new perspectives and methods for the comprehensive calculation and optimization decision-making of population capacity in ancient cities, which is beneficial for the scientific, refined, and systematic advancement of the city's stock renewal work. Since population capacity control and guidance for the ancient city involves numerous factors and the actual situation is highly complex, continuous adjustment, correction, and improvement based on practice will still be required in the future. On one hand, the sample indicators for population capacity calculation and the dimensions and weights of population capacity decisions may vary due to regional differences in different study areas, and will need to be adjusted and corrected through extensive practical application to enhance the accuracy and universality of this calculation method. On the other hand, how to effectively implement and advance population capacity management in ancient city governance is an area that requires further exploration and research.

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