

Planning Sales-Based Affordable Housing Through Population-Employment-Housing-Land Matching: A Case Study of Guangzhou

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Abstract

The development of sales-based affordable housing (SBAH) is an important reform measure for strengthening China's housing security system, and its rational spatial layout is essential to improving the efficiency of public resource allocation. Taking Guangzhou as a case study and starting from the principle of job-housing balance, this paper constructs a parcel-scale technical method for SBAH layout based on population-employment-housing-land matching. On the demand side, an affordability-based demand model is used to identify groups with high, medium and medium-low levels of demand, and the estimates are calibrated with policy requirements and residents' purchase intentions to approximate real demand more closely. On the supply side, the paper systematically identifies unbuilt land and inefficient existing land, matches these resources with demand, and screens suitable parcels by incorporating service facilities, industrial platform distribution and population growth trends. The results show that parcels suitable for SBAH in Guangzhou are mainly concentrated in Science City, Tianhe Smart City and Smart Valley, Baiyun New City and related areas, forming a spatial pattern of "one ring and ten nodes" composed of an SBAH support ring around the old urban area and ten priority layout areas. The method provides an effective pathway for more precise SBAH siting and layout.

Keywords

Sales-based affordable housing; population-employment-housing-land matching; job-housing balance; spatial layout; Guangzhou

Introduction

Planning and constructing affordable housing is a major policy deployment made by the CPC Central Committee from the strategic perspective of advancing common prosperity and Chinese-style modernization. It helps alleviate housing tensions in large cities [1-2] and supports the orderly, effective transformation and high-quality development of the real estate sector. In August 2023, the *Guiding Opinions of the State Council on Planning and Constructing Affordable Housing* proposed the construction of affordable housing for sale, namely sales-based affordable housing. SBAH is essentially housing sold below market price and subject to closed management, targeted at wage-earning groups with housing difficulties and moderate incomes, as well as talent groups needed by cities. Guangzhou, Shanghai, Shenzhen and other cities have begun SBAH pilots, and spatial siting is a key link in implementation.

Past affordable housing projects have often been located far from employment centers [3-5], in peripheral areas [6-9], or in places with insufficient facilities [10-11]. Such spatial mismatch increases residents' time and economic costs, may intensify social conflict [12-14], affects equitable distribution of social resources [15-16], and wastes land and public fiscal resources [17]. Scientific SBAH layout has therefore become an important issue in housing security in the new era.

Research on SBAH remains at an early stage, whereas studies on traditional affordable housing are relatively mature. Existing studies focus on experience, policy and scale forecasting, including

international experience from Singapore, London and other cities [18-20], quantitative evaluation of affordable housing policies [2,21-22], and estimation of the supply scale [23-24] and proportion [25-26] of urban affordable housing using macro data such as resident population and income. Some scholars have also examined spatial layout by analyzing the locations [7,14], equity [27] and implementation effects [28] of completed projects, showing that affordable housing layout is a complex decision involving job-housing balance, employment demand and land use [14,29]. Others have proposed layout strategies based on real-world problems, domestic and international experience and quantitative evaluation [5,15,30-31]. However, existing research tends to focus on either supply or demand, with insufficient integrated consideration. Few studies examine supply-demand relations from a job-housing balance perspective, and most use city-level aggregate statistics rather than community- or parcel-scale spatial analysis, limiting their value for precise siting.

As a city with substantial population inflows, Guangzhou faces acute housing supply-demand tensions and tight land resources. Against the national push to construct SBAH, Guangzhou issued the *Administrative Measures for Sales-Based Affordable Housing in Guangzhou (Trial)* (hereafter the “Administrative Measures”) and related documents, and has been among the first cities nationwide to pilot SBAH construction and sales. Taking Guangzhou as a case, this paper constructs an SBAH layout framework based on job-housing balance and population-employment-housing-land matching. It quantifies housing demand by integrating employment distribution, income characteristics and housing prices, and then matches this demand with land supply to achieve precise matching at community and parcel scales. The aim is to provide decision support for scientific SBAH layout.

1 Sales-Based Affordable Housing: A Key Pillar of the New Housing Security System Combining Rental Allocation and Sales Allocation

China’s housing security system has evolved with urbanization. It moved from an early system combining rental and sales provision, to a rental-focused model, and then toward a more systematic and diversified dual-track system of rental allocation and sales allocation. Through successive forms such as economically affordable housing, low-rent housing, public rental housing and shared-ownership housing, the newly introduced SBAH has become a key pillar of the new housing security system and reflects an upgrading of housing security concepts.

1.1 First Stage (1994-2009): Initial Establishment of a Housing Security System Combining Rental and Sales Provision

To adapt to market-oriented economic reform and the housing needs of low- and middle-income households, the State Council issued the *Decision on Deepening Urban Housing System Reform* in 1994. It first proposed a dual system of economically affordable housing for low- and middle-income households and commercial housing for high-income households, clarifying the reform logic of coordinated development between affordable housing and commercial housing.

In 1998, the State Council issued the *Notice on Further Deepening Urban Housing System Reform and Accelerating Housing Construction*, which first introduced the concept of low-rent housing and identified low-rent housing for low-income households as a key focus of housing reform [1].

At this stage, through government allocation of land, China initially built an affordable housing supply system that combined rental and sales provision, with economically affordable housing and low-rent housing as the main components.

1.2 Second Stage (2009-2023): Rental Provision as the Focus and Expansion of Covered Groups

As urbanization accelerated and housing supply-demand tensions became more prominent, China gradually diversified its housing security system. In 2009, public rental housing was included in the government work report for the first time. In 2010, the Ministry of Housing and Urban-Rural Development issued the *Guiding Opinions on Accelerating the Development of Public Rental Housing*, emphasizing public rental housing to address the housing difficulties of urban low- and middle-income households, newly employed workers and migrant workers. In 2014, public rental housing and low-rent housing were merged into a unified security system.

In 2021, the State Council issued the *Opinions on Accelerating the Development of Affordable Rental Housing*, establishing a housing security system centered on public rental housing, affordable rental housing and shared-ownership housing, with rental provision as the main focus for strengthening housing support for new citizens, young people and other groups.

Shared-ownership housing, as an affordable housing form involving sales allocation, was first piloted in Huai'an, Jiangsu Province in 2007 and expanded to six pilot cities in 2014. It mainly targeted the "sandwich class", those ineligible for public rental housing yet unable to purchase commercial housing. Although it achieved some results, problems such as an incomplete management system and weak exit mechanisms limited wider promotion.

Overall, this stage was dominated by rental-oriented housing security. Flexible land supply and participation by multiple actors effectively alleviated housing difficulties among urban low- and middle-income households, new citizens and migrant workers, providing important support for healthy urbanization.

1.3 Third Stage (2023-Present): A Dual-Track System of Rental Allocation and Sales Allocation, Introducing SBAH and Emphasizing Rational Layout

With changing social demand, the earlier rental-centered housing security system has become insufficient for meeting diversified housing needs. In 2023, the State Council issued the *Guiding Opinions on Planning and Constructing Affordable Housing*, innovatively proposing SBAH and establishing, together with existing rental-based affordable housing, a new dual-track system of rental allocation and sales allocation. Guangzhou, Shanghai, Hangzhou, Chengdu, Kunming, Hefei and other key cities have responded actively by issuing detailed SBAH policies and starting construction.

Compared with major existing affordable housing types (Table 1), SBAH has four typical characteristics. First, ownership is fully sold to buyers, but the housing is subject to closed management and market circulation is restricted. Second, it emphasizes the employment attributes of beneficiaries, covering wage-earning groups with stable employment across industries and introduced talents aligned with urban development needs. Third, land supply is diversified. In addition to allocated state-owned construction land, low-efficiency land can be revitalized through urban village redevelopment and urban renewal. Fourth, SBAH stresses job-housing balance and requires integrated consideration of transport, public services and other supporting facilities.

These characteristics indicate four key requirements for spatial layout. First, real demand groups should be accurately identified through housing affordability under a full-ownership sales model. Second, housing should be closely linked to employment distribution, estimating the demand of different workers around employment locations under the principle of job-housing balance. Third, multiple land-supply safeguards should be provided, with emphasis on unbuilt land and idle or inefficient land. Fourth,

housing layout should be linked to urban development, public transport, public services, major industrial platforms and population growth trends, so that SBAH can help attract talent and improve residential quality.

Affordable housing type	Public rental housing	Affordable rental housing	Shared-ownership housing	Sales-based affordable housing
Supply method	Rental allocation	Rental allocation	Sales allocation	Sales allocation
Implementation scope	Nationwide	Large cities with net population inflows	Pilot cities first; other cities may proceed according to local conditions	Large cities with urban permanent population above 3 million take the lead
Target groups	Low- and middle-income households with housing difficulties; where conditions permit, newly employed workers and migrant workers may be included	New citizens and young people	Urban low- and middle-income households with housing difficulties, eligible rural migrants settling in cities and related groups	Wage-earning groups and introduced talent groups
Land support	Allocation, transfer, lease and equity contribution of state-owned construction land	Transfer, allocation and lease of state-owned construction land; collective commercial construction land; idle land owned by enterprises and institutions; supporting land in industrial parks	Mainly transfer of state-owned construction land	Mainly allocation of state-owned construction land; also lawfully recovered approved-but-unbuilt land, real estate bankruptcy disposal land, and idle or inefficient land
Housing ownership	Government-owned	Owned by the investor	Shared by buyers and government by shares	Owned by buyers

Affordable housing type	Public rental housing	Affordable rental housing	Shared-ownership housing	Sales-based affordable housing
Spatial layout requirements	As far as possible, located in areas with convenient transport and relatively complete public facilities	Industrial parks and surrounding areas, near rail transit stations and in key urban development areas	As far as possible, located in areas with convenient transport, complete facilities and sound functions	Following the principle of job-housing balance; priority to areas with convenient transport and relatively complete public facilities
Main policy basis	<i>Guiding Opinions on Accelerating the Development of Public Rental Housing</i> (Housing Security [2010] No. 87); <i>Measures for the Administration of Public Rental Housing</i>	<i>Opinions on Accelerating the Development of Affordable Rental Housing</i> (State Council General Office [2021] No. 22)	<i>Guiding Opinions on Developing Policy-Oriented Commercial Housing with Shared-Ownership Characteristics in Pilot Cities</i> (Housing Security [2014] No. 174)	<i>Guiding Opinions of the State Council on Planning and Constructing Affordable Housing</i> (State Council [2023] No. 14)

2 Research Framework and Methods

Given the spatial-layout requirements above, SBAH planning should follow the principle of job-housing balance and systematically integrate four types of elements: population, employment, housing and land. The population-employment-housing-land matching framework links these elements step by step to achieve precise coupling between demand and supply.

2.1 Population-Housing Matching: Building an Affordability-Based Demand Model

For SBAH allocation, the affordability of target groups is a key factor [16]. Internationally, the mortgage-to-income ratio is commonly used to measure housing affordability [32-33]:

Mortgage-to-income ratio = annual (monthly) mortgage repayment / annual (monthly) income. (1)

In general, a mortgage-to-income ratio of 30%-35% substantially affects living quality, and a ratio above 50% entails greater risk [34-36]. Under current Chinese requirements, mortgage expenditure should generally not exceed 50% of income. This study therefore sets two thresholds: a 35% stability line, above which households face a relatively heavy economic burden; and a 50% warning line, above which housing is unaffordable. Based on the practice of Guangzhou and many other cities, the price of SBAH is assumed to be about 50% of the price of commercial housing in the same location.

On this basis, the housing price-to-income concept is used to construct an SBAH demand model that classifies people into five groups. First, if the SBAH mortgage-to-income ratio is above 50%, the group has difficulty affording SBAH and is classified as extremely low demand. Second, if the SBAH mortgage-to-income ratio is above 35% but not above 50%, the group can afford SBAH but with a heavy burden and is classified as medium demand. Third, if the commercial-housing mortgage-to-income ratio is above 50% while the SBAH mortgage-to-income ratio is not above 35%, the group cannot afford commercial housing but can afford SBAH with a relatively light burden and is classified as high demand. Fourth, if the commercial-housing mortgage-to-income ratio is above 35% but not above 50%, the group can afford commercial housing with a heavy burden and may either buy commercial housing or purchase SBAH more comfortably; it is classified as medium-low demand. Fifth, if the commercial-housing mortgage-to-income ratio is not above 35%, the group can afford commercial housing relatively easily and is classified as having no demand.

2.2 Population-Employment Matching: Estimating Workers' Income by Industry

Enterprise data for Guangzhou, including industry, address and number of insured employees, were obtained from Qichacha and spatially geocoded through address lookup. Based on the *2023 Guangzhou Human Resources Market Wage Levels and 2022 Enterprise Labor Cost Information* report issued by the Guangzhou Human Resources and Social Security Bureau, wage levels by industry were collected at the 10th, 25th, 50th, 75th and 90th percentiles. Each enterprise was matched with the corresponding industry wage percentiles, and these five published values were used as known points to construct an approximate function linking workers' income to income percentiles for each enterprise.

2.3 Population-Employment-Housing Matching: Fine-Grained Identification of Demand

Commercial housing data in Guangzhou, including address, housing price, land area and building area, were obtained from Fang.com and spatially located. Communities were used as spatial units. The average commercial housing price of each community was calculated from the Guangzhou commercial housing data. Total housing price was then estimated using a per capita purchase area of 35 m² (note 1), and total loan amount was calculated using the standard that 85% of first-home purchase price can be financed (note 2). Annual repayments for buying commercial housing in each community were calculated under a 3% interest rate (note 3), a 30-year loan term and equal principal-and-interest repayment. The SBAH price was then set at half the commercial housing price, and annual repayments for SBAH were calculated in the same way.

Based on these repayments and the SBAH demand model, annual income thresholds P1, P2, P3 and P4 were calculated for different demand types in each community (Table 2). These thresholds were entered into the approximate income-percentile functions to obtain corresponding percentiles Q1, Q2, Q3 and Q4 (Fig. 1). With the number of employees as the base, the population size of each demand type was calculated for each enterprise and then aggregated by the community in which the enterprise was located.

Using affordability as the baseline, the calculation was further calibrated by incorporating policy orientation and purchase intention to improve the realism of demand estimates. Four conditions were added. First, beneficiaries should not own housing property, because both national policy and Guangzhou policy require SBAH to target people with housing difficulties. Second, beneficiaries should have Guangzhou household registration or be introduced talents. The Administrative Measures state that SBAH in Guangzhou is oriented toward eligible local registered households with housing difficulties

and wage-earning groups such as various types of introduced talents. Third, applications should be family-based. Under the Administrative Measures, unmarried, divorced or widowed local registered single applicants should be at least 30 years old, while talent households are not subject to this age limit. Fourth, beneficiaries should have an intention to buy. In a diversified housing supply system, some people who can afford purchase may choose to rent, and SBAH demand should therefore be understood as demand among people with clear purchase intentions. Based on these conditions and data availability, a technical procedure for correcting the number of demanded housing units was established (Fig. 2).

The calculation is expressed as:

$$T_i = N_i \times Y \times Z \times \{ H \times [D \times S + (1 - D) / 2] + (1 - H) \times [R \times D + (1 - D) / 2] \}. \quad (2)$$

In this formula, T_i is the number of units required by demand type i ; N_i is the theoretical population size of demand type i calculated from affordability; Y is the proportion of people in Guangzhou with purchase intentions, set at 40% (note 5); Z is the proportion of people in Guangzhou who do not live in housing owned by themselves or by family members, set at 50.18% (note 6); H is the proportion of Guangzhou registered population in the permanent population, set at 56.12% (note 7); D is the proportion of unmarried, divorced or widowed people among the employed population, set at 32.3% (note 8); S is the proportion of employed people above age 30, set at 59.51% (note 9); and R is the proportion of talents with bachelor's degree or above, set at 13.75% (note 10).

Threshold	Calculation method
P1	Annual SBAH repayment / 50%
P2	Annual SBAH repayment / 35%
P3	Annual commercial-housing repayment / 50%
P4	Annual commercial-housing repayment / 35%

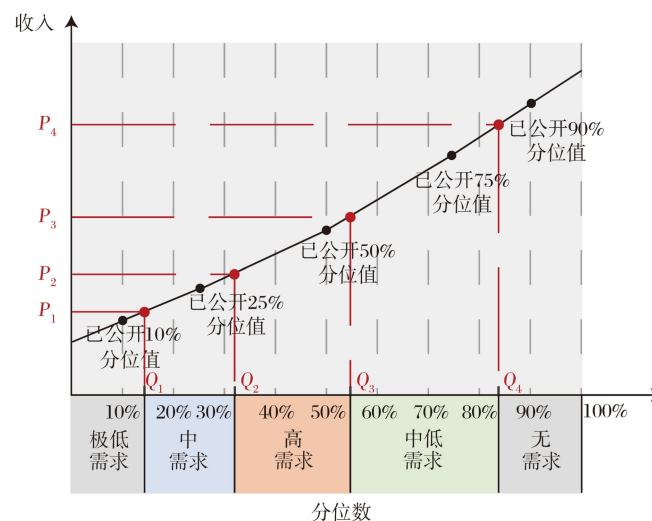


Fig. 1 Correspondence Between Income Thresholds and Percentiles for Populations with Different Demand Types

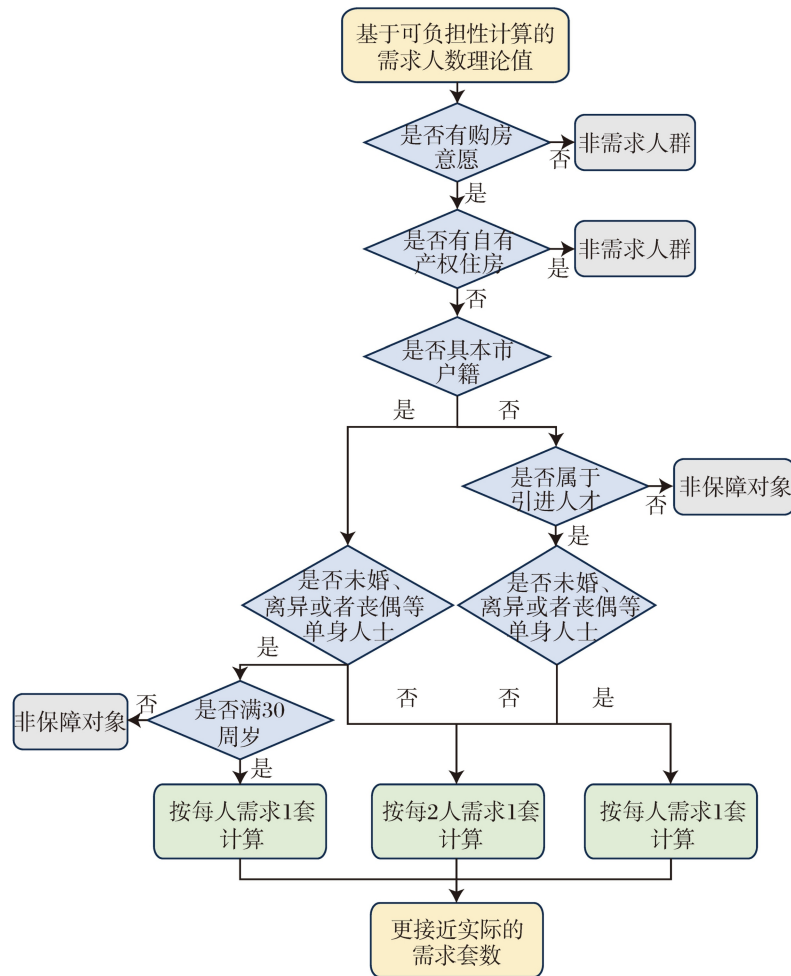


Fig. 2 Technical Block Diagram of Demand Unit Screening

2.4 Population-Employment-Housing-Land Matching: Overlaying Demand and Available Parcels

The study first screened residential land in Guangzhou's regulatory detailed planning database that satisfied rigid control requirements and had not yet been built. It then selected parcels from Guangzhou's inefficient land database whose redevelopment modes included reserve, expropriation, "three-old" redevelopment, land preparation, urban renewal and urban village redevelopment, and whose planned use under regulatory detailed planning was residential and met rigid control requirements. These parcels satisfied planning conditions and basic requirements for SBAH construction, forming the basic spatial land pool.

On this basis, the numbers of high-, medium- and medium-low-demand units within a 3 km range of each parcel were calculated. The three indicators were weighted and aggregated using expert scoring to derive an SBAH demand intensity index for each parcel. This identifies parcels that can better connect to demand and realizes population-employment-housing-land matching.

Finally, based on the demand and supply analysis, the study further incorporated urban development orientation, population agglomeration potential, public transport and public-service facilities to identify parcels suitable for planning and siting. It also proposes strategies for timing and implementation pathways, providing detailed and actionable references.

3 Spatial Distribution of SBAH Demand and Potential Supply in Guangzhou

3.1 Spatial Distribution of SBAH Demand in Guangzhou

Because community area affects both population counts and housing-demand counts, this study uses the density of demanded units at the community level to reflect the spatial distribution of SBAH demand. For the high-demand group, the highest densities occur in Zhujiang New Town and the Financial City area in southern Tianhe District and the southern part of Yuexiu District. Secondary high-density areas include northwestern Haizhu District, Baiyun New City and surrounding areas in Baiyun District, eastern Liwan District, the southern Science City area in Huangpu District, Shiqiao and Wanbo in western Panyu District, and Jiaomen River in Nansha District (Fig. 3).

The spatial distributions of medium-demand and medium-low-demand unit densities are similar to that of high demand. Higher densities are again found in Zhujiang New Town and Financial City in southern Tianhe and southern Yuexiu, followed by northwestern Haizhu, Baiyun New City and surrounding areas, eastern Liwan, southern Science City in Huangpu, Shiqiao and Wanbo in western Panyu, and Jiaomen River in Nansha. The difference is that communities with medium-level density among the medium-demand group are more concentrated, and densities decrease overall in outer districts such as Huadu, Zengcheng and Conghua. By contrast, communities with medium-level density among the medium-low-demand group spread farther outward, with more distribution in Huadu, Conghua, Zengcheng and Nansha.

Overall, areas with high demanded-unit density are mainly concentrated in the central urban area and in parts of Panyu and Nansha where population and industry are relatively concentrated and housing prices are relatively high.

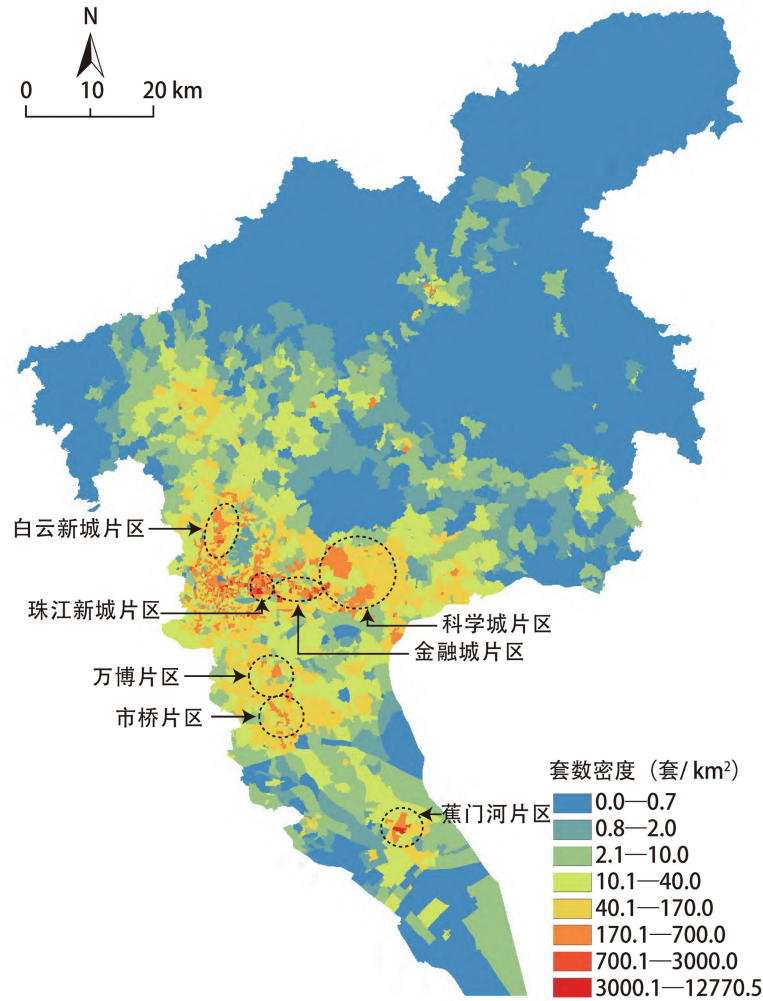


Fig. 3 Density Map of SBAH Units Demanded by High-Demand Groups in Guangzhou Communities

3.2 Spatial Distribution of Potential SBAH Supply in Guangzhou

By screening available parcels from Guangzhou's regulatory detailed planning database and inefficient land database, and overlaying them with the SBAH demand intensity index, the study derives the potential spatial distribution of SBAH supply. After overlay with demand intensity, unbuilt land shows a ring-like pattern. Liwan, Tianhe, Haizhu, southern Huangpu and southwestern Baiyun in the central urban area form an inner ring of high demand intensity, while Jiaomen River in Nansha and central Huadu also form small inner rings with high demand intensity. Overall, demand intensity diffuses from the inner rings toward the periphery. In comparison, because existing land parcels already show small-area agglomeration and are more often located in densely populated and mature built-up areas, their corresponding demand intensity is generally higher (Fig. 4).

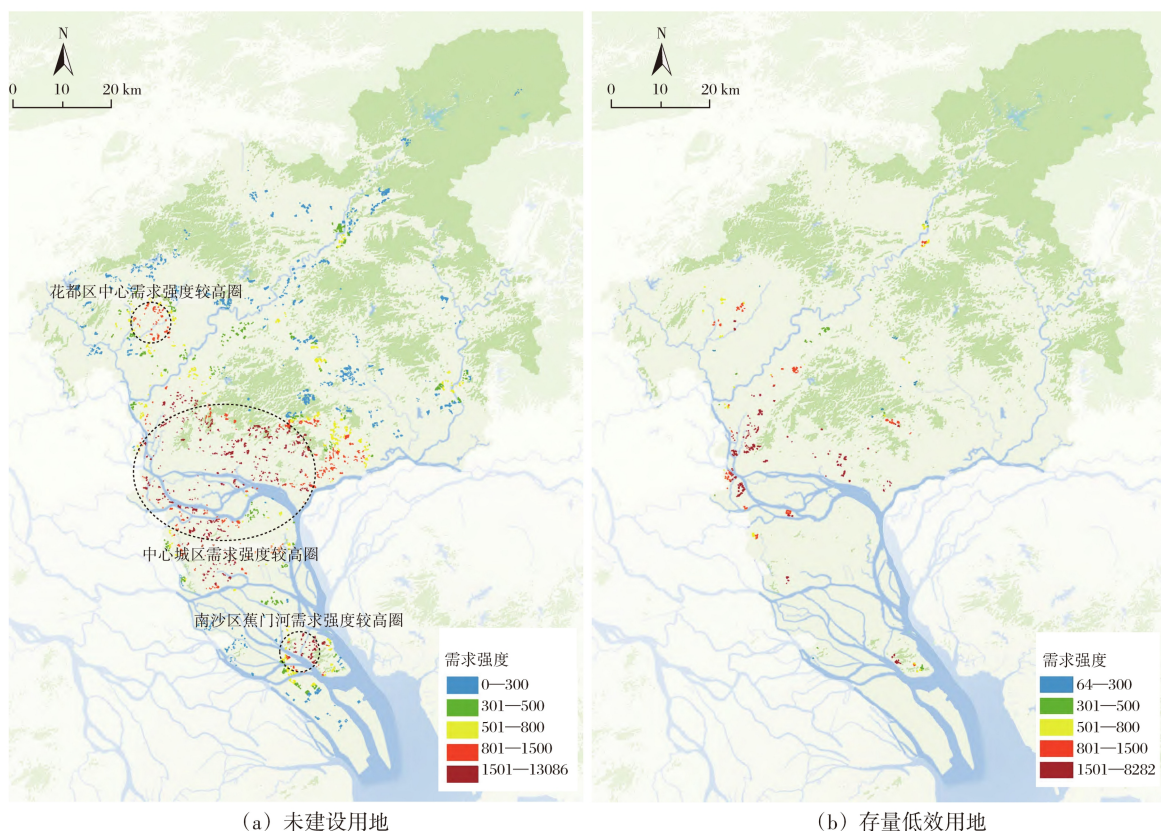


Fig. 4 Distribution of Unbuilt Land and Inefficient Existing Land Corresponding to Different Demand Intensities

4 Discussion of Spatial Layout Strategies for SBAH in Guangzhou

4.1 Planning and Siting

As an important carrier for optimizing urban spatial structure and promoting social integration, SBAH siting is a complex decision requiring coordination among multiple factors. It should reflect a systematic and structural planning logic. Based on identified supply parcels and housing demand intensity, SBAH siting should be further aligned with urban development strategies and major platform layouts, while considering future population agglomeration and public-service facilities, so as to achieve a scientific and rational spatial allocation.

Specifically, available parcels were overlaid with service-facility levels, industrial platform distribution and population growth trends, together with actual demand, to construct the SBAH spatial layout and screen relatively suitable supply parcels. Three conditions were used. For service facilities, an indicator system was established (Table 3), and parcels satisfying five or more indicators were selected. For industrial platform distribution, parcels located within or within 1 km of key industrial platforms were selected. For population growth, population growth rate from the Sixth to the Seventh National Population Census was overlaid, and parcels with growth rates of at least 1.5% were selected. After overlaying these conditions, parcels with higher SBAH demand intensity were further screened to form a land-supply guidance map (Fig. 5). Suitable unbuilt land is mainly distributed in Science City, Tianhe Smart City and Smart Valley, northern Baiyun New City, and the Artificial Intelligence and Digital

Economy Pilot Zone. Suitable inefficient existing land is mainly distributed in Tianhe Smart Valley, northern Science City, Bai'etan Business District and Baiyun New City.

By integrating suitable unbuilt land and inefficient existing land with the urban spatial structure and development orientation, Guangzhou can form an SBAH layout structure of “one ring and ten nodes” (Fig. 6). The “one ring” refers to an SBAH support ring around the old urban area, linking multiple priority layout areas. It is a dense SBAH layout belt and an important belt for population growth and new industrial agglomeration. The “ten nodes” refer to priority SBAH layout areas, including Science City, Tianhe Smart City and Smart Valley, Baiyun New City, Bai'etan Business District and the Eastern Hub area. These areas have high SBAH demand and relatively abundant suitable land resources, making them key areas for strong supply-demand linkage and population-employment-housing-land matching.

No.	Indicator	Calculation method
1	Metro station reachable within 1,000 m	Whether a metro station exists within the 1,000 m buffer of the parcel
2	Park or green space reachable within 1,000 m	Whether a park or green space exists within the 1,000 m buffer of the parcel
3	General hospital reachable within 1,000 m	Whether a general hospital exists within the 1,000 m buffer of the parcel
4	Primary or secondary school reachable within 1,000 m	Whether a primary or secondary school exists within the 1,000 m buffer of the parcel
5	Large commercial facility reachable within 1,000 m	Whether a large commercial facility exists within the 1,000 m buffer of the parcel
6	Cultural facility reachable within 1,000 m	Whether a cultural facility exists within the 1,000 m buffer of the parcel
7	Sports venue reachable within 1,000 m	Whether a sports venue exists within the 1,000 m buffer of the parcel

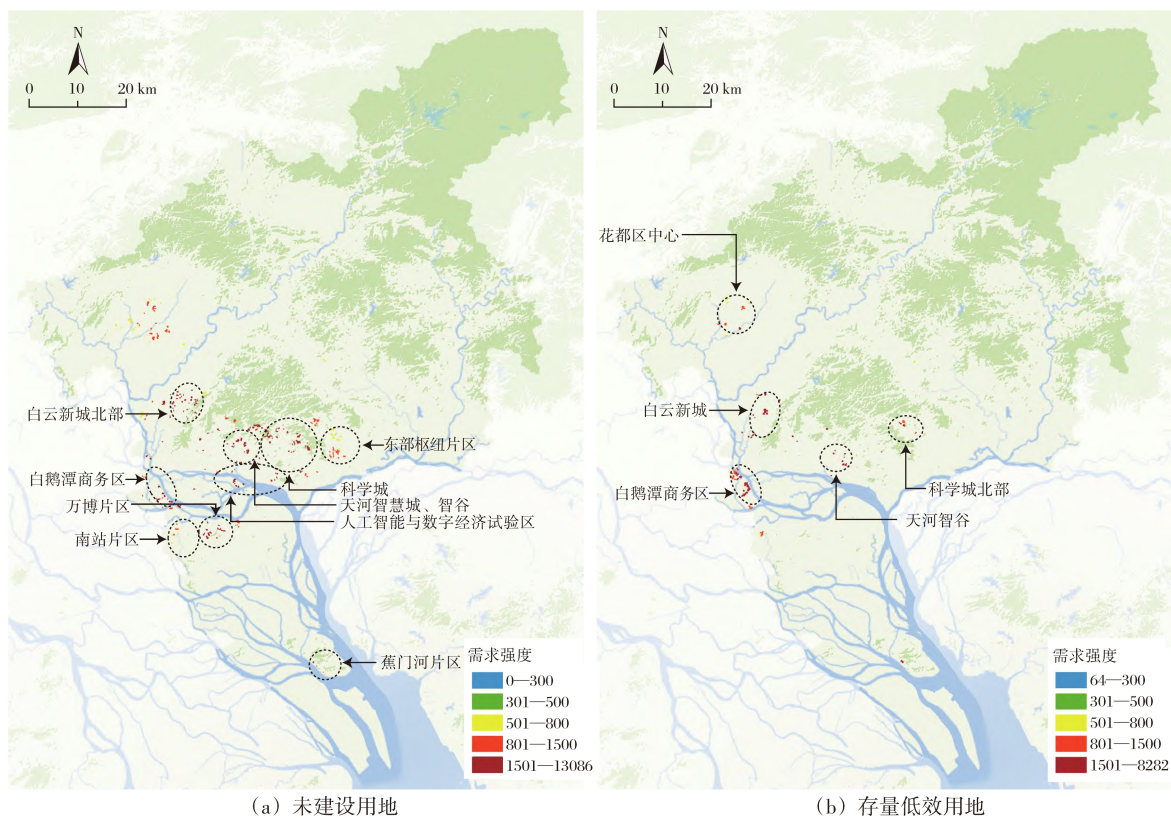


Fig. 5 Distribution of Unbuilt Land and Inefficient Existing Land Suitable for SBAH Development



Fig. 6 Layout Structure of Sales-Based Affordable Housing

4.2 Timing Arrangement

For parcels suitable for supply, implementation timing should consider development cost, the absorption cycle of nearby commercial housing, and construction progress of major surrounding projects. In the short term, priority should be given to unbuilt land located within or near relatively mature major platforms, with short commercial-housing absorption cycles, completed land reserve or clear ownership, and conditions for rapid construction, as well as inefficient existing land already included in annual urban renewal plans. These parcels can support rapid supply.

In the medium term, supply should focus on unbuilt land within or near major platforms whose construction is gradually accelerating and where some time or economic cost is needed for reserve, as well as inefficient land in urban renewal plan areas where renewal will be advanced progressively. In the long term, parcels with higher implementation costs and longer nearby absorption cycles can be considered gradually. At the same time, timing should be adjusted based on the citywide SBAH waiting

list, population changes, industrial layout adjustment and planning revision, ensuring that housing supply remains accurately and continuously aligned with the pace of urban development.

4.3 Implementation Pathways

To systematically promote SBAH construction, several land-support measures can be adopted. First, construction land planned for SBAH should be included in the annual land supply plan and supplied with priority, using allocation methods to control costs. Second, suitable unreserved land for near-term construction should be included in reserve plans in advance, with active efforts to obtain support from special bonds for land reserve. Third, in appropriate urban renewal projects about to be implemented, graded requirements for SBAH supporting construction should be set. Projects in central urban areas, around rail transit stations and near well-developed industrial platforms may appropriately increase their affordable-housing supporting ratios. Fourth, suitable idle and inefficient land should be revitalized more quickly.

In planning approval, a convenient channel should be established for adjusting SBAH land-use planning indicators, and approval procedures for floor-area ratio, green-space ratio and related indicators should be optimized to improve efficiency. In addition, existing housing with long absorption cycles can be purchased as supplementary SBAH supply, enabling rapid supply during market adjustment. Through a diversified model of new supply, stock redevelopment and market purchase, Guangzhou can build a sustainable and healthy SBAH supply system.

5 Conclusion

Using Guangzhou as a case and the concept of job-housing balance as a starting point, this study constructs an SBAH layout framework based on population-employment-housing-land matching. It builds an affordability-based demand model, calibrates demand estimates with policy requirements and residents' willingness, and systematically identifies unbuilt land and inefficient existing land on the supply side. By matching land supply with demand and incorporating service facilities, industrial platform distribution and population growth trends, it screens suitable parcels and provides refined, implementable references for SBAH siting. The approach has strong practical significance.

The study finds that parcels in Guangzhou that match demand and satisfy conditions related to service facilities, industrial platforms and population growth are mainly distributed in Science City, Tianhe Smart City and Smart Valley, Baiyun New City, Bai'etan Business District, the Artificial Intelligence and Digital Economy Pilot Zone, Wanbo area and the Eastern Hub area. Together, these areas form ten priority layout areas and an SBAH support ring around the old urban area, producing a spatial pattern of "one ring and ten nodes."

Many Chinese cities are currently carrying out SBAH construction. The technical method developed in this article has broad applicability and can be extended to other cities as a reference for SBAH practice. As housing prices, residents' income structures and urban planning strategies continue to evolve, future research can use updated data within this model to provide more timely and precise support for decision-making. It should also be noted that this study is constrained by data availability. Employment numbers are estimated from enterprise insured-employee and size information, and registered enterprise addresses are used as enterprise locations. With more data channels in the future, more detailed and direct data can be introduced for further research.

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Notes

1. Data from the Ministry of Housing and Urban-Rural Development show that by the end of 2023, per capita urban housing floor area in China exceeded 40 m². Because housing in Guangzhou, as a megacity, is relatively compact, the study sets per capita purchase area at 35 m².
2. In May 2024, the minimum down payment ratio for first-home purchases in China was reduced to no less than 15%.
3. In 2024, first-home mortgage interest rates in Guangzhou were generally around 3%.
4. In the technical process for correcting housing-unit counts, non-single groups are calculated as one unit per two people. The model takes wage-earning groups as the base, which are mainly young and middle-aged adults and exclude children and the elderly. This corresponds to the policy requirement that SBAH be applied for by household. Because couples may apply for one SBAH unit, non-single groups are calculated as one unit per two people.
5. Based on the “2024 Online Survey on Guangzhou Homebuyers’ Mentality and Consumption Outlook” organized by the real estate channel of ifeng.com, the proportion of people in Guangzhou with purchase intentions is set at 40%.
6. According to data from the Seventh National Population Census, the proportion of Guangzhou residents not living in housing owned by themselves or by family members is 50.18%.
7. According to Guangzhou Municipal Statistics Bureau data, registered population accounts for 56.12% of Guangzhou’s permanent population.
8. Guangzhou has not published the relevant proportions of unmarried, divorced or widowed people, so Guangdong Province data are used as reference. According to the *China Statistical Yearbook 2023*, among people aged 15 and above in Guangdong, 26.6% are unmarried, 2% are divorced and 3.7% are widowed, yielding a combined proportion of 32.3%. This is used as a proxy for the proportion of unmarried, divorced or widowed people in Guangzhou’s employed population.
9. According to data from the Seventh National Population Census, 59.51% of Guangzhou’s employed population is over 30 years old.
10. According to data from the Seventh National Population Census, 13.75% of Guangzhou’s employed population has a bachelor’s degree or above.

References

- [1] Liu Manjun, Wu Jiangyuan. Reflections on the development of affordable housing in Futian District, Shenzhen under the new context [J]. *Housing and Real Estate*, 2024(33): 6–11.
- [2] Zuo Jin, Zhang Hailing, Su Wei, et al. Comparative study on China’s urban rental housing supply system: a perspective based on housing planning policies [J]. *Journal of Western Human Settlements*, 2024, 39(5): 80–87.
- [3] Guo Di, Li Jin, Wang Zheng. Spatial distribution characteristics and optimization strategies of affordable housing in Nanjing [J]. *Modern Urban Research*, 2011, 26(3): 83–88.
- [4] Lin Taizhi, Zhu Qiushi. Planning mechanisms of affordable housing from the perspective of land banking [J]. *Planners*, 2014, 30(12): 25–29.

- [5] Yang Jing, Zhang Song, Wang Dongning. Research on location strategies of affordable housing [J]. *City Planning Review*, 2009(12): 53–58.
- [6] Zhang Xuwen. Research on effective supply of affordable housing in China [D]. Jiangxi University of Finance and Economics, 2021.
- [7] Liu Jianshi. Reflections on spatial location of large-scale affordable housing communities [J]. *Modern Urban Research*, 2016(12): 98–104.
- [8] Li Ye, Jiao Yixue, Gao Heng, et al. Research on the construction status and characteristics of affordable housing in China [J]. *Urban Development Studies*, 2020, 27(7): 19–25.
- [9] Yu Yifan, Li Jijun. The dual marginalization trap of affordable housing [J]. *Urban Planning Forum*, 2013(6): 107–111.
- [10] Liu Ze, Xing Haifeng. Spatial location of affordable housing from a planning management perspective [J]. *City Planning Review*, 2013, 37(7): 73–80.
- [11] Wang Chenghui, Zhang Yuting. Optimization of public facility provision mechanisms in large affordable housing communities [J]. *Urban Planning Forum*, 2017(2): 96–103.
- [12] Yang Hongping, Song Weixuan. Problems and solutions of spatial distribution of affordable housing: a case study of Nanjing [J]. *Urban Problems*, 2012(3): 49–53.
- [13] Zheng Siqi, Zhang Yingjie. Spatial location of affordable housing: theoretical foundations, international experience and China's reality [J]. *Modern Urban Research*, 2010, 25(9): 18–22.
- [14] Zhu Wenjian, Deng Yuanyuan, Li Xingxing. Discussion on spatial layout of affordable housing under rail transit commuting: observations from Shenzhen [J]. *City Planning Review*, 2023, 47(3): 85–96.
- [15] Ding Xu. Suitability evaluation and spatial location choice of affordable housing: a case study of Hangzhou [J]. *City Planning Review*, 2012, 36(9): 70–76.
- [16] Yang Fan, Zhang Xiuning, Wang Jiayin. Spatial distribution and formation mechanism of affordable housing in urban central areas [J]. *Shanghai Urban Planning Review*, 2023(5): 79–85.
- [17] Li Fengqing, Zhao Min. Spatial performance of housing development in polycentric metropolitan areas: a study of Chongqing and further discussion [J]. *Urban Planning Forum*, 2011(3): 8–19.
- [18] Li Wenshuo. Transformation of affordable housing policy in New York City in the 1970s–1980s and its impacts [J]. *World History*, 2021(5): 22–36.
- [19] Lv Cheng, Chen Youhua. Practice of shared ownership housing in the UK and its implications [J]. *City Planning Review*, 2023, 47(11): 123–132.
- [20] Zhang Zuo, Zhu Jieming, Li Jiangfeng. Spatial organization and distribution of large-scale public housing in Singapore [J]. *Urban Planning Forum*, 2010(1): 91–103.
- [21] Li Fang, Rao Dan, Yang Siqi, et al. Quantitative evaluation of affordable rental housing policy [J]. *Urban Problems*, 2022(9): 65–75.
- [22] Zhou Boying, Zhang Lu. Evaluation methods and indicator system of housing security policies [J]. *Urban Development Studies*, 2020, 27(11): 111–117.
- [23] Xiang Weimin, Peng Lijuan. Appropriate scale of affordable housing in Chongqing from a supply-demand perspective [J]. *Chongqing Social Sciences*, 2014(8): 40–46.
- [24] Mou Lingling, Lv Limei, Jia Qing, et al. Demand forecasting of affordable housing based on income threshold in Hebei Province [J]. *Journal of Hebei University of Technology (Social Science Edition)*, 2016, 8(3): 25–32.
- [25] Xu Jiajun. Forecast and analysis of reasonable supply scale of affordable housing: a case study of

Shaoguan City [J]. Economic Research Guide, 2018(17): 106–109.

[26] Liu Zitan. Forecasting and policy study on the scale of affordable housing in Beijing [D]. Beijing University of Civil Engineering and Architecture, 2023.

[27] Shi Hao, Meng Weijun. Spatial layout strategy of urban affordable housing based on social equity [J]. Journal of Chongqing Jiaotong University (Natural Science), 2013, 32(1): 173–176.

[28] Ling Li. From “spatial mismatch” to “spatial adaptation”: analysis of factors influencing affordable housing site selection in Shanghai [J]. Shanghai Urban Planning Review, 2011(3): 58–61.

[29] Cheng Zhuo, Xiao Yong. Research on spatial location of affordable housing in China [J]. Planners, 2015, 31(Suppl. 1): 254–259.

[30] Zhang Jigang, Yang Feng, Zhang Xiaolin. Site suitability evaluation and layout strategy of affordable housing in Shenzhen based on multi-source data [J]. Special Zone Economy, 2019(6): 18–23.

[31] Yu Yang, Zong Yu. Spatial layout of affordable housing in Xi'an based on the living needs of low-income groups [J]. Journal of Xi'an University of Architecture and Technology (Natural Science), 2023, 55(6): 858–870.

[32] Freeman A, Chaplin R, Whitehead C. Rental affordability: a review of international literature [R]. Cambridge: Proper Research Unit, University of Cambridge, 1997.

[33] Robinson M, Scobie G M, Hallinan B. Affordability of housing: concepts, measurement and evidence [R]. Wellington: The Treasury, 2006.

[34] Tang Yin. Study on the impact of house price-to-income ratio on consumption of urban middle-income households [D]. Hangzhou: Zhejiang University of Science and Technology, 2024.

[35] Chen Xin, Ren Wenlong, Zhang Suyuan. Impact of mortgage pressure of middle-income households on cultural consumption: empirical analysis based on CFPS 2016 [J]. Fujian Tribune (Humanities and Social Sciences), 2019(12): 71–81.

[36] Su Duoyong, Zhang Zuguo. Research status and development improvements of house price-to-income ratio: empirical analysis based on Shanghai real estate market [J]. Science and Management, 2009, 29(1): 60–63.

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