

# Spatial Distribution Characteristics and Coverage Rate of Commercial Facilities in 15-minute Radius Livelihood Service Circles of Chunshu Street

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**Abstract** Building a 15-minute radius livelihood service circle from the needs of residents is a top-down process of optimizing urban layout and promoting high-quality development implemented by the government. In September 2022, Xicheng District of Beijing served as a national pilot of the 15-minute radius livelihood service circle. Based on the data of POI, urban walking network and building outline, this paper studies the coverage of commercial service facilities in the 15-minute radius livelihood service circle of Chunshu Street by using kernel density analysis and urban network analysis tools. The research shows that the commercial facilities are concentrated in Zhuangsheng Square and Dazhalian commercial district. There are large gaps in housekeeping and couriers logistics facilities, which need to be further improved.

**Keywords** Chunshu Street, 15-minute radius livelihood service circle, POI, Historic urban areas, Community business

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The 19<sup>th</sup> Party Congress put forward the important spirit of “people-centeredness, and striving to realize the people’s aspirations for a better life”<sup>[1]</sup>. In August 2022, the Ministry of Commerce, the Ministry of Housing and Urban-Rural Development and other 10 departments collaboratively announced the pilot list of the second batch of national 15-minute radius livelihood service circles (hereinafter referred to as “livelihood service circle”), and Xicheng District of Beijing ranked among them. Community business is an important part of livelihood service circle. In November 2022, the *Special Planning of Beijing Commercial Districts (2022–2035)* was officially released, proposing the construction of a “four-level and two-type multidimensional” commercial consumption space system in the city. The plan aims to form a four-level commercial consumption space structure comprising of “international consumption experience area, urban consumption center, regional dynamic consumption circle and community livelihood service circle”, serving the multi-level consumption needs of the public.

In order to solve the problem of urban-rural imbalance, the Japanese government first put forward the concept of “wide area living circle”<sup>[2]</sup>, which is the primitive concept of livelihood service circle. Influenced by Japan, South Korea takes livelihood service circle as an important basis for spatial classification of residential areas<sup>[3]</sup>. The earliest practice of China’s livelihood service circle was carried out in Taiwan, aiming at achieving balanced regional development and improving residents’ quality of life<sup>[4]</sup>. In recent years, people’s demand for the quality of living environment and living

services has further improved, and the theory of human-centered livelihood service circle has appeared in the field of urban construction, with the introduction of relevant regulations and norms and the practice of livelihood service circle construction being carried out one after another. In 2018, the Ministry of Housing and Urban-Rural Development released the *Urban Residential Area Planning and Design Standard (GB5018–2018)*, with a hierarchical division of “5-minute living area, 10-minute living area, 15-minute living area” instead of the past grading model of “residential area, residential district, residential group”. Taking people’s walking time as the starting point of facility grading and supporting, residents can meet the corresponding living service needs within the appropriate walking time, which is convenient to guide the reasonable layout of various supporting facilities.

Community business originated in the United States in the 1950s, when suburban highways were developed, family cars were popular, and a large number of urban residents spread to the suburbs. Under such background, community business came into being for the convenience of people’s life<sup>[5]</sup>, and the community business was mainly based on shopping centers at that time.

China’s high-speed urbanization has promoted the development of community business, and its development has mainly gone through three stages. Before the 1980s, China implemented a planned economy. The State planned the distribution and dispensing of goods needed by residents through commodity distribution points in rural or urban areas,

which became the original community business. With the development of urbanization and the influx of large numbers of people from rural areas into cities, the state began to open up the right to develop housing, and the development of housing accelerated the development of community business. In the late 1990s, in the process of real estate development, a large number of street stores providing residents with daily life consumption were created, forming the prototype of community business. After entering the 21<sup>st</sup> century, the transformation of residents’ lifestyles has led to an increase and diversification of consumer demand, and the development of community business has been emphasized in large and medium-sized cities. Relevant departments have issued the 14<sup>th</sup> *Five-Year Plan for the Construction of Urban and Rural Community Service System, Special Planning of Beijing Commercial Districts (2022–2035)*, etc., and the construction of community business is in full swing.

## 1 Study area and research ideas

### 1.1 Study area

Taking Chunshu Street in Xicheng District of Beijing as the research object, this paper studies the commercial facilities of community in livelihood service circle. Chunshu Street, with a total area of 1.1 km<sup>2</sup>, borders with South Xinhua Street and Dazhalian Street in the east, Luomashi Street and Taoranting Street in the south, Xuanwumenwai Street and Guang’anmennei Street in the west, and Xuanwumen East Street and West Chang’an Street in the north. The residential area consists of 11 residential areas, 1 historic and cultural block and 2 other traditional cottage

areas (Fig.1).

## 1.2 Research ideas

The research ideas are as follows: ① obtaining the POI (Point of interest) of various facilities, administrative boundaries of Dongcheng District and Xicheng District, district boundaries of Chunshu Street, and road networks of core urban areas, and constructing a spatial database of Chunshu Street based on the GIS platform for geographic alignment; ② delineating Chunshu Street livelihood service circle; ③ studying the spatial distribution characteristics of commercial facilities via kernel density analysis; ④ studying the coverage and compliance rate of various commercial facilities via network analysis; ⑤ raising the optimization strategy for the layout of commercial service facilities in the livelihood service circle of Chunshu Street accordingly.

## 2 Data acquisition and processing

The administrative boundary data of the east and west urban areas used in this study came from the website of the Beijing Municipal Government without processing; the settlement boundary data came from Anjike, which was cropped using the administrative boundary of Chunshu Street to obtain the residential area distribution layer of Chunshu Street; the road network data came from Amap, which removed roads that can not be passed by pedestrians, such as highways and expressways, leaving the roads that can be passed by pedestrians, such as urban branch roads, pedestrian streets, and pedestrian bridges; the building outline data came from Amap, without processing; the POI data were all from Amap; the POIs were imported into GIS and cropped with the boundaries of Chunshu Street livelihood service circle to see if the entrances and exits of the buildings at the boundaries were within the range, and the POIs inside the buildings whose entrances and exits at the boundaries were outside of the range were deleted and the remaining data were retained. At this point, the required dataset was successfully established.

## 3 Delineation of livelihood service circle and classification of commercial facilities

### 3.1 Delineation of the livelihood service circle of Chunshu Street

There are some differences in the walking speed of different groups of people. According to the research of Jing Chao<sup>[6]</sup>, the walking speed of children ranges from 4.68 to 5.22 km/h, that

of middle-aged and young people ranges from 3.3 to 4.7 km/h, and that of the elderly ranges from 2.7 to 3.42 km/h. Considering the walking speed of the elderly, children and other people who are not easy to travel, the average walking speed was set to 3.6 km/h. Starting from the geographic center of the residential unit, the 15-minute range of walking was calculated and merged<sup>[7]</sup> to obtain the range of the livelihood service circle of Chunshu Street (Fig.2).

### 3.2 Classification of community commercial facilities

According to the current standard *Setting and Functional Requirements for Community Commercial Facilities* (GB/T 37915-2019) issued by the Ministry of Commerce of the People's Republic of China, community business is classified into shopping service formats and life service formats, including convenience stores, restaurants, cleaning services and other formats, and the scale of different levels of community business is defined. Based on the above provisions, the commercial facilities within the livelihood service circle of Chunshu Street are categorized into three divisions of shopping services, catering services, and life services, containing 12 groups such as convenience stores, supermarkets, Chinese restaurants, beauty salon, and so on. There are 67 convenience stores, 18 supermarkets, 33 composite markets, 7 shopping malls, 182 Chinese restaurants, 11 fast-food restaurants, 51 foreign restaurants, 85 casual restaurants, 94 beauty salons, 23 repair and care stores, 6 housekeeping services, and 26 couriers logistics in the livelihood service circle of Chunshu Street.

## 4 Spatial distribution characteristics of commercial facilities

### 4.1 Kernel density analysis

Kernel density analysis was conducted separately for shopping service facilities, catering service facilities, and life service facilities within the livelihood service circle of Chunshu Street (Fig.3).

### 4.2 Spatial distribution characteristics of commercial facilities

From the overall spatial distribution of shopping service facilities, the four types of shopping facilities are characterized by overall dispersion, local aggregation, dense in the west and sparse in the east, dense in the south and sparse in the north, and there are great differences in the spatial distribution of various facilities. The overall spatial distribution of convenience stores presents the characteristics of multi-core, namely A1 gathering point located

in Zhuangsheng Square, A2 and A3 gathering points located in Dazhalan Commercial Street. The distribution of composite markets forms two significant cores, namely A2 gathering point located in the business district of Dazhalan Street and A4 gathering point located in Taoranting Street. Supermarkets and shopping malls are limited in number and do not show obvious gathering zones. The distribution of supermarkets is mainly concentrated in A3 gathering point of Tianqiao Street on the southeast side of Chunshu Street, while the shopping malls are mainly concentrated in A1 gathering point of Zhuangsheng Square and A3 gathering point of Dazhalan Commercial Street.

From the overall spatial distribution, catering service facilities show the distribution characteristics of "two cores and multiple points". The "two cores" are B1 gathering point located in Zhuangsheng Square and B2 gathering point located in Dazhalan Street. Among them, Chinese restaurants are mainly concentrated in B2 gathering point, foreign restaurants and fast-food restaurants are mainly concentrated in B1 gathering point, while casual restaurants are distributed dispersively at various points, with more concentrated points in B1 Zhuangsheng Square.

From the perspective of overall spatial distribution, the life service facilities show multi-core spatial distribution characteristics, namely C1 gathering point located in Zhuangsheng Square, C2 gathering point located in the north side of Taoranting Street, and C3 gathering point in the northwest side of Tianqiao Street. The centralized distribution points of beauty salon facilities, repair and care facilities and couriers logistics facilities show a high spatial fit with the gathering points of the whole district. There are less housekeeping facilities, mainly distributed in C2 gathering point of Taoranting Street.

## 5 Coverage of commercial facilities

### 5.1 Coverage standard of commercial facilities

When shopping service facilities, catering service facilities, and life service facilities are within the scope of the livelihood service circle of a neighborhood, they can be considered as covered. Considering that there is a functional substitutability of the groups under a division, the following criteria for defining the coverage are made: delimiting the 15-minute walking range with the geographical center of the community. ① Shopping services: there must be at least one convenience store, and at least one supermarket,

composite market or mall facility that meets the requirements. ② Catering services: there must be Chinese and fast food restaurants, and at least one foreign or casual dining restaurant. ③ Life services: beauty salon facilities, repair and care facilities, housekeeping facilities, and couriers logistics facilities are all indispensable. According to the *Setting and Functional Requirements for Community Commercial Facilities* (GB/T 37915-2019), the five facilities, namely, convenience stores, Chinese restaurants, fast-food restaurants, housekeeping services, and couriers logistics services, should be within a 10-minute walking distance of the residential area. The coverage of various facilities is represented by “coverage rate”, which is calculated as the ratio of the number of residential buildings covered by various service facilities to the total number of residential buildings, with a higher coverage ratio indicating that more residential buildings have access to that type of service facility<sup>[8]</sup>.

### 5.2 Coverage of various commercial facilities

According to the above analysis, the scope of 10-minute walking is 600 m, and the five facilities of convenience store, Chinese restaurant, fast-food restaurant, housekeeping and couriers logistics are taken as the center to make a 600 m buffer zone, while the other facilities are analyzed to make a 1,000 m buffer zone (Fig.4). The criteria for defining compliance and coverage rate of various commercial facilities are shown in Table 1.

Within a 15-minute walking distance, convenience stores, supermarkets and composite markets have achieved full coverage, and the coverage rate of shopping malls is 83.07%, indicating that shopping service facilities meet the coverage criteria. Chinese restaurants, fast-food restaurants and casual restaurants have reached full coverage, and the coverage rate of foreign restaurants is 66.14%, suggesting that

food service facilities meet the coverage criteria. Beauty salon facilities, repair and care facilities, and couriers logistics facilities have achieved full coverage, and the coverage rate of housekeeping facilities is 42.86%, mainly distributed in the south side of the livelihood service circle, which can not meet the needs of residents in other areas of the livelihood service circle. Hence, life services do not meet the standard of coverage.

Within a 10-minute walking distance, convenience stores and Chinese restaurants can cover all residential areas in Chunshu Street; fast-food restaurants can cover 99.8% of residential areas in Chunshu Street; housekeeping services can only cover 26.39% of residential areas in Chunshu Street; and couriers logistics can cover 63.54% of residential areas in Chunshu Street. It can be seen that there are large gaps in the existing housekeeping facilities and couriers logistics facilities, which need to be further improved.

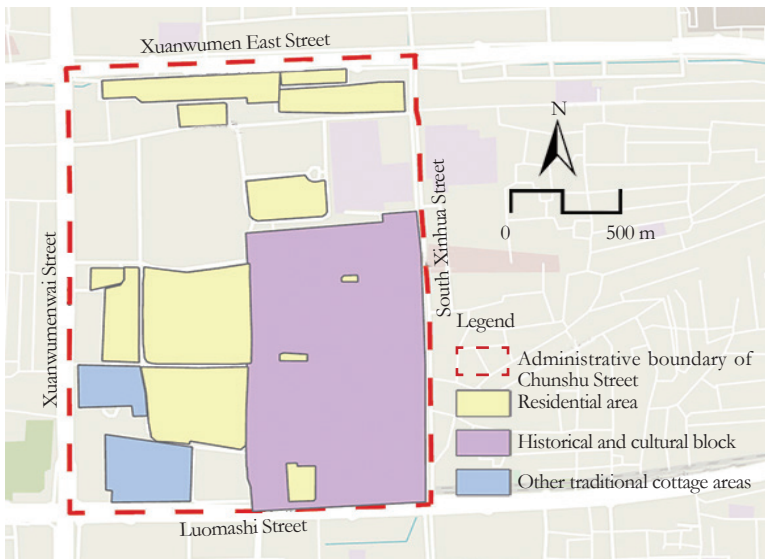


Fig.1 Residential area distribution of Chunshu Street

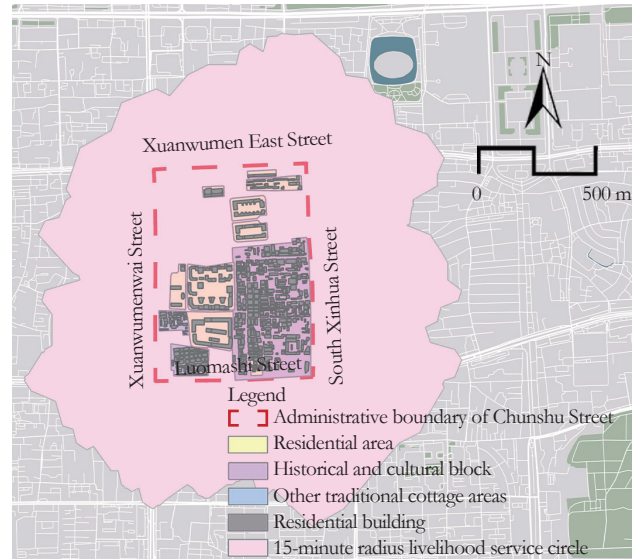


Fig.2 Livelihood service circle of Chunshu Street

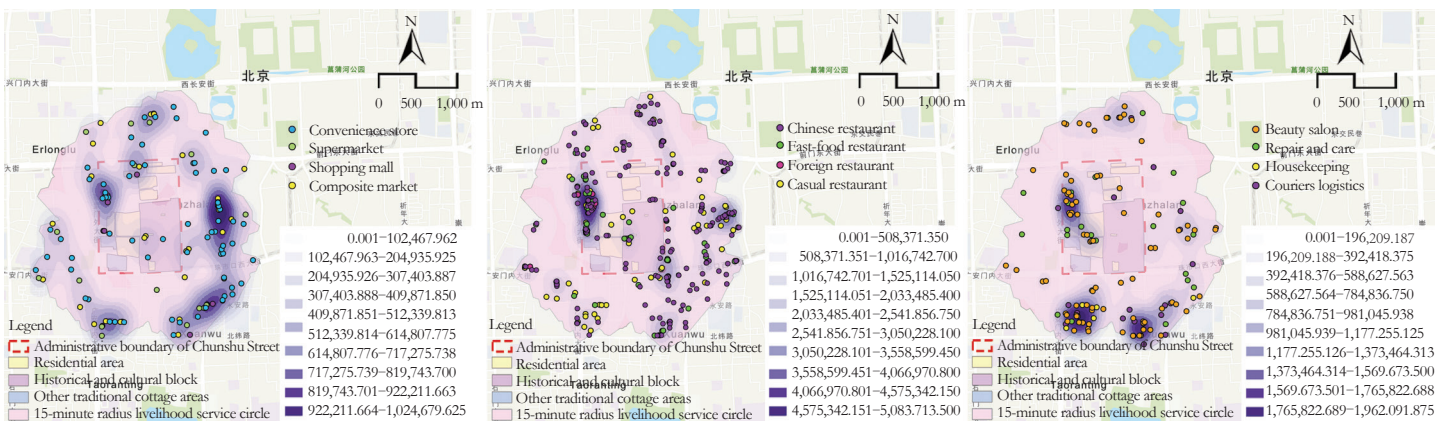


Fig.3 Kernel density analysis of commercial facilities in the livelihood service circle of Chunshu Street



Fig.4 Analysis of the coverage of community commercial facilities in the livelihood service circle of Chunshu Street

## 6 Conclusions

Based on the kernel density analysis and network analysis, the commercial service facilities in the livelihood service circle of Chunshu Street are analyzed, and the following conclusions are drawn. ① The spatial distribution of all kinds of commercial facilities in Chunshu Street shows the characteristics of multi-core, with the core mainly located in Zhuangsheng Square and Dazhalan Commercial Street. This is because there is a commercial complex with three underground floors and five aboveground floors in Zhuangsheng Square, where various commercial facilities such as catering and shopping malls are centrally distributed; Dazhalan is a historical district that is positioned

as a “trade and cultural tourism area” as a whole, attracting a large number of foreign tourists. Most of the businesses here are stores that reflect the characteristics of old Beijing and meet the cultural and catering experience of tourists, and can also meet the consumption needs of nearby residents to a certain extent. ② With a coverage rate of 66.14% for foreign restaurants within a 15-minute walking distance and 100% for casual dining restaurants, the presence of one of the two is sufficient to satisfy the coverage requirement; the coverage rate of 15-minute walking for housekeeping facilities is 95.14%, and that of 10-minute walking is

26.39%, far below the coverage requirement; the coverage rate of 10-minute walking for couriers logistics is 63.54%, which does not satisfy the coverage requirement; and the remaining commercial facilities have a high coverage rate and can meet the needs of residents.

Exploring the spatial distribution and configuration of community business and proposing optimization strategies from the perspective of livelihood service circle is conducive to the realization of the people-centered development goal. However, the optimal location of facility allocation should proceed from the actual situation by adapting to local conditions, and fully consider the particularity of historical blocks while

**Table 1 Standard definition and coverage of community commercial facilities in the livelihood service circle of Chunshu Street**

Division	Group	Definition criteria for facility compliance			Facility coverage rate/%		
		5-minute walking distance	10-minute walking distance	15-minute walking distance	5-minute walking distance	10-minute walking distance	15-minute walking distance
Shopping service	Convenience store	—	▲	—	—	100	—
	Supermarket	—	—	▲	—	—	100
	Composite market	—	—	▲	—	—	100
	Shopping mall	—	—	▲	—	—	83.07
Catering service	Chinese restaurant	—	▲	—	—	100	—
	Fast-food restaurant	—	▲	—	—	99.8	—
	Foreign restaurant	—	—	▲	—	—	66.14
	Casual restaurant	—	—	▲	—	—	100
Life service	Beauty salon	—	—	▲	—	—	100
	Repair and care	—	—	▲	—	—	100
	Housekeeping	—	▲	—	—	26.39	—
	Couriers logistics	—	▲	—	—	63.54	—

comprehensively considering the influence of other factors. The city is a complex and dynamic system, and the construction of livelihood service circle in historic districts, as special areas, requires further in-depth study.

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focus on systematicity and combine protection with development and utilization.

In short, it is an innovative approach to river protection and utilization by seeking solutions to ecological problems in river channels through historical dynamic evolution. Especially it has certain significance by extending the research perspective from the river itself to the related environment of the river basin, as well as the economic and social situation, and exploring the "symptomatic and fundamental" approaches to river regulation, providing reference for similar river regulation, protection, and development and utilization in China.

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