

Study on the Access Convenience of Public Library Layout from the Perspective of Spatial Statistics

-- Taking Beijing as an Example

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Abstract: As an important part of the development of social and cultural undertakings, public library (a public cultural facility that is open to the public free of charge, collects, collates and saves documents and information, provides inquiry, borrowing and related services, and carries out social education) undertakes the important mission of promoting social civilization and progress and improving the quality of citizens. In order to improve the efficiency of public libraries, access convenience is an important issue that must be paid attention to when constructing and layout them. This article uses the basic theories and research methods of spatial statistics, taking Beijing as an example, to analyze the urban population distribution trend, library surrounding facilities construction, and urban transportation development status that affect the accessibility of public libraries. Based on the problems existing in the accessibility of Beijing Public Library, suggestions are proposed to improve the accessibility of the library from three aspects: spatial fairness in layout, strengthening the construction of grassroots libraries, and coordinating the layout of surrounding areas.

Keywords: Spatial Statistics; Public Library; Layout Accessibility.

1. Introduction

The accessibility of public libraries is an important issue that must be paid attention to when planning their layout. The International Library Federation once stipulated in the "Public Library Standards" (2nd edition): "In major residential areas of the city, branch libraries are usually required to be established about 1.5 kilometers away from the library, and a larger library is required to be established about 3-4 kilometers away"[1]. The United Nations Educational, Scientific and Cultural Organization Guidelines for the "Development of Public Library Services" require that "in urban and suburban areas, the time to reach the nearest library by private transportation should not exceed 15 minutes"[2]. The purpose of these regulations is to fully ensure the accessibility and accessibility of public libraries. "The Public Library Law of the People's Republic of China" clearly stated that the country should establish a convenient and practical public library service network that covers both urban and rural areas. Maximizing public access to public libraries should become a key issue that China needs to pay attention to in the future planning and layout of public libraries.

"The geographical spatial distribution of libraries refers to describing the construction situation and regional distribution characteristics of libraries from a geographical spatial perspective"[3]. The spatial distribution pattern and hotspots of public libraries are important carriers that reflect the current development status and balanced characteristics of the public library industry"[4]. Spatial statistics is a theory and method for statistical analysis of data with spatial distribution characteristics, which pays special attention to the concept of "proximity" and infiltrates it into the field of statistical analysis. This article takes Beijing as an example and uses the scientific perspective and technical methods of spatial statistics to study the accessibility of the layout of public

libraries in Beijing, aiming to improve the overall service efficiency of the Beijing public library system.

2. Distribution Characteristics of Public Libraries in Beijing

The construction of public libraries in Beijing has achieved remarkable results, and a total of 426 libraries in Beijing have been obtained through web crawling methods. According to statistics, there are a total of 360 public libraries of all levels and types in Beijing, accounting for 84.5%, including one national library and one municipal library, respectively the National Library of China and the Capital Library; 16 district libraries; There are 126 street (community) libraries in the six districts of the main city, accounting for 37% of the city's community libraries; 86 school libraries; 83 other specialized libraries. The classification and statistical results of 426 public libraries are shown in Table 1:

Table 1. Library Classification Statistical Results

Categories	Different types of public libraries	School libraries	Specialized libraries
Number	360	86	83
Percentage	84%	20.1%	19.4%

The geographical distribution of Beijing Library is mainly concentrated in the six main districts of the city, namely Dongcheng District, Xicheng District, Chaoyang District, Haidian District, Fengtai District, and Shijingshan District. At the same time, due to the large number of universities in Beijing, university libraries have also become the main library resources in some areas, such as Daxing District and Changping District. It should be pointed out that Haidian District is the area with the richest resources of public libraries and university libraries at all levels and types. By comparison, the library resources owned by districts and

counties such as Mentougou District and Pinggu District are relatively scarce. Beijing Municipal Library, the overall layout presents a characteristic of abundant resources, but poor regional distribution balance.

3. Factors Affecting the Accessibility of Public Libraries in Beijing

3.1. The Balance between the Distribution of Public Libraries and the Trend of Population Mobility Affects the Accessibility

At present, Beijing has a permanent population of 21.843 million, with Chaoyang and Haidian districts having a permanent population of over 3 million, with a total population of 3.449 million and 3.13 million, respectively. Five ecological conservation areas, namely Pinggu, Huairou, Mentougou, Miyun, and Yanqing, with a permanent population of around 500000.

The population density of Xicheng District and Dongcheng District in Beijing is 21800 people/square kilometer and 16900 people/square kilometer, respectively, making them the two districts with the highest population density in the city. However, according to the data from China's seventh population census, over the past decade, the permanent population of Beijing has been flowing from the central urban area to the surrounding areas. The central urban area has a permanent population of 10.988 million, accounting for 50.2%; The permanent population of the six districts in the main city has decreased, with a total decrease of 728000 people over the past decade, an average annual decrease of 0.6%, and the proportion of the city's permanent population has also decreased from 59.7% in 2010 to 50.2%, a decrease of 9.5 percentage points. The population distribution in Beijing is showing a trend of divergence from the central urban area to the surrounding areas.

Through the above analysis of the distribution characteristics of public libraries in Beijing, the public libraries at all levels and types of Beijing are still mainly distributed in the central urban area, and the public library resources in non-central urban areas are relatively scarce. There is an obvious imbalance between the "centralization" of public library layout and the "peripheralization" of population flow, which greatly affects the convenience of citizens visiting public libraries. In accordance with the trend of population flow in the process of urban development, the layout of public libraries is an important factor to improve the accessibility of public libraries.

3.2. The Compatibility between the Construction of Public Library and the Surrounding Facilities Affects the Accessibility

Although the location of the library itself is relatively fixed and not easy to change for a certain period of time, the construction layout of the surrounding facilities of the library is also an important factor affecting the convenience of citizens visiting the library. "The layout of a library in a specific area does not exist in isolation, but rather needs to consider the coordination with other public facilities, transportation conditions, and cultural venues, forming a reader centered and convenient library network system, embedded in the actual work and living environment of

readers"[5]. When other public facilities around the library are complete and commercial and entertainment activities are abundant, it provides conditions and possibilities for turning many potential visiting citizens into real visiting citizens. Related studies have pointed out that "the complexity of community members travel chains is related to the activities they undertake, such as shopping, socializing, entertainment, shuttle transportation, work, and personal business"[6]. When access to libraries can be combined with other travel tasks for citizens, such as schools, banks, shopping, etc., the frequency and likelihood of citizen visits will inevitably increase. This means that "the layout of public library outlets can only better leverage the agglomeration effect and brand effect of public cultural institutions by coordinating with population resources, educational facilities, cultural facilities, and sports facilities"[7]. Therefore, it is necessary to coordinate the layout of libraries from the perspective of improving the entire urban public service supporting system and comprehensive commercial development layout.

Therefore, it is necessary to coordinate the layout of library from the perspective of perfecting the public service supporting system and the comprehensive layout of commercial development. Only by continuously improving the adaptability between public libraries and surrounding facilities can readers' willingness and convenience to visit public libraries be enhanced by filling readers' travel chain.

3.3. The Coordination between the Layout of Public Libraries and the Development of Urban Transportation Affects the Accessibility

Another important factor that affects the convenience of citizens visiting libraries is the tools and time of their visits. "The spatial distribution pattern of accessibility is similar to the circular road network pattern in the main urban area of Beijing, with decreasing radiation from the city center to the surrounding areas"[8]. Due to the limited number and capacity of public parking lots, as well as the limited number of private cars for travel, The main ways for Beijing citizens to visit libraries are by bike, public transportation, or walking. Due to the large scale of Beijing, the proportion of citizens who can visit libraries on foot and by bike is not high. According to a survey, "the larger the city, the more readers will use public transportation to reach the museum, and the time and distance they can bear is also limited"[9]. The public transportation system in Beijing is relatively developed, with the largest urban rail transit network in China. At the same time, it has multiple lines and numerous stations, making it the main urban public transportation network in Beijing.

However, with the rapid development of public transportation in Beijing, the serious traffic congestion in the central urban area and the relative shortage of public transportation resources in the surrounding urban areas are also quite severe. If citizens need to experience prolonged traffic congestion when going to the library, it will directly affect their willingness and experience of visiting the library. At the same time, due to the abundant quantity but uneven distribution of Beijing's libraries, the demand for citizens outside the central urban area to visit the central urban library needs to be met through public transportation. But the distribution of public transportation network cables in Beijing is not balanced, and the uneven coverage of transportation network cables will inevitably affect the enthusiasm and convenience of citizens visiting public libraries.

4. Strategies for Improving the Accessibility of Beijing Public Libraries

"Strengthening the layout and network construction of public libraries, improving the standardization and equalization of public library services, has gradually become the main goal of future development of public libraries"[10]. Improving the convenience of visiting Beijing public libraries is an important content to achieve this goal.

4.1. Improving Visiting Convenience through Spatial Fairness of Library Layout

Due to the investment of public libraries at all levels being mainly from local governments, and the differences in economic development among different regions, there is a significant gap in the development of public libraries in various regions of Beijing. It is recommended that cities fully consider the spatial fairness of public library construction layout. For a super large city like Beijing, which is constantly expanding in scale, it is necessary to increase the number and quality of public library construction in non central urban areas based on the perspective of promoting balanced economic and cultural development in different regions, and in accordance with the new trend of urban scale development and population mobility. This is a key link to improve the convenience of citizens visiting libraries in a wide range of regions.

4.2. Enhancing the Convenience of Visits by Strengthening the Construction of Grassroots Libraries

Generally speaking, the service volume of public libraries is inversely proportional to the service radius. The smaller the service radius, the higher the service volume. In other words, the probability of citizens visiting public libraries is inversely proportional to the service distance. The closer the distance, the greater the probability. It is suggested that when planning and laying out public libraries in cities, it is necessary to start from expanding social coverage and improving accessibility, construct a "large--medium--small-- micro" stereoscopic public library system, and ultimately form a reasonably arranged, inter library resource sharing, and efficient and high-quality library service network, thereby effectively improving the accessibility of citizens. At the same time, Beijing can combine the experience of China's public library general branch system that began in the early 21st century, fully utilize the rich resources of Beijing's national libraries, and actively carry out planning for the systematic layout of the general branch library. "The general--branch library system refers to a group of libraries funded by the same construction entity and managed by the same regulatory agency, with one library in a core position and the other libraries in a subordinate position"[11]. This model can effectively alleviate the problem of imbalanced and insufficient layout of urban public libraries, thereby improving the operational efficiency of the entire public library system.

4.3. Improving the Convenience of Visits by Coordinating the Field Layout Planning of the Library

"The distribution of population, convenient transportation

within the region, and administrative divisions all affect the location planning of libraries, which are factors considered in the layout and construction of public libraries"[12]. The more sufficient bus stops, rail transit, bicycle rental points, etc. around the library, the more convenient it is for citizens to visit. By improving the travel chain of citizens, the accessibility and convenience of the library space can be improved. Therefore, in the layout and construction of urban public libraries, placing the library as a public service setting in a convenient transportation and living environment, and prioritizing its planning is an important measure to effectively improve the accessibility of citizens and improve the utilization rate of the library.

5. Conclusion

As an important component of the development of social and cultural undertakings, public libraries undertake the important mission of promoting social civilization progress and improving the quality of citizens. The layout planning of public libraries has always been paid attention to by various countries, and many countries have relatively clear regulations on the setting requirements and service radius of public libraries. The core indicator of the culture section of the "Global Cities Indicator" sets "the number of cultural facilities per 100,000 people". Since the 1980s, Western developed countries have successively reached the standard of having a public library every 30,000 people or within 3 kilometers, basically realizing the mode that citizens can walk to the library in 20 minutes. There is some gap between the layout planning of our country's public libraries and the international standard. To maximize the public's convenient access to public libraries should become the focus of our country's future public library network layout. Spatial statistics is a rapidly developing field of statistics in recent years. The core of spatial statistics is to analyze the correlation and heterogeneity of spatial statistics. The study of accessibility and accessibility of public libraries in Beijing through spatial statistics can provide a basis for the scientific planning and layout of the construction of public libraries in Beijing, and is also a new perspective for further research on the construction of public library system in China.

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