Chapter 2
Explore the Impact of the Metro Station to the Surrounding Area

Lingru Yang

Abstract The development of rail transit for the impact of urban land use has become increasingly prominent, and researching the influence of rail transit on urban development has become one of the hot topics of the moment. In the city level, the metro is the artery of urban development, so the reasonable selection of metro station becomes an important part for the regional development and construction. Well, what is on earth the interactive relationship between the station and the surrounding area? This study is based on the thinking of the question, and selects the Shengtai Road Station on the Southern extension line of Nanjing Metro Line 1 as an example, analyzing the impact of the metro station to the development of the surrounding area from different levels and scale on the basis of spot investigation and data analysis. Trying to draw the law of how the rail transportation guide urban development, as well as exploring that what factors should be considered to the construction of the station surrounding areas and which road the regional development should take.

Keywords Metro station • Metro line • Urban development • Surrounding area • The land use

2.1 Background

Urban rail transit is a kind of urban passenger transportation which is featured as quick, efficient, energy saving, environmental protection and high-capacity, along with the development of rail transit, its impact on the development of urban land is becoming increasingly prominent. Southern extension line of the Nanjing Metro Line1 (southern extension line for short) starts from Andemen station stretching

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south to Dongshan new urban area, through the Nanjing station which is under the construction of the Beijing-Shanghai high-speed railway station in Nanjing, across the Yuhua District, Jiangning District and ends at the China Pharmaceutical University Station. The length of the line is 25.08 km. Shengtai Road Station area is an important node between Dongshan Town and the Development Zone, and it was once an important carrier of the Jiangning economic leaps and bounds. With the rapid development of urbanization in Nanjing, Shengtai Road Station area is facing the challenge of transforming. So the opening of the Southern extension is undoubtedly a best opportunity.

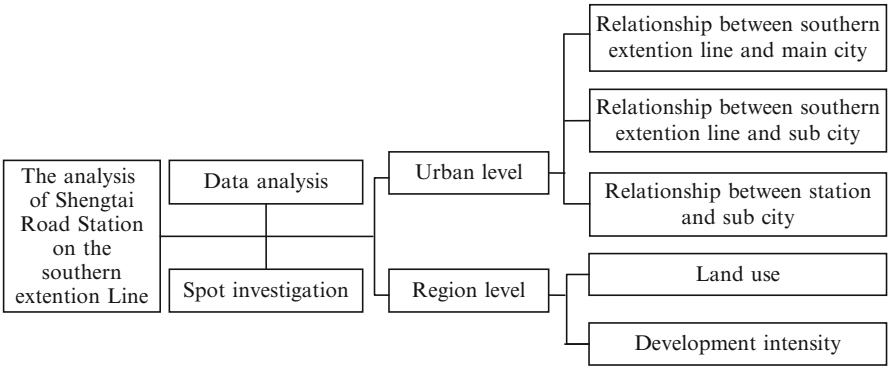
2.2 Research Summary

This study will give a comprehensive understanding on the basis of spot investigation and data analysis of the situation of Shengtai Road station and its surrounding areas. From the statistical analysis of the data, we will get further understanding of the relationship between Shengtai Road station and its surrounding areas and rail transit.

2.2.1 Research Object

As the circle effect of rail transit station, the main object is a range that uses Shengtai Road Station as the center of the circle, and 1,000 m for the radius of the circle, which is divided into four layers from the radius of 100, 200, 500 to 1,000 m to comparative study. The main focus of the survey is the scale and structure of the land use.

2.2.2 Research Framework



2.3 Relationship Between the Metro and Urban Development

2.3.1 Study of the Relationship Between Southern Extension Line and the Development of the Main City

Nanjing is experiencing the process of transforming from the big city to the mega-city, so it has new requirements for Dongshan Sub City in aspects of the urban population, industrial development, center system formation and transport facilities construction. The construction of southern extension line is under this background, expecting to ease the stress of development of the main city by having close contact with the Dongshan Sub City.

The new round of city planning of Nanjing (2010) forecasts that by 2030, Nanjing urban population will reach 11.3 million, which is about twice that of the urban population in 2007. The Main city population density is about 15,000 people/km^2, and the Sub City population density is 10,000/km^2, the size of the population is more than 500,000 people. The construction of southern extension line can solve the problem of the population movements between the main and sub city.

According to the theory of economic location and distribution characteristic of the modern urban industry, the industry within the city range will show "Circle" layout, while the Dongshan sub city is located at the junction of the first circle and the second circle, so it should focus on the development of modern service industry and high-tech industries. Southern extension line can better promote alternating the evolution of the modern service industry and high-tech industries.

According to the new general plan for Nanjing, the new city center system will change from the original basis of "one main city with multi-sub cities" to "city center – city sub-center – new city center – groups" (regional) city center system. In Dongshan Sub City there are a city center of south Nanjing, the Dongshan sub city center, as well as multiple groups centers. Southern extension line acts as the spine to support the entire Dongshan sub city center system.

It is in this context of development, according to the Nanjing rail transportation network diagram (2050), in Dongshan sub city there will be line 7 (Southern extension line), line 5, and yudai line rail transit as well as high-speed rail hub – Nanjing South Station. This will greatly enhance the locational advantages of the Dongshan sub city (Figs. 2.1, 2.2, 2.3, and 2.4).

2.3.2 Study of the Relationship Between Southern Extension Line and the Development of Dongshan Sub City

Since the end of last century, the development of Jiangning focus on the West Development Zone, and the Dongshan Town centers in the east. The former is the

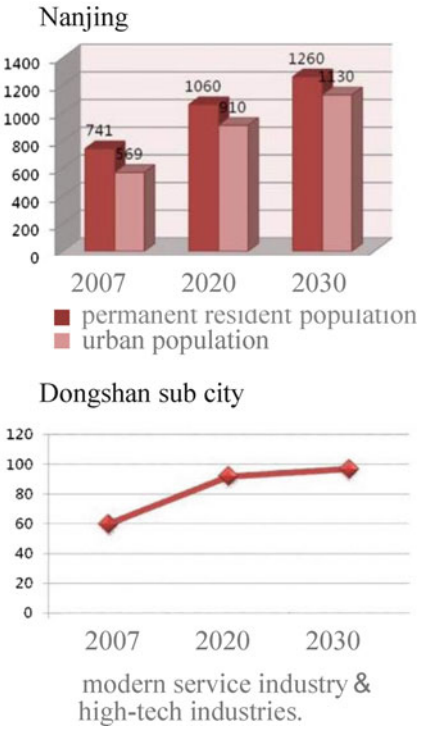


Fig. 2.1 Urban population diagram

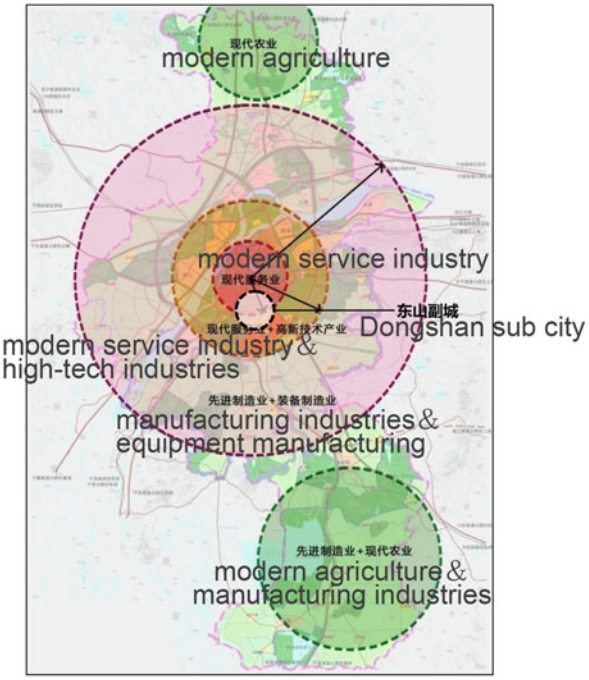


Fig. 2.2 Layout of industrial development diagram

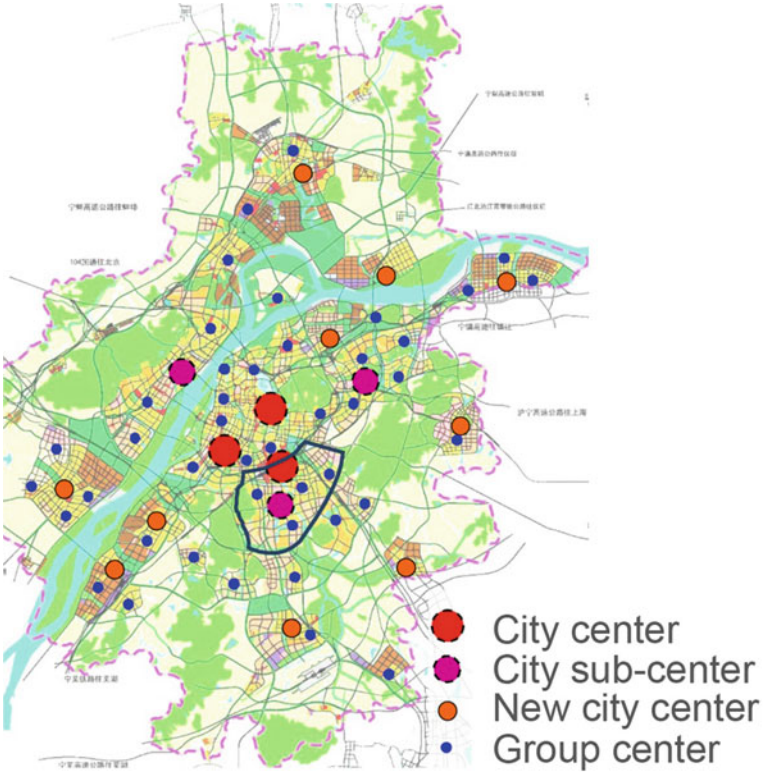


Fig. 2.3 City center system diagram

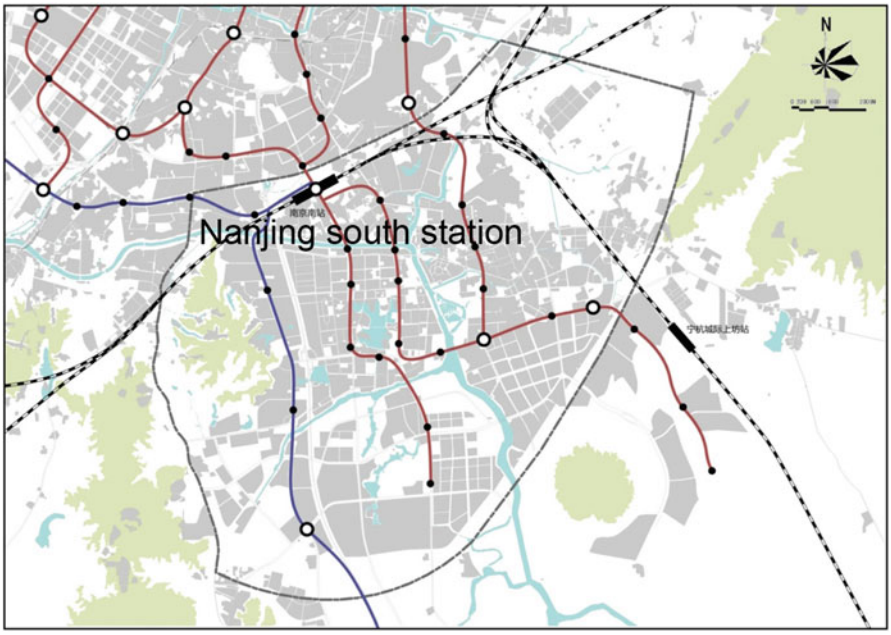


Fig. 2.4 Dongshan sub city traffic facilities diagram

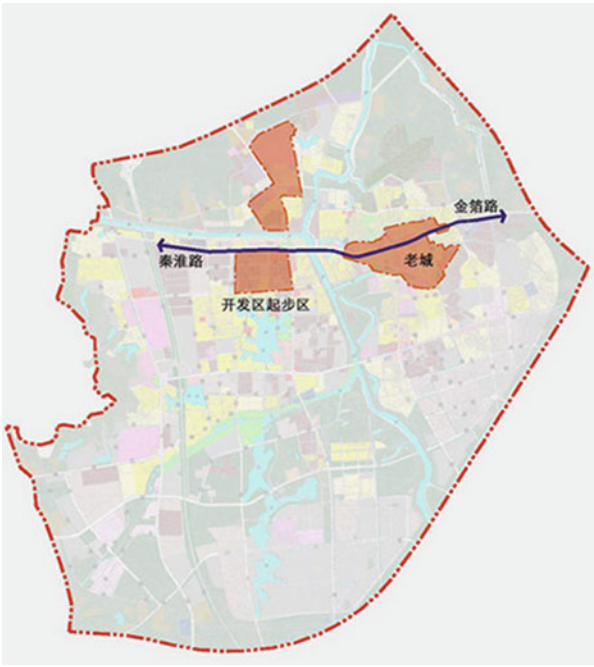


Fig. 2.5 Period of industrial land use (1992)

important industry pillar in Jiangning district, while the latter is the living supporting center in Jiangning. The situation that the industry and life supporting are separated has been restricting the development of Jiangning City. According to a new round of Jiangning city general planning requirements, the area which is to the north of Baijia Lake, between Shuanglong Avenue and Liyuan Road will be built as the new city center area, and coincides with the southern extension line radiation range, and Shengtai Road is located in a more important node position (Figs. 2.5, 2.6, 2.7, and 2.8).

2.3.3 Study of the Correlation Between Metro Station and Dongshan Sub City

Shengtai Road Station is located in the northwest of the sub center of Dongshan sub city, near the center of the circle of three groups. Radiation stations 1,000 m range overlaps the sub city hub range.

Besides, near the central of the Shengtai Road Station there are a number of public facilities, including commercial land, land for finance, insurance, commercial comprehensive land and so on.

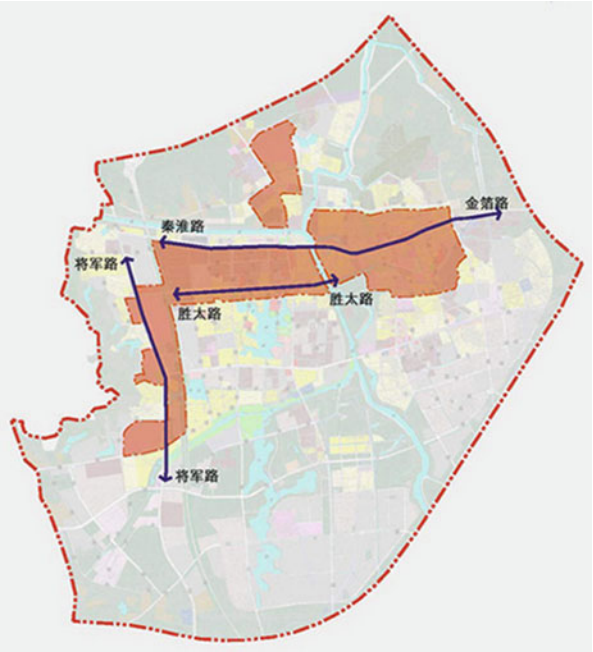


Fig. 2.6 Period of Jiangning development (1998)

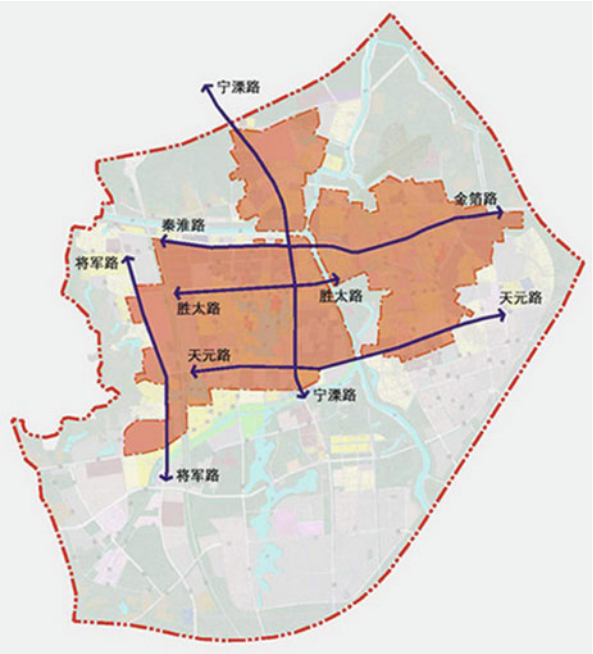


Fig. 2.7 Period of national development zones

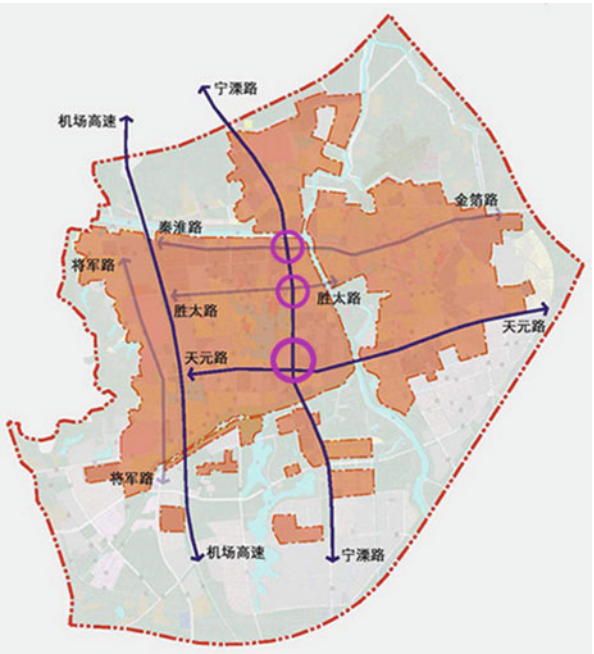


Fig. 2.8 Period of new city

Within 1,000 m of Shengtai Road Station is the distribution of a number of large settlements, including Lakeside Apartments, Shengtai new apartment, Wangfu garden, Baijia Lake villa garden, artistic apartment and so on.

But in the same context, it is also distributed a large number of industrial land, mainly concentrated in the North of Shengtai Road, West of Shuanglong Road, south of Chitian Road, and East of Shuanglong road (Figs. 2.9, 2.10, 2.11, and 2.12).

2.4 The Impact of the Metro Station to the Surrounding Area

2.4.1 Impact to Land Use

For more specific reflection of the impact of the construction of the metro stations to the condition of the surroundings, this study will use the research methods of a combination of vertical and horizontal.

The vertical method will use time as units, setting the characteristics years by comparing the change of land development around the metro stations before or after the construction of metro stations and analyze the trend of the change. As the Nanjing southern extension line opened on May 28th, 2010, this study sets the land use in 2009 which was before the metro station was built as the research object, the

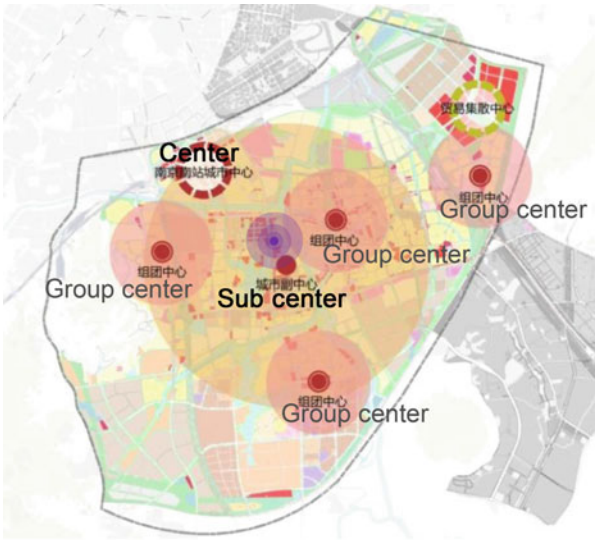


Fig. 2.9 Stations and city center system

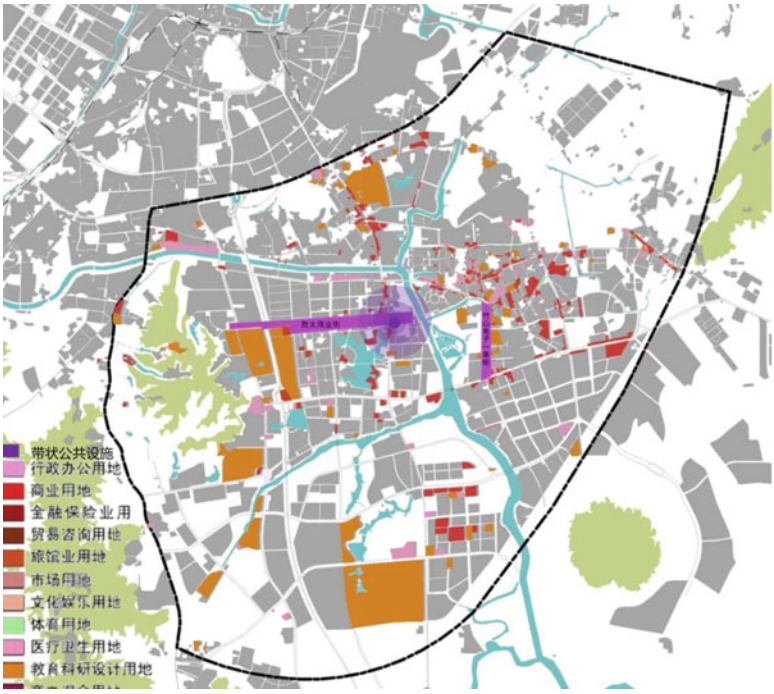


Fig. 2.10 Stations and urban public facilities

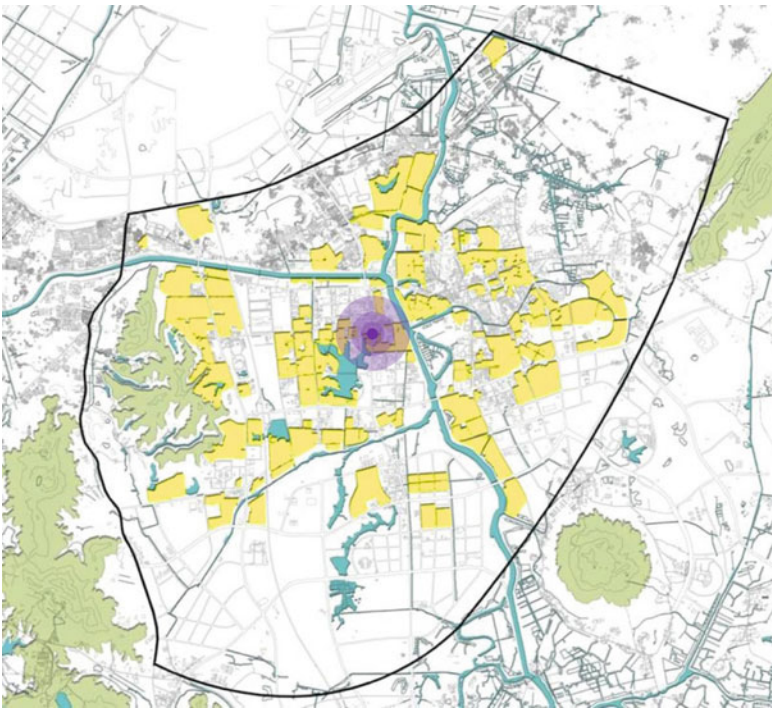


Fig. 2.11 Stations and urban settlements

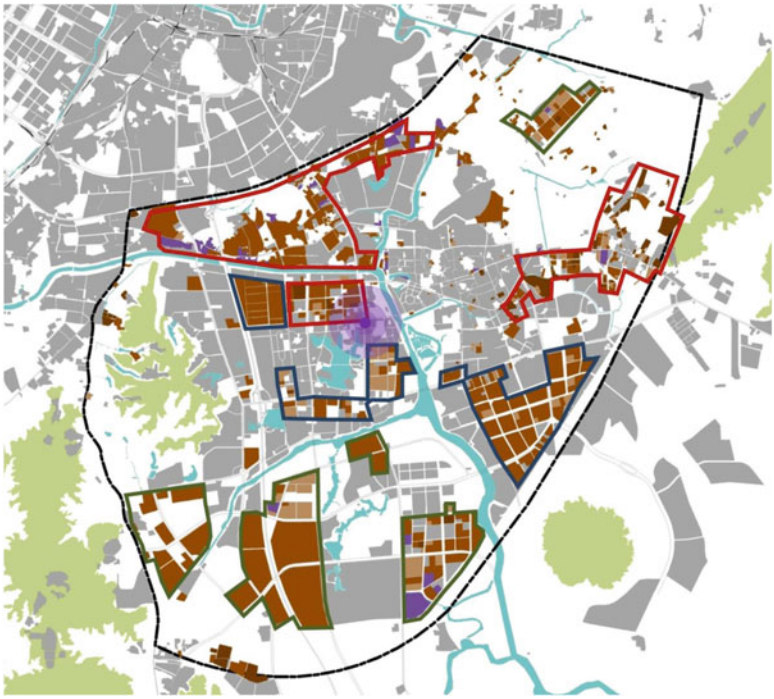


Fig. 2.12 Stations and urban industrial areas

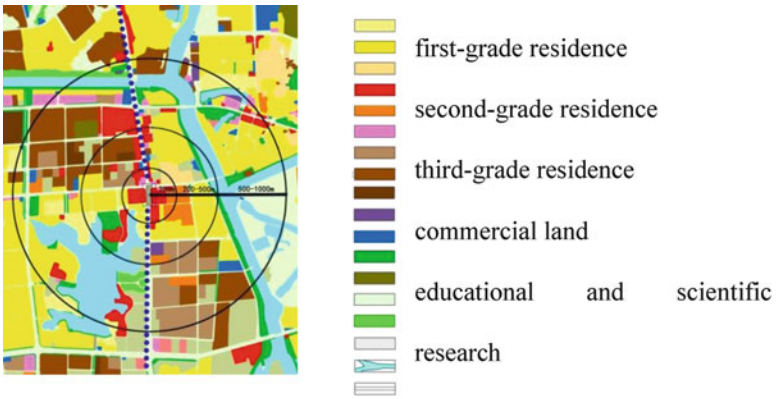


Fig. 2.13 Present land use situation of the surrounding area

current land use is based on field research, and future land development of the surrounding area around the metro stations will use the controlled detailed planning drawings of the area between 2010 and 2030 years for reference. And through the statistical analysis of the hypothesis to test and verify whether the construction of metro station has significant effects on surrounding land use.

The horizontal method will research by dividing the circle of ring layer. According to the transportation planning theory, the adjustment of the metro station on the nature of the surrounding land can be divided into less than 200 m, 200–500 m and more than 500 m. This study is a comparative study, takes Shengtai Road metro station as the center, and divides outside area into three layers, core layer 0–200 m, inner layer 200–500 m and the outer layer of 500–1,000 m (Fig. 2.13).

2.4.1.1 Land Use of the Surrounding Area

Shengtai Road station is located at the crossroad between Shengtai Road and Shuanglong Street, and it is a commercial street, there is a centralized commercial land existing by the Shengtai Road station. According to land use distribution of the surrounding area, we can see that to the east of Shuanglong Road, most of the residential land located in this area with living vitality; to the west of Shuanglong Road and the south of Shengtai Road, as it's surrounded by the Baijia Lake, it has excellent environmental conditions. There is not a large number of better green beauty of the landscape, but also the distribution of large tracts of residential areas, the construction of the villa area, international hotels, clubs and other recreational architectures; and to the west of Shuanglong Road and the north of Shengtai Road is a central area of science and technology zones. Thus, land use of the station surroundings has various functions, and many kinds of people mixed together, so the metro station as the form of public transport can be full used by the crowd surroundings (Table 2.1).

Table 2.1 Land use function structure (within 1,000 m ring layer)

The main land use types	Residence	Commercial	Manufacture	Green space	Transportation	Water	Others
Area (ha)	94.7	41.1	27.3	9.8	81.6	41.9	17.6
Structure (%)	30.2	13.1	8.7	3.1	26	13.3	5.6

2.4.1.2 Distance and Land Use

From the vertical and horizontal comparison and analysis, we can conclude that the station of public buildings in the inner ring is higher than the outer ring, showing the characteristics that public facilities are centralized distribution around the station, and residential land is mainly distributed in the outer ring, this phenomenon reflects the characteristics that the commercial areas are usually located in the intensive rail transit and walk zone, because only businessmen can pay the higher rent, and service radius is about 200 m. Secondly, in the reasonable area of rail transportation, jobs are relatively less, so the main land use is residential land, and the service radius is about 500 m or so. In the periphery of the reasonable pedestrian transport more than 500 m range, there are city park, industrial land, and form the secondary closely related area of rail transit station. According to the research to the land use of the Shengtai Road station and the surrounding area, we can analyze that the metro station really has certain impact on the land use of the surrounding area (Tables 2.2, 2.3, and 2.4).

2.4.2 Impact to Land Development Intensity

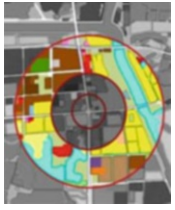
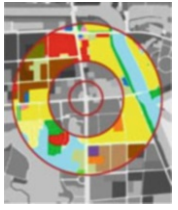
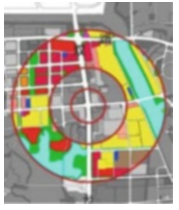
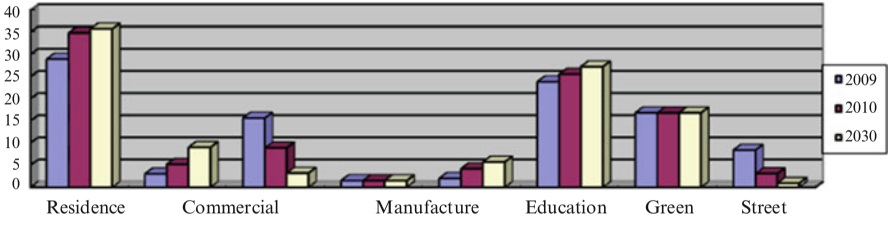
2.4.2.1 Land Development Intensity of the Surrounding Area

Shengtai Road Station surroundings is mainly used as residential and enterprise factory, the scenic Baijia Lake accounted for almost a quarter of the area of the scope of the study, which makes the region overall volume rate is not high. Only in the commercial center of Shengtai Road station surrounding area, the complex volume rate is relatively high, and new residential and business office building in the surrounding area of the stations usually have a height of 20 or more layers. We can clearly see the land use development trend of the station surroundings (Fig. 2.14).

2.4.2.2 Distance and Land Development Intensity

The station is the center, radiating outward and dividing the surrounding area into three layers, it can be found by comparing the land development intensity of the kernel of the station to the outer ring: the proportion of the low-intensity

Table 2.2 Land evaluation of the surrounding area (500–1,000 m ring layer)

Characteristics years	Before the metro station built (2009)	After the metro station built (2010)	According to the control detailed planning (2030)
Land use map			
Residence (ha)	68	82	84
Commercial (ha)	7.1	12.3	21.2
Manufacture (ha)	36.7	21	7.5
Education & scientific research (ha)	3.6	3.6	3.6
Green space (ha)	4.7	9.8	13.8
Street (ha)	56	60	64
Water (ha)	39.6	39.6	39.6
Others (ha)	19.8	7.2	2.2
Comprehensive study			

Judging from the outer layers of data and statistics, the weighting of residential land is large, and volume growth trend of development increases, and construction of infrastructure facilities trends also increases, the intensity of land development increases, and the amount of industrial land reduces, environmental construction of green space are valued

Table 2.3 Land evaluation of the surrounding area (200–500 m ring layer)

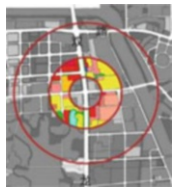
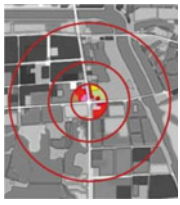
Characteristics years	Before the metro station built (2009)	After the metro station built (2010)	According to the control detailed planning (2030)
Land use map			
Residence (ha)	4.4	12.1	13.4
Commercial (ha)	11.4	12	16.4
Education & scientific research (ha)	8.6	8.6	8.6
Manufacture (ha)	7.1	6	2.9
Street (ha)	15.6	17.6	18
Water (ha)	2.3	2.3	2.3
Others (ha)	16.6	7.4	4.4
Comprehensive study	According to the above statistics, within layers 200–500 m, commercial development decreases, and residential land development intensity is strong, type of land increased, and with the future advancement of the land utilization rate will continue to increase		

Table 2.4 Land evaluation of the surrounding area (0–200 m ring layer)

Characteristics years	Before the metro station built (2009)	After the metro station built (2010)	According to the control detailed planning (2030)
Land use map			
Residence (ha)	0.53	0.62	0.53
Commercial (ha)	4.1	5.6	7.2
Manufacture (ha)	0.45	0.3	0.25
Street (ha)	3.8	4.0	4.0
Utilities (ha)	–	–	0.4
Others (ha)	3.68	2.04	0.18
Comprehensive study	In the core circle, Residential land and industrial land have a small proportion, public services land is dominated, and has a rapid growth before and after the construction of the metro station		

development (FAR $<$ 1) and medium-intensity development (1 $<$ FAR $<$ 3) increased, and the number of high-intensity (FAR $>$ 3) declined. From the current situation of Shengtai Road, the development intensity of the inner ring is higher than that of the outer ring. As the time of Shengtai Road Station construction is

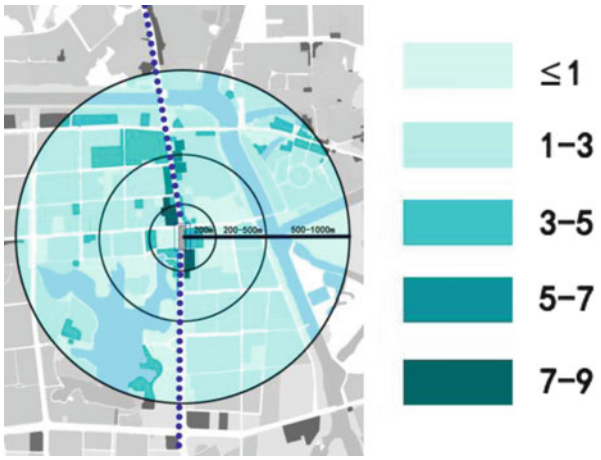


Fig. 2.14 FAR of the surrounding area

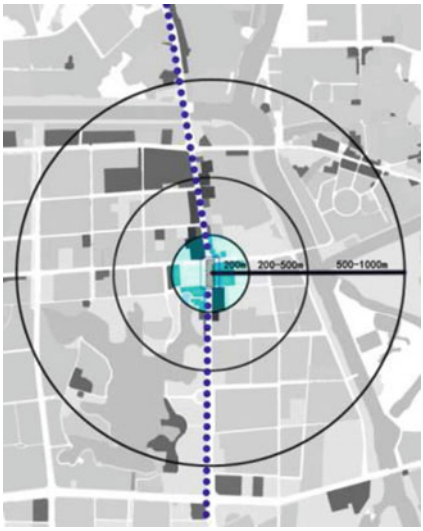


Fig. 2.15 0–200 m ring layer

short, we do not have enough data to easily get this conclusion, but from the land use situation of the construction of the station surroundings, this phenomenon is indeed consistent with the principle of land bid-rent curve and reflects that the impact of the transportation to the land use is showing the law of diminishing, in the future it will be more clear in front of us (Figs. 2.15, 2.16, 2.17, and 2.18).

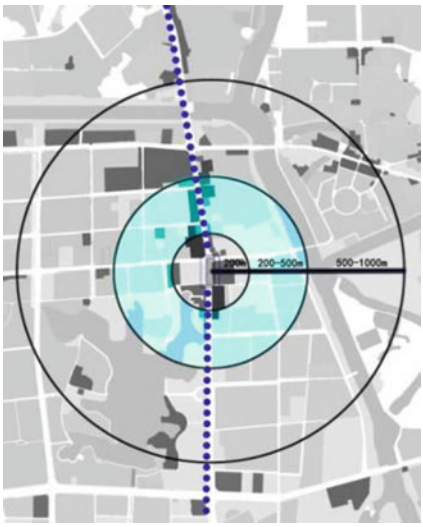


Fig. 2.16 200–500 m ring layer

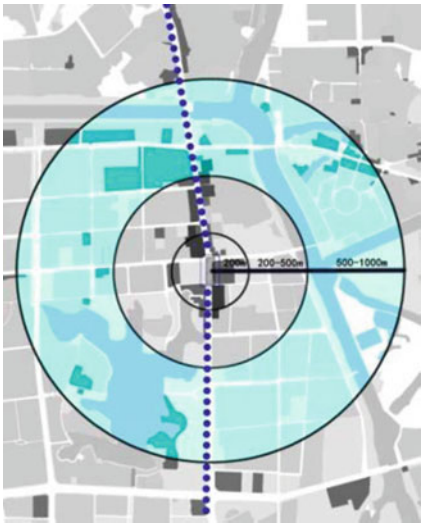


Fig. 2.17 500–1,000 m ring layer

2.5 Conclusion

Metro is the main artery to the development of the city, the metro stations are important points, the construction of the stations will vibrant the station surrounding areas and promote the value of land and enhance the intensity of development. Through the investigation of Shengtai Road, analyze the interaction between station and the city and region from the city level and the station level, to further

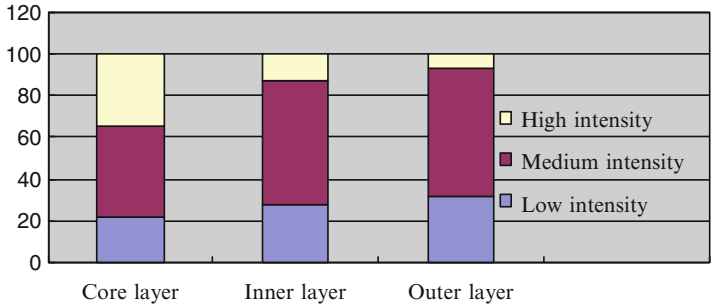


Fig. 2.18 Distribution gradient of development intensity in surrounding area

understand the influence scope and degree of the station. This has important practical significance for the promotion of public transportation, city function and underground space development, and balance the benefits of the public, environmental and economic interests to ensure that the development and construction of the region is in a healthy, harmonious, and sustainable direction.

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