Research on residential differentiation in urban fringe areas from the perspective of spatial justice -- A Case Study of Xi'an City

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Abstract. Residence is one of the four functions of the city. The spatial layout of the residential area affects the sustainable development of the city. With the rapid development of social economy and the continuous expansion of urban space, the living space structure in the marginal area of Xi'an has been adjusted, and the living space differentiation has become increasingly obvious. Based on the theory of space justice and using the methods of space analysis, statistical analysis and field research, this paper concludes that the core of living space in the edge area of Xi'an lies in the city center, and the future development direction is northeast and southwest. The characteristics of housing price are that the middle price of residential area is the most and the number of high-end and low-end residential area is relatively small. The housing types are divided into four categories: high, high-medium, medium and low. The marginalization of residential areas is high, the middle and high-end residential areas are multi-centralized, and the middle and low-priced residential areas are marginalized, and the degree of regional differentiation is gradually deepening. This is an important feature of the differentiation of residential areas in the marginal areas. Finally, the fairness of the living space structure in the social area was evaluated, and corresponding optimization suggestions were put forward.

1. Introduction

With the acceleration of urbanization, the resources and infrastructure in the urban center are gradually improved, and the urban fringe has become the main area of urban development and expansion. Spatial society should pay attention to people's living quality and spatial structure of social space [1]. The marginal area of Xi'an has complex population structure and imperfect infrastructure. Therefore, the study of residential differentiation in the marginal area of Xi'an is of great practical significance.

The study of residential space differentiation abroad adopts the method of qualitative and quantitative combination. Engels first noticed the mancunian phenomenon in the 19th century. In the 1930s, the Chicago school constructed three urban spatial structure models [2]. In the late 20th century, under the influence of racial discrimination, public rental housing in Detroit, Boston and elsewhere is heavily black and poor.

The study on residential differentiation in China began in the 1980s. Empirical studies on housing reform were carried out in Shanghai, Guangzhou and other large cities [3]. With the reform of housing...
system, residents' choice of living space presents diversified characteristics. Xue Fengxuan studied the community distribution in Beijing based on population census and housing census data [4]. Luo Zhenyu studied the centralized relocation of land-lost farmers, which made the spatial division of living space more intense and intensified social isolation [5].

It can be concluded from the above research progress that foreign research results focus on the practical problems in developed countries. Domestic researches on residential differentiation focus on the heterogeneity of material space, but lack of study on urban residential differentiation from the perspective of spatial justice. Based on this, this paper takes Xi’an as an example. From the perspective of spatial justice, this paper using espatial analysis and field research to explore the characteristics of residential differentiation in Xi’an, proposing rationalization suggestions for the improvement of residential spatial structure in urban fringe.

2. Current situation and problems of the research area

2.1. Survey of research area

Xi’an, located in Guanzhong plain, has jurisdiction over 11 districts and 2 counties, covering a total area of 10108 square kilometers. According to the data of 2018, in 2017, the number of permanent residents in the city was 8.832 million, the urban population was 6.2644 million, and the urbanization level reached 70.9%.

In this paper, the research area is divided into seven districts in Xi’an city: BeiLin district, LianHu district, YanTa district, WeiYang district, BaQiao district, XinCheng district and the north part of QinLing mountain in Chang’an district. According to the space scope of Xi’an urban edge area defined by ZhouXiaochi [6], QianZhua [7] and other scholars, this paper divides the edge area of Xi’an into inner edge area and outer edge area (figure 1).

The rapid development of social economy is positively correlated with the increase of housing construction investment. In recent years, Xi’an has accelerated the economic development of the city, accelerated the development of urban living space, and led to more obvious residential space differentiation through industrial restructuring, the construction of new development zones, the promotion of real estate industry and the attraction of foreign investment (figure 2).

The development of real estate industry provides more living space and the price difference between residential areas leads to the formation of different residential areas. Under the influence of the market, the living space continues to expand to the urban fringe, forming a diversified suburban social group and forming scattered living space.

![Figure 1. Extent of the Marginal Area of Xi’an](image)

![Figure 2. Impact of Economic Factors](image)

The establishment of development zone is an important way to realize the spatial expansion and reorganization of urban functional areas. The development zone has superior economic policies, modern infrastructure and advanced management system. It attracts high quality and specialized talents, and gradually forms the new office building concentration area and elite residential area.

The amount of urban development capital increased year by year, while the proportion of housing increased from 11.89% in 2010 to 45.56% in 2017, and the proportion of completed housing increased...
from 21.69% in 2010 to 23.54% in 2017 (table 1).

| Table1. Real Estate Development Area and Proportion of Xi’an Development Zone |
|--------------------------------------------------|
| Development zone | The whole city | Accounted for | Development zone | The whole city | Accounted for |
|-------------------|----------------|---------------|-------------------|----------------|---------------|
| Construction area | 808.54         | 6800.17       | 11.89%            | 7458.41        | 16368.72      | 45.57%        |
| Residential construction area | 1818.03        | 5776.9        | 31.99%            | 4424.24        | 10672.61      | 41.45%        |
| Floor area completed | 100.59         | 463.76        | 21.69%            | 430.35         | 1828.45       | 23.54%        |
| Completed residential area | 88.87          | 412.39        | 21.55%            | 333.98         | 1257.06       | 26.57%        |

2.2. Data Sources
The social and economic data in this paper are mainly derived from Xi’an statistical yearbook (2010-2018), statistical bulletin of economic and social development, development plan of greater Xi’an (2017-2021) and general plan of Xi’an city (2008-2020). Excel and SPSS are used for mathematical statistical analysis. Landsat TM/ETM/OLI remote sensing images were used as the main data source for land use data. Questionnaire and field survey data were collected from residents in the marginal area of Xi’an.

2.3. Research methods

2.3.1. Ellipse of standard deviation. The standard deviation ellipse reflects the core distribution of living space and the future development direction and trend. Suppose a region is composed of n subregions, w is the attribute value or weight of the ith region, M (X, Y) is the center of gravity of the i subregion, and the calculation formula of the center of gravity is:

\[ M(X,Y) = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}, \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i} \]  

Second, determine the shape of the ellipse. Where x and y are the coordinates of the i subdomain, and n is the number of subdomains.

\[ A = \sum_{i=1}^{n} x_i^2 - \sum_{i=1}^{n} y_i^2 \]

\[ B = \sqrt{\left(\sum_{i=1}^{n} x_i^2 - \sum_{i=1}^{n} y_i^2\right)^2 + 4\left(\sum_{i=1}^{n} x_i y_i\right)^2} \]

\[ C = 2\sum_{i=1}^{n} x_i y_i \]

Finally, determine the standard deviation of xy axis:

\[ \theta_x = \sqrt{\frac{\sum_{i=1}^{n} x_i (x\cos\theta - y\sin\theta)^2}{n}} \]

\[ \theta_y = \sqrt{\frac{\sum_{i=1}^{n} y_i (x\cos\theta + y\sin\theta)^2}{n}} \]

2.3.2. Kriging interpolation method. Kriging interpolation estimates the unknown samples by combining the data of the known sample points with the spatial direction of the unknown samples and assigns weights to the known sample points to show the gradient difference of the house price.

\[ Z(x_0) = \sum_{k=0}^{N} Z(x_k) W_i \]

Z (x₀) is the unknown sample, Z (xᵢ) is the known sample size around the unknown sample, Wᵢ is the known sample weight, and N is the known sample size.

2.4. Differentiation characteristics of living space in the marginal area of Xi’an City

2.4.1. Residential space distribution center and development direction. The major axis of the ellipse is the area with the largest number of residential areas (figure 3). From FengCheng No.5 road to electronic No.2 road, the living space distribution on the short oval axis is less. From the west second
ring road to the east second ring road, Xi’an has a large number of residential areas in the northern and southern directions of the urban fringe, while there are fewer residential areas in the east and west directions. The oval center is located in the central area of the city, which indicates that the core of the living space is located in the center of the city of Xi’an. The rotation direction of the oval is northeast to southwest, indicating that the future development of living space will expand to northeast and southwest.

2.4.2. Density of living space. The analysis of residential space density reflects the concentration of residential space (figure 4).

(1) First level residential circle. Residential area distribution density is the highest, mainly for the north of the city LongShouyuan residential circle, the east of the city HuJiamiao residential circle. HuJiamiao residential circle is close to the east second ring road and because of its proximity to the city center, has a prominent traffic advantage.

(2) Second level residential circle. The distribution density of residential areas is high, including the southwest high-tech residential area, the southern suburbs of the university city residential area. High-tech living circle has the beautiful environment and developed transportation system; The living area of the university town has a good cultural atmosphere and complete service facilities.

(3) Third level residential circle. The distribution density of residential areas is medium, including QuJiang residential circle, ZhangJiabao residential circle, Tumen residential circle and TaiHua Road residential circle. Among them, the QuJiang residential circle has functions such as tourism, science and education, exhibition, accommodation, commercial facilities, leisure and entertainment facilities, cultural industry, landscaping and other functions are gradually improving.

(4) The fourth level residential circle. Residential areas are less densely populated, including the three-bridge residential area and the textile city residential area. SanQiao residential area is located in Xi’an, an important entrance and exit of XianYang and BaoJi. The land reserve is relatively large and the price is relatively low. With the commercial development of SanQiao, it will become a popular residential circle in the west; with the city textile art street and railway park Construction, the number of textile city residential areas will gradually increase.

2.4.3. Living space price grade. According to the residential price of the sample residential area, the residential price of Xi’an marginal area is divided into four levels, namely >15000/yuan/m², 9000-15000 yuan/m², 6000-9000 yuan/m², and 3000-6000 yuan/m². Among them, 6000-9000 yuan/m² accounts for the most, up to 41.9%, and >15000 yuan/m² accounts for the least, only 4.5%.

Kriging interpolation method is used to make spatial layout differences for price attributes in statistics. According to different housing prices, it can be divided into three categories (figure 5).

(1) High price residential circle. The price distribution range is ≥15000 yuan/m² and 9000-15000 yuan/m², including the high-tech residential areas. The price in QuJiang new area is higher than that in the high-tech development zone. High-end residential buildings in QuJiang new area account for about 2/3 of the total residential buildings, and high-end residential buildings in high-tech new area account for about 1/3, indicating that more and more high-income people choose to buy real estate in QuJiang new area.

(2) Middle price residential circle. The price distribution range is mainly 6000-9000 yuan/m², and the middle price residential area accounts for the highest proportion of all residential types in the marginal area. The distribution characteristics of middle price residential circle are basically distributed along the periphery with the high price residential circle as the center, including ChanBa ecological district residential circle, JingKai district residential circle and east second ring residential circle. The middle price residential areas are mainly located in northeast and southwest, and the middle price meets the demand of the middle class.

(3) Low price residential circle. The price distribution is concentrated at 3000-6000 yuan/m². It is distributed in ZaoYuan West Road and SanQiao Road, Textile City Interchange, Space City and Grassland Area. The lower residential areas are located in the eastern, western and northern parts of
the city, providing affordable housing for the middle and lower classes.

2.4.4. Different types of residence. According to the results of cluster analysis, the residential area in Xi'an is divided into four types of communities, which are high-grade residential areas, medium-to-high-end residential areas, mid-range residential areas and low-end residential areas (Figure 6).

1. High-grade residential area. Mainly villas and middle and high-grade residential areas, mainly distributed in the adjacent commercial center, landscape belt, development zone and other areas, the geographical location is superior, occupying most public resources. Most of the residents are ruling elites, wealth elites and cultural elites with high social prestige, and the high-income groups gather in the residence to form high-grade residential areas. Residential areas in QuJiang new area have landscape resources such as Nan lake and DaTang FuRong garden. The average price of ZiWei garden city is about 19000 yuan/m².

2. Middle and high-grade residential areas. The middle and high-end residential areas are mainly high-rise apartments, including commercial, serviced and ordinary apartments, which are mainly distributed near the main roads of the region. The main living objects are middle and high income people. High-rise and small high-rise buildings are the main residential types, and an average price of 7600 yuan/m², most of which are 40-60 m². The economic development zone is mainly small and high-level, with an average price of 7000 yuan/m².

3. Middle-grade residential area. With unit residence and general commodity house give priority to, distributive feature is not apparent, and meet the need of general working class.

The ordinary residence in the center of the city, although the construction cycle is long, its superior geographical location and surrounding facilities are complete, and the hospital, school and shopping center are very closed, public transportation is very convenient.

4. Low-grade residential area. Low-grade residential areas are mainly affordable housing, including rental and purchase of low-income housing. Affordable housing provided by the government is designed to ease the pressure on low and middle income families to buy homes. The low-grade residential areas in Xi'an are usually located in the suburbs of the city, and the surrounding facilities are not perfect.

3. Conclusion

This paper uses quantitative analysis to study the residential space density and the change trend of residential space distribution in the marginal area of Xi'an. The core of living space in the edge area of Xi'an is in the city center, and the future development direction is northeast and southwest. The differentiation characteristics of residential areas in the marginal area of Xi'an are that residential areas are highly marginalized, middle and high-grade residential areas are distributed in multiple centers. The degree of differentiation between regions is gradually deepening. The residential structure in the
marginal area of Xi’an is faced with the problems of insufficient number of low-end residential communities, serious isolation of high-end residential communities and uneven allocation of public resources.

Different mixed lifestyles should be adopted in different areas of Xi’an. A certain proportion of residential buildings suitable for middle-income purchasing power should be developed to provide housing subsidies for the demolition residents. In newly developed residential areas in urban fringe areas, a certain proportion of affordable housing should be encouraged to be established and the proportion of commercial housing and affordable housing should be reasonably determined according to market demand.

When building a mixed community, multiple forms should be adopted to avoid housing simplification. When planning residential units, the wishes of each group should be considered. In the space where the integration of adjacent classes is gradually realized and reduce the possibility of class homogenization.

The same group of people can help to improve the relevance of community services. According to the communication methods of various residents, create various communication spaces and improve the quality of residents culture. With the gradual improvement of the community network in the community, social stability has been maintained. We will improve the development of low-income communities, improve the urban landscape, enrich community forms, organize social activities and strengthen communication and exchanges.

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