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Analysis on Spatial Change Characteristics and Influencing Factors of Urban Fringes in Southern Shaanxi

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Abstract

Urban fringe is the most frequent area of urban-rural land use change, which is of great significance for the study of urban development. With the expansion of cities, the social and environmental problems in urban fringe have become increasingly prominent. Southern Shaanxi is located in an important ecological functional area in China, and its economic development is relatively lagging behind. Coordinating Industry and environment is an important issue for urban development. This study analyzed the spatial change characteristics and main driving factors of urban fringe in Hanzhong, Ankang and Shangluo in southern Shaanxi. The results show that in the past decade, the proportion of industrial industries in Hanzhong, Ankang and Shangluo has experienced a process of first rising and then falling, and the upgrading of industrial structure has a negative impact on the overall urban population flow. The rapid increase of urban population and the significant non-agricultural phenomenon of agricultural population have resulted in the continuous expansion of urban scale. The rapid growth of industrial output value is reflected in the continuous expansion of industrial land in urban fringe areas, which also poses a threat to the local environment. Therefore, reasonable control of city scale and optimization of industrial structure play an important role in the green and sustainable development of Southern Shaanxi.

Keywords

Urban Fringe; Spatial Change; Industrial Land; Southern Shaanxi.

1. Introduction

Since the China's reform and opening up, the economy has developed rapidly, and the urban space has continued to expand. The area of urban built-up area has increased from 7438 km^2 in 1981 to 58455 km^2 in 2018 [1], an increase of nearly seven times. The urban-rural integration development strategy has promoted the formation and development of urban fringe, which has become an important part of urban space in China [2]. The division of urban fringe is of great significance for the study of urban-rural integration development, the control of urban scale and the improvement of land use efficiency [3-4]. This area has a mixed land use mode and is a transition zone between industrial and agricultural land [5-6]. With the change of urban form and pattern, the industrial industries in the core area of the city gradually spread

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to the countryside, forming a new gathering point. At present, the land use and spatial planning of urban fringe is still the focus of foreign academic research. The urban fringe is a changing transition zone. It has complex and huge stakeholder groups, and the land use competition is very fierce [7-9].

China's urbanization process and related research started relatively late. In the research, we need to learn from foreign mature research methods and carry out research activities with social value in combination with China's system and regional characteristics. Small and medium-sized urban fringe often includes the category of county and town. Therefore, it will be more accurate to use the expression of urban fringe to replace urban fringe in this study. With the implementation of China's urban-rural integration development strategy, urban-rural integration development and ecological environment issues have aroused widespread concern. Researchers began to realize the importance of urban-rural overall planning and ecological construction in urban fringe. At the present stage, the research contents of urban fringe in China mainly focus on spatial expansion, evolution texture and land use, and lack of research on ecological environment protection and healthy development of human settlements. Especially in small and medium-sized cities, there are many gaps in this kind of research, which seriously restricts the construction of new urbanization. In recent years, the research and practice of defining the scope of urban fringe has been increasing, but the research on small and medium-sized towns is still relatively small. In addition, although the research method has gradually changed from the empiricism of fuzzy definition to the scientism of accurate identification, there is still less comprehensive analysis combining qualitative and quantitative analysis. Compared with other regions, southern Shaanxi is an economically backward region in Shaanxi province, with a slow pace of urbanization. Urban development is significantly affected by natural factors such as vegetation, terrain and rivers. Less research has been carried out on urban scale and urban development boundary under resource constraints. In addition, according to the national main function zoning and the main function zoning of Shaanxi province, southern Shaanxi is located in Qinba mountain area, a key ecological function area in China, with fragile ecological resources and low environmental carrying capacity. Especially in the urban fringe, the ecological problems are prominent, and the contradiction between urban and rural development is amplified, which seriously threatens the health of the regional human settlements. The scientific identification and division of urban fringe will help to find the internal causes of problems and alleviate the contradiction between social development and ecological environment protection.

2. Study Areas

In terms of administrative division, southern Shaanxi includes three prefecture level cities,Hanzhong, Ankang and Shangluo. It is between 105°30′30″~111°1′25″E and 31°42′~34°25′40″, with a total area of 7.05 km^2, accounting for about 34.3% of the total area of Shaanxi Province. Southern Shaanxi is located in the Qinling Bashan mountains between the Yangtze River and the Yellow River. There are various soil types in southern Shaanxi, mainly mountain brown soil and yellow brown soil. According to the national ecological function zoning, southern Shaanxi is an important and extremely important soil conservation and biodiversity conservation area. According to the report on the ecological environment of Shaanxi province in 2020, all counties and districts in southern Shaanxi are rated as good or above, significantly higher than those in Guanzhong and Northern Shaanxi. According to the 2021 Shaanxi statistical yearbook, by the end of 2020, the total resident population in southern Shaanxi was 7.75 million, accounting for 19.60% of the total population of the province. The proportion of urban population in Hanzhong, Ankang and Shangluo is 50.96%, 49.92% and 48.03% respectively, which is far lower than the proportion of urban population in Shaanxi

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Province (62.66%). In 2020, the industrial output value of Hanzhong, Ankang and Shangluo will be 49.42 billion yuan, 34.25 billion yuan and 22.56 billion yuan, accounting for 31.01%, 31.46% and 30.50% of the gross domestic product (GDP) respectively. The per capita GDP will be 49179 yuan, 43378 yuan and 35381 yuan respectively. Southern Shaanxi is rich in natural resources and beautiful ecological environment, but its urban construction and economic development lag behind other regions in Shaanxi Province.

3. Materials and Methods

The study takes the central urban areas of Hanzhong, Ankang and Shangluo as research scope, mainly including Hantai District, Hanbin District and Shangzhou District of Hanzhong. Its spatial scope refers to the overall urban planning of Hanzhong (2010-2020), the overall urban planning of Ankang (2017-2035) and the overall urban planning of Shangluo (2011-2020). The spatial identification of urban fringe uses GF-2, Landsat-7 remote sensing data and worldpop population data set. The spatial resolution of the data set is 100 m, which is based on night light data, land use data, distance factors and elevation information of various land use types. The weight layer of population distribution is estimated by random forest model, and then the population spatialization is realized by zoning density mapping. The eco-environmental data and socio-economic statistical data of Southern Shaanxi are derived from the Shaanxi Provincial Eco-environmental Status Bulletin and the Shaanxi Statistical Yearbook (2011-2021).

In this study, three factors closely related to urban development, namely landscape disorder, impervious surface coverage (ISC) and population density, were selected to establish an index system for identifying urban fringe, and the extraction range of urban fringe was identified by combining the sliding T-Test method. The first step is to calculate the landscape disorder degree, impervious surface coverage and population density. In terms of the calculation of landscape disorder degree, firstly, ENVI 5.3 software is used to perform atmospheric correction, fusion, mosaic and clipping operations on the remote sensing images in the study area. Then, object-oriented SVM method is used to classify the images for land use and calculate the landscape disorder degree. The impervious surface coverage is calculated by using the mixed pixel decomposition method for the preprocessed image. Population density is the DN value of pixels obtained by reprojecting and clipping wordpop data with ArcGIS 10.3 software. The second step is to build the identification index system of urban fringe according to the landscape disorder degree, impervious surface coverage and population density, and determine the weight through principal component analysis. In the third step, the sliding T-Test method is used to identify the mutation points of the inner and outer boundaries of the urban fringe, and finally the range of the urban fringe is obtained by connecting the mutation points.

4. Results

The results show that from 2010 to 2020, the central urban area of Hanzhong (North Bank of Hanjiang River) extends to the northwest, the impact of human activities on land use is significantly enhanced, and the area of urban fringe is gradually expanding, with an expansion rate of 102.4%, showing an obvious trend of North expansion; There is a significant difference between the north bank and the South Bank of the Hanjiang River in the central urban area of Ankang. The area of the central urban area and the urban fringe on the North Bank of the Hanjiang River has expanded significantly, showing the characteristics of extending to the west, while there is no significant change on the South Bank of the Hanjiang River. The overall expansion ratio of the urban fringe is 90.5%; Compared with the spatial evolution characteristics of the outward expanding urban fringe in Hanzhong and Ankang, there is no obvious change in the central urban area and the urban fringe in Shangluo. The spatial evolution of the urban fringe belongs to the internal filling type. On the one hand, it is determined by the

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overall economic and social development of Shangluo. On the other hand, there are many mountains, and the scarcity of land resources suitable for construction restricts the expansion of the city.

5. Discussion

In 2010, the permanent residents of Hanzhong, Ankang and Shangluo were 3.42 million, 2.63 million and 2.34 million respectively, and the urban population proportion was 37.08%, 34.60% and 27.30% respectively. By 2020, the permanent population decreased by 6.14%, 5.32% and 12.39% respectively, and the urban population proportion increased to 50.96%, 49.92% and 48.03%. The data shows that the urban population is losing, the urbanization rate is increasing steadily, and the gap between different regions is narrowing, but it is still lower than the provincial average level (62.66%). In Shangluo, in particular, the annual average loss of permanent residents exceeded 1% from 2010 to 2020, but the proportion of urban population increased by 20.73%. From 2010 to 2020, the per capita GDP of Hanzhong, Ankang and Shangluo increased by 243.96%, 257.17% and 214.11% respectively. Although the growth rate is significantly higher than the provincial average level (151.11%), the overall income level is still low and the economic development is relatively backward. As shown in Figure 1, the industrial output value of Hanzhong, Ankang and Shangluo increased significantly by 35.677 billion yuan, 26.527 billion yuan and 16.822 billion yuan respectively, with an increase of 259.64%, 343.53% and 293.32%. At the same time, in 2020, the industrial output value of Hanzhong, Ankang and Shangluo accounted for 31.01%, 31.46% and 30.50% of GDP respectively. However, from 2010 to 2020, it shows the characteristics of first rising and then falling. Among them, from 2015 to 2020, the proportion of industrial output value in Ankang's GDP decreased by 4.69%.

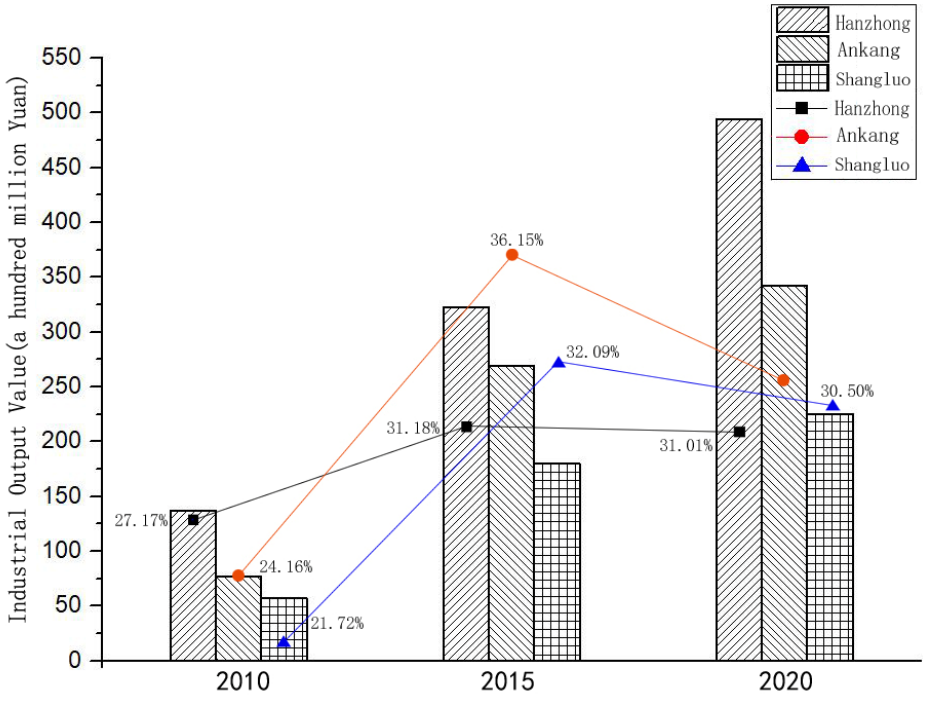

Figure 1. Industrial output value and its proportion in GDP of Hanzhong, Ankang and Shangluo in 2010, 2015 and 2020

In 2014, the State Council of China issued the national new urbanization plan (2014-2020), which emphasized that the urbanization of people should be the core and the urbanization of

agricultural transfer population should be orderly promoted. At the same time, it emphasizes that urbanization should reflect the requirements of ecological civilization, green, low-carbon, saving and intensive, and puts forward that green production should become the mainstream of urban economic life. In 2018, the Central Committee of the Communist Party of China and the State Council issued the strategic plan for Rural Revitalization (2018-2022), which clearly put forward the basic content of ecological livability: improving the living environment and improving the ecological environment. The communique on the ecological environment of Shaanxi Province shows that the ecological environment of Shaanxi continues to improve during the 12th Five Year Plan and 13th five year plan. Especially during the 13th five year plan period, the ecological index (EI) of Shaanxi Province increased from 59.99 in 2015 to 69.79 in 2020. The improvement effect of ecological environment quality is remarkable. From high to low, the index of regional ecological environment status is as follows: Southern Shaanxi, central Shaanxi and Northern Shaanxi. According to the comprehensive evaluation results of Eco-environmental Status of each city (District), Hanzhong City, Ankang City and Shangluo city rank among the top three in the Eco-environmental Status Index, and the Eco-environmental Status is good.

6. Conclusion

To sum up, the policy orientation is consistent with the changes in population, industry, ecological environment, urban and rural construction, etc. Under the macro-control of national policies, the upgrading of industrial structure has a negative impact on the overall urban population flow. The rapid increase of urban population and the significant non-agricultural phenomenon of agricultural population have resulted in the continuous expansion of urban scale. The rapid growth of industrial output value is reflected in the continuous expansion of industrial land scale in the urban fringe, resulting in the decline of ecological environment quality and the increase of land pollution risk in the urban fringe. With the proposal and continuous promotion of new urbanization and Rural Revitalization policies, the industrial structure has been upgraded and transformed, and the proportion of industrial output value in GDP has been declining. Hanzhong and Ankang have made great efforts to develop service industry and green ecological industry. The expansion of urban fringe is obvious, and the types of land use include residential land, cultivated land, industrial and mining storage land, transportation land and commercial land, showing the characteristics of mixed and inefficient utilization as a whole. The spatial evolution of Shangluo urban fringe belongs to the internal filling type, which is mainly due to the continuous improvement of industrial structure and industrial technology. The land types are mainly industrial, mining and storage land. Especially in the eastern suburb of Shangzhou district, it is an important industrial park in Shangluo city.

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