Research on the Measurement of Urban-Rural Integration Level in Sichuan Province

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Abstract

Promoting the integrated development of urban and rural areas is of great significance for narrowing the development gap between urban and rural areas, establishing a new type of urban-rural relationship, and achieving high-quality socialist modernization. This paper focuses on Sichuan Province and constructs an indicator system for the degree of urban-rural integration based on four dimensions: economic integration, social integration, population integration, and spatial integration. Then, using the entropy value method, it conducts a quantitative evaluation of the development status of urban-rural integration in the province from 2013 to 2022 to reveal the dynamic changes in its level of urban-rural integration. The results show that from 2013 to 2022, the overall level of urban-rural integration in Sichuan Province has shown an upward trend. Among the dimensions of urban-rural integration, social integration and spatial integration have achieved significant results, not only showing good current integration trends but also demonstrating rapid development speeds, presenting a positive development trend. In contrast, economic integration and population integration have performed less satisfactorily, with integration levels remaining at a relatively low level and slower development speeds, urgently requiring further optimization and improvement to achieve comprehensive and balanced urban-rural integration. The results indicate that the overall level of urban-rural integration in Sichuan Province is currently low, with disparities in regional development, unequal distribution of public services and infrastructure, and prominent issues of semi-urbanization in different areas.

Keywords: urban and rural integration, entropy value method, horizontal measurement

1. Introduction

Cities and rural areas, as two important components of the integration of urban and rural development, are indivisible yet contradictory entities. In 2019, the state officially issued a clear opinion aimed at "reconstructing the new type of urban-rural relationship," firmly "advancing towards the path of integrated urban-rural development," and fully "promoting rural revitalization and the modernization of agriculture and rural areas." [1] To guide the development of urban and rural areas and usher in a new chapter of integrated urban-rural development. In promoting the integration of urban and rural areas, constructing a comprehensive evaluation system for the level of urban-rural development to quantitatively analyze the depth and breadth of urban-rural integration is crucial for guiding the implementation of the rural revitalization strategy and achieving balanced urban-rural development.

2. Literature Review

The existing research on the integration of urban and rural areas is relatively abundant. Liu Minghui and Qiao Lu start from the evolution patterns of urban-rural relations, arguing that the integration of urban and rural areas is a powerful measure to address the imbalances and inadequacies in development, combining the theory and practice of urban-rural integration with Chinas path to modernization[2] Tu Shengwei believes that the integration of urban and rural areas should also pay attention to the comprehensive development of people and promote the mutual complementarity and coordinated development between urban and rural departments [3] Zhou Jianing and other scholars believe that the integration of multiple dimensions including economy, society, population, space and ecology is the high-quality development of urban-rural integration, so they constructed an evaluation index system of urban-rural integration including these five dimensions and selected 29 indicators for measurement [4] Li Junjie et al. proposed that in order to promote the integrated development of urban and rural areas in ethnic minority regions, 26 indicators were selected to conduct quantitative evaluation from three dimensions: the foundation of urban-rural integration, the driving factors of urban-rural integration, and the effects of urban-rural integration, so

as to accurately measure the development degree and trend of urban-rural integration in ethnic minority regions [5] Ye Chao and other scholars believe that the integrated development of urban and rural areas can promote the construction of socialist modernization, so they construct an index system from three dimensions of economy, society and population to measure the degree of urban-rural integration in the Yangtze River Delta region [6]错误!未找到引用源。.

Through the sorting and summary of literature on urban-rural integration and gray prediction, urban-rural integration mainly involves the research on urban-rural theory, connotation and development level measurement, but there is little systematic study on the level of urban-rural integration in Sichuan Province.

3. Measurement of Urban-Rural Integration Level in Sichuan Province

Urban-rural integration is a continuously evolving dynamic process whose development trend is influenced by multiple factors. To scientifically and reasonably promote urban-rural integration, it is essential to deeply understand its evolutionary patterns and identify and analyze the key factors and constraints affecting integration. This enables the government to formulate more precise and effective policies and measures, optimizing the allocation of urban-rural resources, strengthening economic ties between cities and rural areas, and facilitating the smooth flow of economic activities. Consequently, this achieves coordinated development between urban and rural areas, ultimately achieving the goal of urban-rural integration. This study, based on the actual conditions of Sichuan Province, has pioneered the construction of an evaluation index system covering four dimensions: economy, society, population, and space. Subsequently, the entropy value method was used to measure the degree of urban-rural integration in Sichuan Province. Finally, through the measurement results, a thorough analysis of the status of urban-rural integration development in Sichuan Province was conducted, and on this basis, the problems and challenges faced by Sichuan Province in advancing urban-rural integration were identified and outlined.

3.1 Data Sources and Indicator Selection

The main sources of data are the Sichuan Provincial Statistical Yearbook from 201 3 to 202 2, the China Statistical Yearbook, and the National Bureau of Statistics. Based on the principles of data availability, objectivity, and operability, this study draws on relevant literature reviews to construct an evaluation index system for the integration degree of urban and rural areas in Sichuan Province, as shown in Table 1. The goal level of the evaluation index system is the integration degree of urban and rural areas in Sichuan Province, the criterion level includes four dimensions of integration: economic, social, population, and spatial aspects, and the indicator level specifically comprises 19 indicators.

Table 1. Evaluation index system of urban-rural integration in Sichuan Province

Target level	The criteria layer	Indicator layer	attribute
		X1Urban and rural per capita GDP / (yuan/person)	forward direction
		X2Per capita consumption ratio of urban and rural households	negative direction
	Urban-rural economic integration B1	X3The ratio of per capita disposable income between urban and rural areas	negative direction
		X4Engel coefficient ratio of urban and rural residents	forward direction
		X5Binary contrast coefficient	forward direction
		X6The ratio of beds in urban and rural medical and health institutions	negative direction
	Urban-rural social integration B2	X7Urban and rural cultural and educational entertainment comparison coefficient	negative direction
		X8Urban-rural per capita health care comparison coefficient	negative direction
Urban-rural integration A		X9The ratio of the number of urban and rural residents receiving subsistence allowances	negative direction
		X10Coverage of unemployment insurance for urban and rural residents	forward direction

		X11The ratio of nonfarm to agricultural employment	forward direction
	Urban-rural population integration B3	X12Urbanization level of population	forward direction
		X13Employment disparity coefficient	negative direction
		X14Land urbanization level	forward direction
		X15Traffic network density	forward direction
	Urban-rural space integration B4	X16turnover of passenger traffic	forward direction
		X17Per capita private car ownership in urban and rural areas	forward direction
		X18Urban spatial expansion ratio	forward direction
		X19Cultivated land area ratio	forward direction

3.2 Research Methods

In the existing related literature studies, entropy value method is often used for processing, followed by principal component analysis, Delphi method, and factor analysis. Considering the advantages and disadvantages of various evaluation methods and combining with the actual situation of urban-rural integration development research, this paper ultimately selects the entropy value method to analyze the indicators, and the specific calculation process and results are as follows:

Step 1, standardize the data. In the data processing phase of the first step, this study adopts the deviation method to implement standardization operations on the data. Given that the standardized values obtained by the deviation method contain 0 values, which can have a certain impact in subsequent calculations, this paper optimizes the process by adding an additional 0.001 units to the standardized values.

When it is a positive indicator: $X'_{ij}X'_{ij} = \frac{X_{ij}-min(X_{ij})}{max(X_{ij})-min(x_{ij})} + 0.001$

$$(2.1)$$

When it is a negative indicator: $X'_{ij}X'_{ij} = \frac{max(X_{ij})-X_{ij}}{max(X_{ij})-min(x_{ij})} + 0.001$

$$(2.2)$$

Among them, is the value after standardization; is the original value of the index; is the maximum value of the index; is the minimum value of the index. $X'_{ij}X_{ij}Max(x_{ij})$ j $Min(x_{ij})j$

The second step is to calculate the proportion of each research object under each index on the basis of standardization. j i

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \quad (2.3)$$

The proportion is the constant indicating the number of subjects under the index. $P_{ij}m$ j

The third step is to calculate the information entropy of each indicator, as shown in the formula $E_j k = \frac{1}{ln(m)}$

$$E_j = -k * \sum_{i=1}^{m} p_{ij} * ln(p_{ij}) \quad (2.4)$$

Among them, is the entropy value of the first index, is a constant indicating the number of subjects under the first index, and is the proportion of the first subject under the first index. $E_j jo \leq E_j \leq 1m$ ^{j} $P_{ij}j$ i

Step 4, calculate the difference coefficient. g_j

$$g_j = 1 - E_j \tag{2.5}$$

Step 5, calculate the weight value of each index. W_j

$$W_j = \frac{g_j}{\sum_{j=1}^{n} g_j} \tag{2.6}$$

Step 6, calculate the development level of urban-rural integration in four dimensions. The degree of integration of urban-rural integration in Sichuan province in four dimensions of economy, society, population and space is as follows F_B

$$F_{B=1,2,3,4,} = \sum_{j=1}^{m} w_j * x'_{ij} \tag{2.7}$$

Step 7, calculate the comprehensive measurement function of urban-rural integration development in Sichuan Province. F_A

$$F_A = \sum_{j=1}^{m} W_j * x'_{ij} \tag{2.8}$$

Using the above calculation formula, the data of 19 indicators for the level of urban-rural integration in Sichuan Province from 2013 to 2022 were calculated, obtaining the weights of each indicator, as shown in Table 2. Then, multiplying the weights by the standardized data, the integration degree of each dimension from 2013 to 2022 was obtained, and finally, the comprehensive score of Sichuan Provinces urban-rural integration from 2013 to 2022 was derived, as shown in Table 3. $W_j W_j X'_{ij}$

Table 2. Weight table of indicators of integrated development level between urban and rural areas in Sichuan Province

Target level	The criteria layer	Indicator layer	Entropy value	coefficient of variation	weight
Urban-rural integration A	Urban-rural economic integration B1	X1Urban and rural per capita GDP / (yuan/person)	0.915	0.085	0.060
		X2Per capita consumption ratio of urban and rural households	0.920	0.080	0.056
		X3The ratio of per capita disposable income between urban and rural areas	0.940	0.060	0.042
		X4Engel coefficient ratio of urban and rural residents	0.964	0.036	0.025
		X5Binary contrast coefficient	0.927	0.073	0.052
	Urban-rural social integration B2	X6The ratio of beds in urban and rural medical and health institutions	0.898	0.102	0.072
		X7Urban and rural cultural, educational and entertainment comparison coefficient	0.968	0.032	0.023
		X8Urban-rural per capita health care comparison coefficient	0.939	0.061	0.043
		X9The ratio of the number of urban and rural residents receiving subsistence allowances	0.899	0.101	0.071
		X10Coverage of unemployment insurance for urban and rural residents	0.880	0.120	0.085
		X11The ratio of nonfarm to agricultural employment	0.933	0.067	0.047
	Urban-rural population integration B3	X12Urbanization level of population	0.921	0.079	0.056
		X13Employment disparity coefficient	0.933	0.067	0.047

	X14Land urbanization level	0.930	0.070	0.050
	X15Traffic network density	0.900	0.100	0.071
Urban-rural space integration B4	X16turnover of passenger traffic	0.956	0.044	0.031
	X17Per capita private car ownership in urban and rural areas	0.934	0.066	0.047
	X18Urban spatial expansion ratio	0.882	0.118	0.084
	X19Cultivated land area ratio	0.948	0.052	0.037

Table 3 Criteria layers and comprehensive evaluation values of urban-rural integration in Sichuan Province from 2013 to 2022

a particular year	Urban-rural economic integration	Urban-rural integration	Urban-rural population integration	Urban-rural space integration	Overall score
2013	0.024	0.033	0.015	0.146	0.218
2014	0.061	0.059	0.030	0.172	0.321
2015	0.084	0.068	0.047	0.183	0.383
2016	0.102	0.108	0.074	0.181	0.465
2017	0.122	0.137	0.094	0.186	0.540
2018	0.133	0.201	0.117	0.193	0.644
2019	0.165	0.258	0.134	0.186	0.742
2020	0.225	0.234	0.154	0.207	0.821
2021	0.227	0.261	0.163	0.219	0.870
2022	0.222	0.264	0.150	0.217	0.854

3.3 Measurement Result Analysis

3.3.1 Analysis of the Overall Level of Integrated Urban and Rural Development in Sichuan Province

The overall comprehensive trend of urban-rural integration development in Sichuan Province from 2013 to 2022 is upward, rising from 0.218 in 2013 to 0.854 in 2022, as shown in Figure 1. Specifically, from 2013 to 2021, it shows an upward trend, increasing from 0.218 to 0.870. During these years, the upward trend was quite noticeable, with the integration levels of urban-rural economies, societies, populations, and spaces continuously increasing. From 2021 to 2022, it shows a downward trend, decreasing from 0.870 to 0.854. The decline in 2021 was due to pandemic control measures, leading to a general downward trend in urban-rural economies, populations, and spaces, ultimately resulting in an overall downward trend in the level of urban-rural integration development.
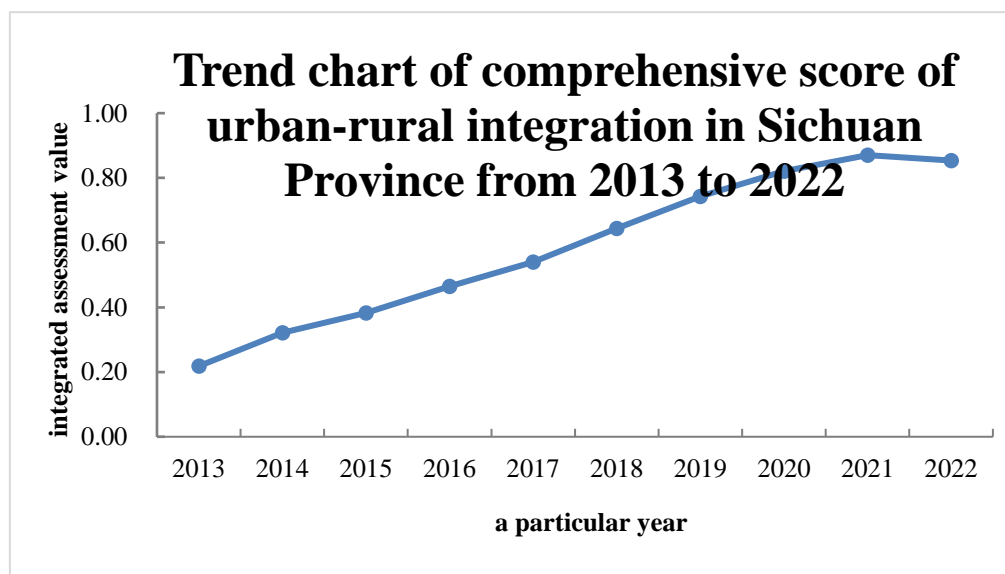

Figure 1. Trend chart of comprehensive score of urban-rural integration in Sichuan Province from 2013 to 2022

3.3.2 Analysis of Urban and Rural Integration Development Criteria at Various Levels in Sichuan Province

From 2013 to 2022, although the standard scores of various criteria of urban-rural integration development level in Sichuan province fluctuated slightly from year to year, the overall trend showed a steady improvement, as shown in Figure 2. The specific analysis is as follows.
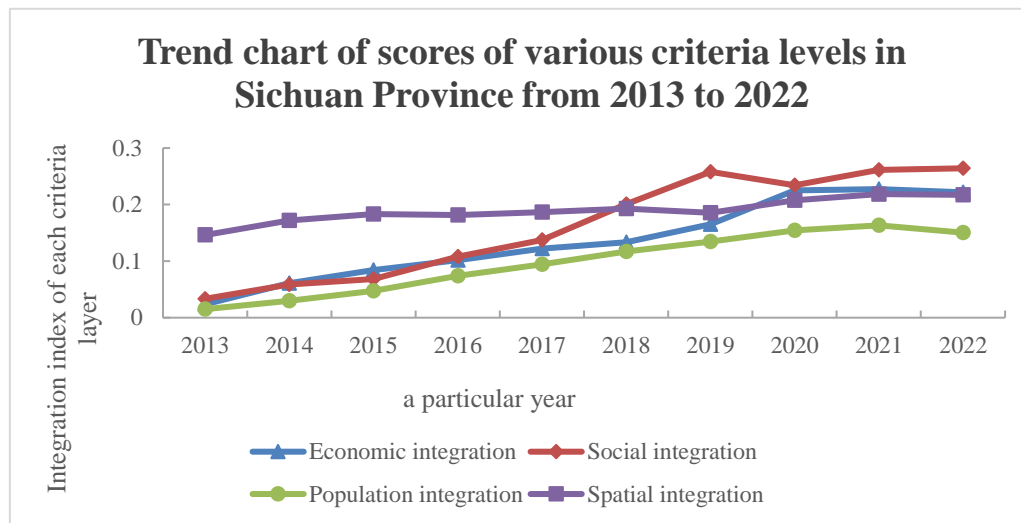

Figure 2. Trend chart of scores of various criteria layers of urban-rural integration in Sichuan Province from 2013 to 2022

The level of integrated urban-rural economic development. From 2013 to 2022, although Sichuans urban-rural economic integration level was at a moderate level among the four benchmark grades, it generally showed a steady upward trend. According to the data, the score for urban-rural economic integration increased from 0.024 in 2013 to 0.222 in 2022. Based on the original data, Sichuan Provinces per capita GDP also saw annual growth, increasing from 32,750 yuan in 2013 to 67,777 yuan in 2022; the per capita consumption ratio of urban-rural households decreased from 2.186 in 2013 to 1.607 in 2022; and the per capita disposable income ratio between urban and rural areas decreased from 2.652 in 2013 to 2.315 in 2022. Over these 10 years, the economic development gap between urban and rural areas in Sichuan Province has become increasingly smaller, and the degree of urban-rural economic integration has continuously improved.

The level of urban-rural social integration. From 2013 to 2022, Sichuan Provinces urban-rural social integration development level was at a moderate level in four benchmark aspects: economy, society, population, and space, with the largest fluctuation range. Specifically, from 2013 to 2017, the growth rate of urban-rural social integration was relatively slow. However, since the implementation of the Rural Revitalization Strategy in 2018, Sichuan Province has made significant progress in urban-rural social integration, with the urban-rural cultural and educational entertainment comparison coefficient and the urban-rural per capita medical care comparison coefficient continuously decreasing, and the minimum living security population and unemployment insurance coverage of urban and rural residents continuously increasing. Urban-rural infrastructure and healthcare have been continuously improving, promoting the enhancement of urban-rural social integration levels.

The level of integrated development between urban and rural populations in Sichuan Province. From 2013 to 2022, the provinces score for integrated development between urban and rural populations was relatively low among the four benchmark layers of economy, society, population, and space, and its degree of integration was the lowest compared to others. However, the overall trend shows a yearly increasing trend, steadily rising from 0.015 in 2013 to 0.150 in 2022. According to the raw data, the urbanization level of Sichuan Province increased from 32.5% in 2013 to 42.1% in 2022, and the employment disparity coefficient also rose from-0.211 in 2013 to 0.066 in 2022. In recent years, the flow and migration of people between urban and rural areas have not only optimized the employment structure of urban and rural residents but also improved employment issues and promoted better integration of populations between urban and rural areas.

The level of integrated development between urban and rural spaces. Sichuan Provinces score in urban-rural space integration stood out from 2013 to 2022, not only ranking among the top in four benchmark layers—economy, society, population, and space—but also showing the smallest fluctuation, indicating a stable growth trend. The

score steadily increased from 0.0146 in 2013 to 0.217 in 2022. According to the raw data, Sichuan Provinces overall land urbanization level rose from 0.042 in 2013 to 0.070 in 2022; the transportation network density increased from 0.042 in 2013 to 0.070 in 2022; and the urban spatial expansion ratio decreased from 4.554 in 2013 to 2.998 in 2022. As the land urbanization rate continues to rise and the transportation network improves, the distance between cities and rural areas has significantly shortened. These efforts have gradually reduced the differences between cities and rural areas, leading to the gradual formation of a new pattern of integrated development between urban and rural spaces.

4. Problems Existing in the Integrated Development of Urban and Rural Areas in Sichuan Province

4.1 The Overall Level of Urban-Rural Integration is Low, and Regional Development Varies

In recent years, thanks to a series of agricultural support policies, the economic and social landscape of rural areas has been completely renewed, achieving significant progress. However, the accelerating process of urbanization acts like a double-edged sword, bringing prosperity and development to towns while also triggering large-scale migration of rural populations to cities, directly leading to the "hollowing out" dilemma in rural areas. Moreover, the issue of population aging is becoming increasingly prominent in rural regions. At the same time, due to generally low levels of education and low productivity in small-scale farming, it is difficult to increase rural income relying solely on existing rural labor. Although farmers income levels have shown an upward trend compared to before, the relative income when compared to urban residents has not increased significantly but has instead worsened. According to raw data, the disposable income of urban and rural residents in Sichuan Province indeed shows a yearly increasing trend. The per capita disposable income of urban residents was 22,228 yuan in 2013, increasing to 43,233 yuan by 2022; the per capita disposable income of rural residents was 8,381 yuan in 2013, increasing to 18,672 yuan by 2022. The data shows that the absolute numerical gap between the two remains significant. In 2022, the disposable income of urban residents was 2.31 times that of rural residents, indicating that the income disparity between urban and rural areas has not fundamentally changed.

4.2 There is still Room for Improvement in the Integration of Urban and Rural Areas, and there are Uneven Phenomena in the Supply of Public Services and Infrastructure

The imbalance between urban and rural public services and infrastructure supply is a common problem in China, which is rooted in the long-term dual economic structure that has led to the long-term imbalance between urban and rural development [7] Although the country has been continuously introducing new policies to promote rural development in recent years, and rural areas have made certain progress, the relative gap between urban and rural areas is still widening compared to urban development. Compared to cities, Sichuan Province lags behind in public services such as healthcare and social security in rural areas. In terms of basic education, due to population migration and mobility, coupled with relatively backward conditions, rural areas lag behind in teacher strength and school hardware development. Although the expenditure ratio on cultural and educational entertainment between urban and rural residents in Sichuan Province from 2013 to 2022 has narrowed, decreasing from 5.26 in 2013 to 1.88 in 2022, the expenditure amount of urban residents is still significantly higher than that of rural residents. In the field of healthcare, urban medical resources lead rural areas in terms of personnel allocation and equipment configuration. From 2013 to 2022, the per capita expenditure on medical care for both urban and rural residents has been increasing annually, but the expenditure of urban residents remains higher than that of rural residents. In 2013, the per capita expenditure on medical care for urban residents was 1019 yuan, which increased to 2343 yuan by 2022; in 2013, the per capita expenditure on medical care for rural residents was 557 yuan, which increased to 1878 yuan by 2022. Despite the growth in healthcare expenditure for rural residentsFaster, but urban residents expenditure on healthcare remains high, reflecting the disparity in healthcare consumption between urban and rural areas. In terms of social security, rural residents enjoy significantly lower social security benefits compared to urban areas. In the field of infrastructure construction, there has been noticeable improvement in aspects such as farmland water conservancy, road construction, rural power grids, and water supply. However, some rural areas still lack improvements in basic rural infrastructure, such as road hardening.

4.3 The Level of Urban-Rural Integration Continues to Increase Steadily, but the Problem of Semi-Urbanization in Different Places is Prominent

With the rapid economic development and urbanization of Sichuan Province, a large number of rural residents have migrated to cities, leading to a shortage of rural labor and exacerbating employment issues. The urbanization level of Sichuan Provinces population increased from 32.5% in 2013 to 42.1% in 2022. Although the proportion of urban population has risen, the economic and social disparities between urban and rural areas remain significant. There are still considerable gaps compared to cities in terms of infrastructure construction, public service levels, and job opportunities provided in rural areas. From 2013 to 2022, the number of employed urban residents in

Sichuan Province continuously increased, rising from 18.28 million in 2013 to 25.08 million in 2022, while the number of employed rural residents continuously decreased, dropping from 28.06 million in 2013 to 21.98 million in 2022. The trend of one-way migration of rural residents to cities is difficult to reverse. The long-term existence of the dual urban-rural structure has led to differences in many aspects between urban and rural areas, hindering the integration of urban and rural populations. This results in rural residents facing multiple obstacles such as cultural differences and social discrimination during their integration into urban societies, making it difficult for them to truly integrate into urban communities, which can also lead to an increase in social contradictions and instability.

5. Conclusions

This study constructs a comprehensive evaluation index system of urban-rural integration development in Sichuan Province from four dimensions: urban-rural economy, society, population and space, evaluates and analyzes the degree of urban-rural integration in Sichuan Province from 2013 to 2022, and finally draws a conclusion that the overall degree of urban-rural integration in Sichuan Province is on the rise from 2013 to 2022, and the integration of various dimensions also shows a fluctuating upward trend in varying degrees. However, the overall level of urban-rural integration in Sichuan Province is relatively low at present. In order to further promote the development of urban-rural integration in Sichuan Province in the future, we need to focus on a series of problems, such as regional development differences, uneven supply of urban-rural public services and infrastructure, and prominent problems of semi urbanization in different places, so as to better promote the integration of urban and rural areas in Sichuan Province.

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