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Evaluation and Spatiotemporal Evolution of Urban Comprehensive Resilience in Anhui Province

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Abstract: Resilience is a kind of characteristic that a city can self-regulate and continue to develop in the face of disaster risk. It is an important indicator to measure whether a city is healthy and safe, and also an innovative path to solve urban economic, ecological and social problems. It has important practical significance for the high-quality and sustainable development of a city. By means of CRITIC empowerment method, an urban resilience evaluation index system composed of economic resilience, social resilience, ecological resilience, infrastructure resilience and 20 indicators, including GDP, has been constructed, and the urban resilience level of 16 prefecture-level cities in Anhui Province from 2010 to 2020 has been measured. And I compare and analyze the development and change of the resilience level of each city in time and space. The results show that: (1) During the study period, the average resilience level of cities in Anhui Province has a certain degree of improvement and fluctuates with time, but the degree of disequilibrium among cities is deepened; (2) The overall resilience level of Anhui cities is low, and the provincial capital Hefei has an obvious advantage in resilience level, while other cities show a low and uniform distribution, and the average resilience level of marginal cities is low; (3) From the perspective of space, the average toughness level of central and southern cities showed an upward trend, while the index of most cities in northern Anhui showed a downward phenomenon. Finally, based on the analysis of the research results, the paper puts forward some countermeasures and suggestions to optimize the urban resilience of Anhui province.

Keywords: CRITIC empowerment method; toughness level; Anhui

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1. Introduction

In recent years, the process of urbanization in China is experiencing ultra-high level of development, the level of urban land space development and utilization is constantly improving, and the overall strength is steadily improving. However, with the rapid economic and social development, the inner structure of the city is gradually complicated [1], the risks faced by the city tend to be uncertain, and the impact of the outside world is more and more vulnerable and sensitive. The outbreak of the novel coronavirus pneumonia epidemic at the end of 2019 has revealed the shortcomings of urban construction in grass-roots governance, public services and people's livelihood security, making the country have to face up to the issues of urban emergency response resilience, spatial governance and urban safety in times of crisis [2]. The construction of Resilient city enables the city system to resist various unknown risks and disasters with its own defense capabilities, reduce the losses caused by risks, and restore to the normal situation before the disaster as soon as possible. And the wisdom of resilient city can make the city repeatedly sum up experience after the impact, and intelligently improve the ability to respond to external risks. In the context that China is promoting the construction of national space

planning, it is necessary to explore how to plan resilient cities and improve the resilience level of cities.

At the first United Nations World Conference on Disaster Reduction in 1994, the concept of "Resilient city" was first proposed, and subsequently, the Netherlands, Japan and other countries have carried out practical exploration of resilient city planning [3]. During this period, research on resilient cities in China has entered the initial exploration stage. In 2015, research on the resilience enhancement planning of urban municipal facilities began, marking the first practice of resilience theory in China's urban planning scope [4]. The evaluation of urban resilience level is a key basis for transforming the concept of resilience into practice. The entropy weight method has been used to evaluate urban economic resilience [5], and the analytic hierarchy process has been applied to assess the resilience of multiple provinces and cities, including Beijing and Shanghai [6]. These research results have greatly promoted the theoretical and practical development of resilient cities in China. However, most domestic studies on the evaluation of resilient cities establish an evaluation index system from a single dimension, focusing on economically developed regions, and rarely assess the ability of a large region to cope with risks from the perspective of comprehensive resilience. Anhui Province, as a large resource-based province, with the rise of central cities, the integration of the Yangtze River Delta, and other advantages, has significant opportunities to build high-level resilient cities. Based on previous studies, the CRITIC weighting method was applied to select 20 indicators from four dimensions — economy, society, ecology, and infrastructure—to establish a resilient city evaluation system. Using Anhui Province as an example, the comprehensive resilience level of 16 prefecture-level cities in Anhui from 2010 to 2020 was measured, and the temporal and spatial evolution differentiation patterns of each city's comprehensive resilience were analyzed. The research is expected to provide decision-making references for improving the comprehensive resilience level of cities in Anhui Province, preventing future shocks, enhancing the adaptability and resilience of cities, and formulating policies for the development of high-quality, high-level cities.

2. Objects, Methods and Data Sources of the Study

2.1. Object of Study

Based on the principle of unity of research objects and taking into account the availability of data, 16 prefecture-level cities in Anhui Province are selected as research objects in this paper. Starting with 20 indicators from 4 dimensions of the 16 cities, the comprehensive resilience level of each city in Anhui Province from 2010 to 2020 was synthesized.

2.2. Research Methods

2.2.1. Min-Max Normalization

The process used in this paper is called Min-max normalization, also known as deviation normalization, and is a linear transformation of raw data so that the final data values are all in the range [0,1].

$$Y_{ij} = \frac{\chi_{ij} - min(\chi_{1j},\ \chi_{2j},\ \cdots,\ \chi_{\alpha j})}{max(\chi_{1j},\ \chi_{2j},\ \cdots,\ \chi_{\alpha j}) - min(\chi_{1j},\ \chi_{2j},\ \cdots,\ \chi_{\alpha j})} \quad (1)$$

(i= 1,2,; ⋯αj= 1,2,)⋯β

In the formula, select a city and an indicator, representing the actual value of the JTH indicator of city i, representing the standard value of the JTH indicator of city i, referring to the minimum value in the JTH indicator, and referring to the maximum value in the JTH indicator.$\alpha\beta\chi_{ij}Y_{ij}min(\chi_{1j},\ \chi_{2j},\cdots,\ \chi_{\alpha j})max(\chi_{1j},\ \chi_{2j},\cdots,\ \chi_{\alpha j})$.

2.2.2. CRITIC Weighting Method

CRITIC is an objective weight assignment method, which takes the contrast strength in the same indicator and the conflict between each indicator as the guide to comprehensively evaluate the objective weight of an indicator [7].

The calculation of the contrast strength of indicators:

$$S_j = \sqrt{\frac{\sum_{i=1}^{\alpha}\left(\chi_{ij}-\frac{1}{\alpha}\sum_{i=1}^{\alpha}\chi_{ij}\right)^2}{\alpha-1}} \quad (2)$$

Where, represents the standard deviation of the JTH indicator. S_jThe calculation of index conflict:

$$\theta_j = \sum_{t=1}^{\beta}(1-r_{tj}) \quad (3)$$

Where, represents the correlation coefficient between indicators t and j, and r_{tj}represents the $\theta_j$conflict of the JTH indicator.

The calculation of the amount of information;

$$C_j = S_j \times \theta_j \quad (4)$$

Where, represents the information contained by indicator j.C_j

Weight coefficient calculation:

$$W_j = \frac{C_j}{\sum_{i=1}^{\beta} C_j} \quad (5)$$

Where, is the objective weight of indicator j.W_j

2.2.3. Calculation of Urban Comprehensive Resilience Level Index

This paper uses the most commonly used method of calculating the evaluation index, the calculation formula is as follows:

$$\kappa_i = \sum_{j=1}^{\beta} W_j \times Y_{ij} \quad (6)$$

Where, is the weight of indicator j, is the JTH standard value of city i, and represents the comprehensive resilience level index of city i.$W_j Y_{ij} \kappa_i$

2.3. Data Sources

The research data in this paper are panel data of 16 prefecture-level cities in Anhui from 2010 to 2020. The data are mainly from China City Statistical Yearbook, China Finance Yearbook, Anhui Statistical Yearbook, and statistical yearbook and bulletin of prefecture-level cities from 2010 to 2020.

3. Comprehensive Urban Resilience Measurement and Spatio-Temporal Evolution Analysis of Anhui

3.1. Index System of Comprehensive Urban Resilience Evaluation

Following the principles of objectivity, comparability and scientificity of the research, indicators were selected from four aspects: economy, ecology, society and infrastructure, and an evaluation index system of comprehensive urban resilience level was established, consisting of 19 third-level indicators such as GDP.

1) Economic resilience can be regarded as the ability of an urban economic system to maintain and maintain its own system function after facing conflicts [8]. It includes two aspects: one is the resilience of the economic system to resist external shocks, reduce losses and maintain balance; The second is that the economic system can adjust its original ability to adapt to the complex situation after the disaster. Economic resilience is closely related to urban production and consumption levels and industrial structure, so it can be measured by five indicators: gross domestic product (GDP), the proportion of the tertiary industry in GDP, and the total sales of social consumer goods.
2) Social resilience is mainly a great integration of micro, meso and macro systems, that is, emphasizing the relevant links and interactions among individuals, groups and social organizations. In other words, when a city encounters an

emergency situation, it takes the main body of the social structure as the leading force to effectively realize the social integration [9]. To this end, five indicators are used to evaluate urban social resilience, including the unemployment rate of urban residents, the number of urban and rural residents participating in basic medical insurance and the number of beds in medical and health institutions.

3) Ecological resilience mainly starts from ecological carrying capacity, sustainability and resilience. It emphasizes that in the event of external impact, the urban ecosystem can become a natural barrier to protect the urban system at the minimum cost of ecological environment while maintaining its own ecological structure fundamentally unchanged, and realize the harmony between man and nature. Based on this, urban ecological resilience is comprehensively evaluated from the four aspects of urban air quality, green coverage rate, and three wastes discharge and disposal and utilization.
4) Infrastructure resilience mainly focuses on the study and analysis of the relationship between the level of urban resilience and the layout and location of infrastructure, facility management and the completeness of facilities, etc. It is a measure of a city's ability to adjust and recover when infrastructure is damaged after a disaster. In urban infrastructure, water, electricity and transportation systems play an important role in resilience assessment, which can ensure the basic living needs of urban and rural residents in times of crisis. Indicators are selected from the length of urban drainage pipes and the number of public transportation operations.

The weights of indicators determined by the weight method of CRITIC are shown in Table 1.

Table 1. Evaluation index system and weight of comprehensive resilience level of the city.1

Target Layer	Dimension layer	Indicator layer	Indicator properties	Weights
Urban resilience	Economic resilience (0.195)	GDP (billion yuan)	+	0.028
		GDP per capita (yuan/person)	-	0.049
		Share of tertiary industry in GDP (%)	+	0.051
		Total general public budget revenue (ten thousand yuan)	+	0.029
		Total sales of consumer goods (10,000 yuan)	+	0.038
	Social resilience (0.236)	Registered urban unemployment rate (%)	-	0.092
		Number of urban and rural residents participating in basic medical insurance (people)	+	0.042
		Number of beds in medical and health institutions (Zhang)	+	0.039
		Number of students in institutions of higher learning (persons)	+	0.028
		Total number of posts and telecommunications services (ten thousand yuan)	+	0.035
	Ecological resilience (0.347)	Green coverage rate of built-up area (%)	+	0.053
		Number of days with air quality at or above Grade II (days)	+	0.102

	Total industrial wastewater discharge (10,000 tons)	-	0.071
	Industrial sulfur dioxide emissions (tons)	-	0.061
	Comprehensive utilization of general industrial solid waste (tons)	+	0.060
	Urban drainage pipes (km)	+	0.028
Infrastructure resilience (0.223)	Number of public transport in operation at the end of the year (vehicles)	+	0.028
	Urban water penetration rate (%)	+	0.059
	Urban gas penetration (%)	+	0.045
	Per capita urban road area (square meters)	+	0.063

3.2. Analysis of Comprehensive Level and Time Evolution of Urban Resilience in Anhui Province

In this paper, the data of 16 prefecture-level cities in Anhui Province from 2010 to 2020 are comprehensively calculated, as shown in Table 2.

Table 2. Comprehensive resilience level index of cities in Anhui Province.2

Year / City	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hefei City	0.460	0.465	0.466	0.546	0.579	0.603	0.604	0.646	0.648	0.649	0.658
Huaibei City	0.357	0.338	0.371	0.357	0.363	0.337	0.342	0.342	0.320	0.301	0.311
Bozhou City	0.327	0.294	0.281	0.283	0.257	0.288	0.244	0.252	0.262	0.329	0.317
Suzhou City	0.362	0.380	0.353	0.361	0.351	0.332	0.315	0.303	0.319	0.305	0.347
Bengbu City	0.384	0.366	0.336	0.348	0.309	0.292	0.290	0.304	0.305	0.301	0.357
Fuyang City	0.214	0.281	0.214	0.252	0.230	0.225	0.214	0.225	0.294	0.320	0.302
Huainan City	0.463	0.441	0.469	0.450	0.433	0.467	0.418	0.399	0.396	0.385	0.406
Chu-zhou City	0.361	0.372	0.394	0.406	0.402	0.402	0.407	0.409	0.406	0.411	0.411
Liuan City	0.337	0.313	0.324	0.321	0.331	0.341	0.343	0.389	0.354	0.371	0.347
Ma 'an-shan City	0.424	0.425	0.430	0.433	0.446	0.448	0.462	0.463	0.470	0.470	0.507
Wuhu City	0.395	0.473	0.495	0.491	0.501	0.477	0.467	0.440	0.429	0.413	0.437
Xuancheng City	0.340	0.334	0.386	0.364	0.351	0.370	0.371	0.376	0.376	0.390	0.395
Tongling City	0.388	0.369	0.403	0.403	0.383	0.373	0.390	0.383	0.386	0.391	0.426

Chizhou City	0.323	0.313	0.302	0.308	0.310	0.311	0.322	0.331	0.338	0.347	0.378
Anqing City	0.326	0.319	0.370	0.374	0.383	0.379	0.366	0.376	0.367	0.370	0.379
Huang-shan City	0.398	0.379	0.342	0.347	0.355	0.363	0.369	0.371	0.387	0.406	0.411
AVER-AGE	0.366	0.366	0.371	0.378	0.374	0.375	0.370	0.375	0.379	0.385	0.399

(1) The overall level of urban resilience in Anhui province increased, while individual cities decreased

According to the comprehensive resilience level index of Anhui Province in Table 2, the average resilience level of cities in Anhui Province shows an increasing trend during the decade from 2010 to 2020. As can be seen from the data, Hefei and Ma 'anshan have the largest growth rate, increasing from 0.460 and 0.424 in 2010 to 0.658 and 0.507 in 2020 respectively. This is because Hefei, as the capital city of Anhui Province, has a high degree of government financial investment and attention in public safety and social security. Since Chaohu Lake became the inner lake of Hefei, Hefei has become the direction of striving to be "a famous lake city and an innovative highland". In 2014, Hefei compiled the Comprehensive Plan for the Failure of Municipal Infrastructure, integrated and optimized the city's municipal facilities resources, and greatly improved the resilience level in the dimension of infrastructure. However, Ma 'Anshan has gained a great opportunity due to the planning of Nanjing metropolitan Area, and has improved its economic and social resilience to different degrees. However, there are also some cities' resilience levels have been downgraded, among which the most obvious decline is Huainan City, which ranks the first in terms of urban resilience from 0.463 in 2010, and ranks the seventh by 2020, a decline of 0.057. Although Huainan's economic resilience and infrastructure resilience have improved slightly, the proportion of Huainan's primary and secondary industries is too large, and the proportion of primary industry even exceeds 10%. And Huainan's economic growth is mainly based on traditional backward coal, and ecological resilience has been showing a negative growth trend.

(2) The uneven degree of urban resilience has increased

Although the overall level of urban resilience in Anhui Province has improved, the gap between cities is also widening, and the degree of imbalance is getting worse. From 2010 to 2020, the extreme range of total resilience increased from 0.249 in 2010 to 0.356 in 2020. Through the data, it is found that the cities with large changes in the resilience index are mainly due to the change of ecological resilience. The cities that rise in the ranking have significantly improved their ecological resilience. Most of these cities emphasize ecological economy and industrial greening, and the government attaches great importance to ecological construction. However, the decline in the resilience level of the urban ecological resilience of the increase of a small or even negative growth situation, most of these areas are dominated by the first and second industries, the industrial structure is seriously unbalanced, serious damage to the ecosystem.

(3) The level division of urban resilience in Anhui Province

In order to better understand the characteristics of the comprehensive resilience level and time evolution of Anhui Province, this paper divides the urban resilience level in the range of [0,1] into 5 grades according to the method of equal interval division: 0 ~ 0.2 is considered as low resilience; Between 0.2 and 0.4 (including 0.2) is considered as low toughness; Between 0.4 and 0.6 (including 0.4) is considered as medium toughness; Between 0.6 and 0.8 (including 0.6) is high toughness, and between 0.8 and 1.0 (including 0.8) is called high toughness.

The number of cities within each grade of urban resilience level in Anhui Province in 2010, 2010 and 2020 was selected for statistics, as shown in Figure 1. As can be seen from

Figure 1, in 2010, the number of cities with low toughness, high toughness and high toughness was zero, and most of them were concentrated in the lower toughness grade. Low toughness cities accounted for 81% of the whole Anhui Province, and 3 medium-toughness cities accounted for 19%. In 2015 and 2020, the number of low-resilient cities was zero, and there were more resilient cities. Generally speaking, the number of high-resilient cities is gradually increasing, but there are still no strong resilient cities in the province.

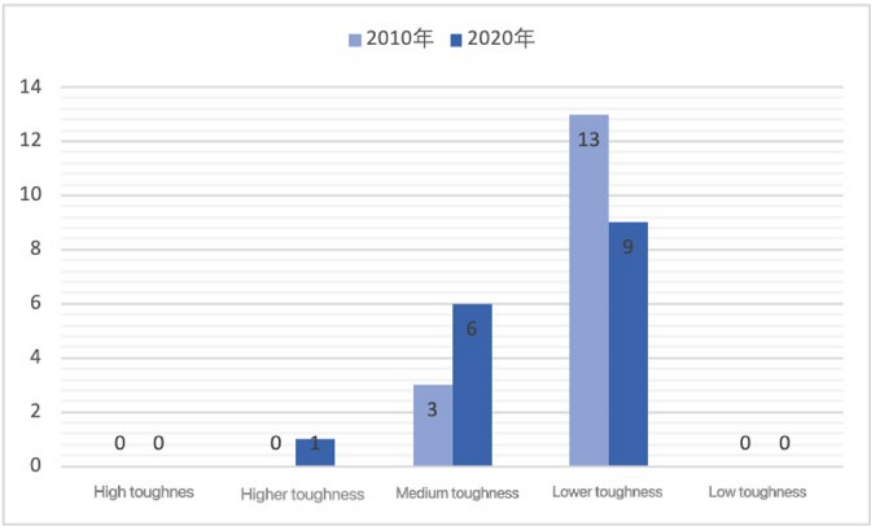

Figure 1. Statistical map of urban resilience levels in Anhui Province in 2010, 2015 and 2020.

3.3. Analysis on Spatial Evolution of Comprehensive Level of Urban Resilience in Anhui Province

In order to see the spatial evolution characteristics of the resilience level in the province more directly, this paper expressed the urban resilience level levels in 2010 and 2020 in the map of Anhui Province through arcgis, as shown in Figure 2 and Figure 3.

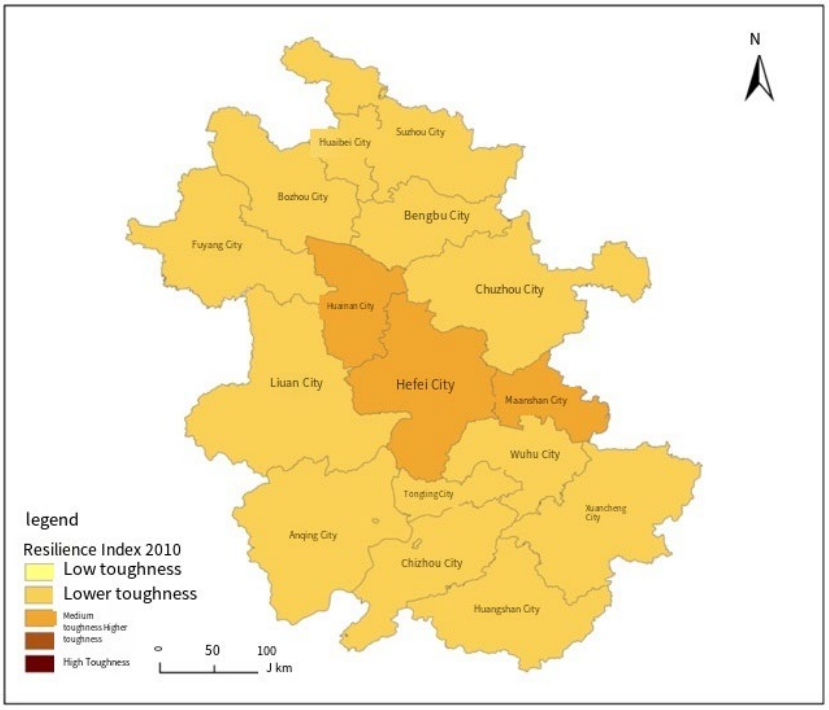

Figure 2. Spatial distribution map of urban resilience grade in Anhui Province in 2010.

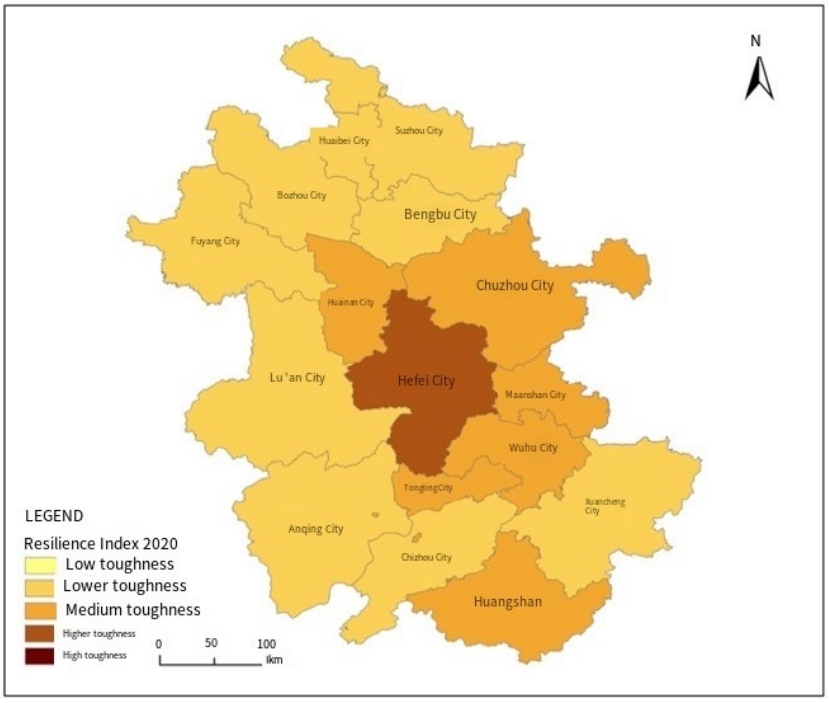

Figure 3. Spatial distribution of urban resilience levels in Anhui Province in 2020.

From the figure, it can be clearly seen that the resilience level of cities in central and southern Anhui is on the rise, and almost all of them are at the medium level. However, the resilience level of cities in northern Anhui is still at a low level with slow development speed.

From the perspective of urban administrative level, the urban resilience level of the provincial capital Hefei has improved more rapidly. This figure shows that Hefei takes the lead in entering the higher level of resilience. As a provincial capital city, Hefei has begun to highlight its advantages, and it is the only and the first city to be promoted to a higher level of resilience. This is inseparable from the close connection between provincial capital city and surrounding cities, and the strong regional mobility of provincial capital city. According to the figure the resilience level of several cities around Hefei has been continuously improved to a certain extent. However, due to the weak resilience foundation in the four dimensions, non-provincial capital cities are bound to have certain disadvantages in the growth rate of resilience compared with provincial capital cities. In the region, the resilience level of provincial capital cities and non-provincial capital cities is bound to show an unbalanced trend, and such spatial pattern of urban resilience is difficult to change in the short term. Although Huangshan City is far away from the provincial capital, its own ecological resources bring it natural advantages, and it is inseparable from Huangshan Mountain joining the Hangzhou metropolitan area. The resilience level of Huainan has remained relatively stable, which is closely related to its entry into the Hefei metropolitan area. In addition, the urban infrastructure is improving day by day, such as the high-speed rail is becoming more developed, and the cross-regional economic development has achieved remarkable results. The resilience level of most northern cities even appears retrogressive phenomenon, the relative foundation of ecology and infrastructure of these cities is poor, the community governance ability is backward and the emergency response ability is relatively slow, which directly affects the stability of the city and the spatial carrying capacity, and then the resilience index of the city is low, in addition, this and the provincial capital city radiation force is not wide enough also has a certain correlation.

All in all, the overall comprehensive resilience level of Anhui Province is still low, showing an obvious regional differentiation gap of "high in the middle and low around".

The resilience level of the provincial capital city has obvious advantages, other cities show a low toughness uniform distribution, and the average toughness level of the marginal city is low.

4. Conclusions and Suggestions

In conclusion, the average resilience level of cities in Anhui Province showed a trend of small fluctuation growth during the study period. There are obvious regional differences in spatial resilience. At the regional level, the resilience level of the central provincial capital city is higher than that of other surrounding cities, and the resilience difference is larger. The toughness level of most cities in northern Anhui showed a retrogressive trend, while that of cities in middle and southern Anhui increased.

According to the research results of this paper, the views of scholars and the experience of the construction of resilient cities at home and abroad are integrated, and the following suggestions are put forward on how to improve the resilience level and build resilient cities in Anhui province.

1) To advocate the coordinated economic development of the whole province, local governments should explore a suitable road for regional economic development according to local conditions, give appropriate preferential subsidy policies, vigorously promote the optimization and transformation of industrial structure, build a multiple intelligent industrial system and formulate a regular review and assessment system, and truly implement the policy; increase the use of new driving forces, expand the application of digital economy in the industry, promote the development of the economy to green and sustainable, and enhance the competitiveness of the city. In addition, we should give play to the exemplary role of large cities, expand the radiation surface of central cities, and enhance economic resilience. Priority should be given to the development of provincial capitals and cities with high levels of resilience. Then give play to the leading role of urban agglomerations, take provincial capitals as the center, grasp the spillover effect, connect cities in and around the province in turn, promote exchanges and contacts among cities, promote the transformation of cities with low resilience level to high resilience, and advocate common economic development within the region.
2) Social resilience is an important requirement in urban planning and construction. First of all, social income distribution should be continuously improved to narrow the gap between the rich and the poor, so as to further optimize the structure of all social strata. Actively improve all kinds of policies benefiting the people, such as medical insurance, social security, etc., to solve problems in citizens' lives. Secondly, local governments need to strongly support and connect with the construction of urban grassroots organizations to give full play to their important role in times of crisis. In the construction of grassroots organizations, the emergency management ability and professional knowledge of the staff within the organization should be continuously improved, and the necessary materials should be equipped when disasters occur. With the help of planning means, the grid management mode of grassroots organizations should be assisted on the basis of digital platforms, and the emergency information release platform should be improved to promote the enthusiasm of residents to participate. At the same time, the digital platform can realize a variety of new models of data census, so that water, electricity, gas and other integration, to meet the various requirements of residents. More importantly, the planning of resilient cities must further strengthen the mode of diversified participation of subjects. Extensive public participation is an important force in the face of sudden crises, and the combination of top-level design and the masses is an important link in the construction of resilient cities. Communities should mobilize the enthusiasm of

residents to participate, carry out science popularization activities in resilient cities, and strive to realize the valuable opinions of residents as an important basis for planning and practice. Finally, legal means can be adopted to improve the basic responsibilities of all social subjects and strengthen the precise participation of the whole society.

3) On the one hand, the ecological system is the natural protective barrier of the city. We should protect the ecological barrier of the territorial space and hold the final ecological defense line. For ecological functional areas, we should strictly abide by the principle of protecting the ecological system, constantly promote the restoration of the ecological environment, introduce relevant policies to gradually transfer the population of ecological functional areas to urban areas, and strictly restrict the development and construction of this area. On the other hand, we should always grasp the demarcation of double evaluation and triple life space in the territorial spatial planning, so as to realize the resilient support of the three major Spaces of production, living and ecology. We should promote the ecological resilience value of ecosystems and achieve harmony and win-win results between man and nature. In terms of industry, the government should vigorously support the development of low-pollution and sustainable intelligent high-tech industries, constantly optimize China's industrial structure, and cultivate a new model of green development. In terms of supervision, the government should implement strict control over the use of land space, strengthen urban environmental legislation and law enforcement, and strictly control urban environmental protection, so as to form a legalized mechanism.
4) To improve the comprehensive urban capacity for disaster relief and emergency response, attention should be paid to improving the resilience of infrastructure. Increase the investment in infrastructure hardware and software, and carry out intelligent and intelligent management of emergency reserve resources such as water, electricity, gas, transportation and medical care, so as to ensure the normal operation of the city in a critical state. The government should also improve the planning and construction of disaster prevention systems such as flood and flood prevention, drought and hail prevention, conduct hierarchical management of public health emergencies, improve the professional quality of medical personnel, strengthen the emergency response capability of medical teams, arrange emergency drills, and standardize the emergency response within medical institutions. In addition, it is necessary to speed up the construction of a legal system for disaster prevention and reduction and territorial resilience planning in line with China's national conditions, highlighting the key strength of disaster prevention and reduction and emergency management planning in the territorial spatial planning system. In addition, the government should also closely cooperate with various departments, increase efforts to promote the grid management of grass-roots emergency response, and form a good atmosphere of joint governance, coordination and participation of the whole society.

References

1. W. Du, G. Zhai, Y. Shi, and Y. Lu, "Structural resilience disparities in regional city networks under the influence of Typhoon Fitow and COVID-19," *Cities*, vol. 155, p. 105460, 2024, doi: 10.1016/j.cities.2024.105460.
2. M. Gao, Z. Wang, and H. Yang, "Review of urban flood resilience: insights from scientometric and systematic analysis," *Int. J. Environ. Res. Public Health*, vol. 19, no. 14, p. 8837, 2022, doi: 10.3390/ijerph19148837.
3. S. Li, Z. Chang, X. Wang, X. Bu, M. Chen, and J. Zhang, "A toughness-evaluating and toughness-improving method of power security infrastructures," in *Proc. 2022 2nd Int. Conf. on Comput. Control and Robotics (ICCCR)*, Mar. 2022, pp. 146-150, doi: 10.1109/ICCCR54399.2022.9790225.
4. H. Lustick, "Going restorative, staying tough: Urban principals' perceptions of restorative practices in collocated small schools," *Educ. Urban Soc.*, vol. 53, no. 7, pp. 739-760, 2021, doi: 10.1177/0013124520974335.

5. S. Diao, J. Yuan, and Y. Wu, "Performance evaluation of urban comprehensive carrying capacity of Harbin, Heilongjiang Province in China," *Chinese Geogr. Sci.*, vol. 29, pp. 579-590, 2019, doi: 10.1007/s11769-019-1056-9.
6. F. Stuart, "Code of the tweet: Urban gang violence in the social media age," *Soc. Probl.*, vol. 67, no. 2, pp. 191-207, 2020, doi: 10.1093/socpro/spz010.
7. T. Taggart, A. L. Brown, and T. Kershaw, "Neighborhood contexts and marijuana use among urban dwelling emerging adult men," *Am. J. Men's Health*, vol. 12, no. 4, pp. 944-951, 2018, doi: 10.1177/1557988317753222.
8. D. Tang, J. Li, Z. Zhao, V. Boamah, and D. D. Lansana, "The influence of industrial structure transformation on urban resilience based on 110 prefecture-level cities in the Yangtze River," *Sustainable Cities Soc.*, vol. 96, p. 104621, 2023, doi: 10.1016/j.scs.2023.104621.
9. C. Zhang and C. Dong, "The influence of social support on the mental health of elderly individuals in healthy communities with the framework of mental toughness," *Psychol. Res. Behav. Manag.*, pp. 2977-2988, 2023, doi: 10.2147/PRBM.S413901.