

Research on the Evaluation of Urban Quality in Yunnan Province Based on Principal Component Analysis Approach

Linglin Kang, Jie Jin*

School of Logistics and Management Engineering, Yunnan University of Finance and Economics, China

* Corresponding author

Abstract: Urban quality represents the spiritual taste and development quality of a city, and is the unity of the two. The level of urban quality reflects the level of the whole process of a city's planning, construction and management, and also directly affects the convenience and comfort of citizens' life, as well as relates to the agglomeration and attraction of various resource elements such as talents and industries. In other words, it is a comprehensive reflection of a city's strength, directly reflecting a city's economic development strength, urban social and cultural conditions, the beauty of the ecological environment, the level of public services and the living conditions of residents. China's economic development has entered a new period, has shifted from the stage of high-speed growth to the stage of high-quality development, and a clear understanding of the quality of the city is of great significance to high-quality development. This paper uses principal component analysis to conduct a comprehensive evaluation study of urban quality in 16 cities and towns in Yunnan Province from five dimensions: quality of urban economic development, social and cultural quality, quality of ecological environment, quality of public services, and quality of life of residents, using empirical data for the period of 2017-2021 as a sample of 16 cities and towns in Yunnan Province. The study found that although the comprehensive index of urban quality of each state and city in Yunnan Province has been steadily increasing year by year, the gap between the states and cities has not been significantly reduced. The development level of city sub-quality in each state and city in Yunnan Province is not balanced, and there are geographical differences, with a few cities, such as Kunming, having higher quality, while the quality of the majority of cities needs to be improved. The comprehensive scores of these city qualities are affected by indicators of economic development, social progress and environmental protection, and also show their own characteristics and advantages. In order to improve the quality of cities in Yunnan Province, it is recommended that policy guidance be strengthened, coordinated development among cities be promoted, investment in environmental protection be increased, and the development of social programs be advanced.

Keywords: Urban quality, Principal component analysis, Comprehensive evaluation.

1. Introduction

Since the reform and opening up, China's economy has continued to grow at a high rate and become the second largest economy in the world. With the increasing pressure on resources and the environment, China's socio-economic development has entered a period of transition, i.e., from the stage of high-speed growth to the stage of high-quality development. In this era, China's urban development is no longer purely pursuing quantitative increase, but focusing on the improvement of urban quality, and urban quality has gradually become an important research field. In order to accurately implement the new development concept, comprehensively enhance the people's sense of happiness, accessibility and security, and make cities healthier, safer, more livable and smarter, various regions have issued policies or executive documents for the enhancement of urban functions and quality. Therefore, a comprehensive evaluation of urban quality and a clear understanding of the state of urban development are of great significance for high-quality development. As an important province in western China, the development status of urban quality in Yunnan Province needs to be further studied and evaluated. Therefore, the purpose of this paper is to evaluate and study the urban quality of Yunnan Province based on the principal component analysis method, which provides a reference for improving the urban quality of Yunnan Province.

2. Literature Review

With the acceleration of China's urbanization process in recent years, urban quality has become one of the focuses of attention for academics and local governments.

Urban quality originated from the study of quality of life in the West, and evolved with the development of society [1]. Senlier et al. believe that the evaluation of urban quality of life should be based on a combination of subjective and objective methods, in which the objective indicators include socio-economics, civic participation, education and recreation, culture and the environment, etc., and the subjective indicators include the residents' perception of quality of life [2]. Weerdenburga et al. believe that urban spatial leisure activities, leisure tourism and related urban policies and planning should be included in the examination of urban quality [3]. Wang Enhui and Zhao Guoqing constructed a comprehensive evaluation index system of urban quality from four aspects of economy, culture, society and environment, and utilized the entropy value method to evaluate the urban quality of Wuhu city [4]. Ma Ben and Xue Yang quantitatively analyzed the urbanization quality of the Beijing-Tianjin-Hebei city cluster by establishing an urbanization quality evaluation model and applying the mutation theory from four perspectives: economy, life, service and ecology. Xu Lin and Cao Honghua constructed a comprehensive evaluation index system covering both natural

physical environment quality and social and human environment quality to evaluate the quality of 31 key cities [5]. Yang Shaobo believes that city quality construction should focus on factors such as humanism, quality of life, urban design, humanistic care, ecological environment, and innovation and entrepreneurship atmosphere [6]. Zeng Wei believes that urban culture is the soul of improving urban quality, and the cultural development of modernized cities will ultimately promote the improvement of urban quality [7]. Zhao Yujun [8] and Gao Yunhong [9] construct a comprehensive evaluation index system of urban quality covering five aspects, including economic development, ecological environment, public service, social culture and residents' life, from the connotation of urban quality. Gu Weizhong based on the goal orientation of urban construction to improve the quality of people's life, from the five points of the foundation, soul, guarantee, key and purpose of building quality cities as the theoretical basis for the construction of the quality city index evaluation system framework [10]. Sun Ruifeng utilizes multi-source data such as spatial morphology data and streetscape pictures to establish a basic database for quantitative research on street spatial quality, and builds a street spatial quality evaluation index system from the dual dimensions of material spatial composition and subjective spatial perception of urban street spatial quality, including five evaluation indexes of street spatial carrying capacity, street spatial attractiveness, travel safety, environmental comfort, and social interaction [11]. Li Wensheng et al. constructed a high-quality underground space as the goal, based on the concept of "people-oriented", starting from human perception, focusing on the human experience of "safety, efficiency, comfort, green" and other aspects, and put forward a people-oriented underground space quality evaluation index system, refining the network underground space quality evaluation index system. The index system of human-centered underground space quality evaluation is proposed to refine the elements of network underground space quality optimization planning and design, to lay the foundation for proposing a reasonable evaluation index system of urban underground space quality and establishing the evaluation method adapted to it, and to provide technical support for realizing the transition from qualitative evaluation to quantitative evaluation of the quality of underground space planning, and for creating high-quality underground space scientifically through evaluation for construction [12]. Wang S J, based on the angle of low-carbon development of the city. Wang S J constructed an index system of urban development intensity assessment from six aspects of land use, economic development, urban population, ecological environment, infrastructure and public services [13]. Tang Tieqiu et al. established a modernized quality city assessment index system including five areas of economic and social quality, natural environment quality, historical and humanistic quality, infrastructure quality and social service quality, and provided specific countermeasure opinions on the modernized quality city goal implemented in Jiaxing as an example [14]. Luo Zhanfu studied the quality of Lanxi city cluster from eight perspectives, including land use, economy, society, ecology, environmental protection, transportation, municipal and image quality, with the study object of Lanxi city cluster [15]. In addition to various scholars' studies, governments around the world have also gradually explored the construction of the assessment system and the selection of indicators of urban quality through practical cases, for example, the management

committee of Zhejiang City's "City of Quality" thematic investigation project team has included the five aspects of economic quality of life, humanistic quality of life, political quality of life, community quality of life, and environmental quality of life into the reference scope of urban quality. For example, the management committee of the Zhejiang City "City of Quality" project team included five aspects of economic quality of life, human quality of life, political quality of life, community quality of life, and environmental quality of life in the reference scope of city quality, and selected 50 indicators for assessment around the above five aspects. The report of Yangzhou City has constructed a three-tier indicator hierarchy, in which the first category of indicators includes industrial product quality, construction product quality, environmental product quality, community product quality, and daily life product quality, while the second category has 19 indicators and the third category has 60 indicators.

To summarize, domestic and foreign scholars' research on the comprehensive evaluation of urban quality mainly starts from five major connotations, namely, economy, social culture, ecological environment, public service and residents' life. The research methods of scholars at home and abroad are also similar, most of them tend to start from the five connotations of urban quality and construct relevant indicators, collect relevant data, and finally utilize relevant methods to carry out empirical analysis of urban quality. This paper refers to the existing authoritative literature, from the urban economic development, social and cultural, ecological environment, public services and residents' life of the five connotations of urban quality, taking the 16 cities and towns in Yunnan Province as an example, to build the evaluation indexes suitable for the 16 cities and towns in Yunnan Province, and to carry out a comprehensive evaluation of urban quality. Based on the results of the comprehensive evaluation of Yunnan Province, we analyze the differences and characteristics of the urban quality of the 16 cities and put forward countermeasures to improve the urban quality of Yunnan Province, which provides a reference basis for the formulation of targeted policies and measures and the promotion of high-quality development in Yunnan Province.

3. Construction of A Comprehensive Evaluation Index System for Urban Quality

The design of the comprehensive evaluation index system in this paper is based on the connotation of urban quality, with improving the quality of urban development as the core, taking into account the coordinated development of urban economy, ecology, culture, social governance and urban construction, and focusing on highlighting the important position of quality in urban development. Cities are the spiritual and spatial carriers of human development. Research has found that, in the context of high-quality development, the quality of modern cities is mainly reflected in five connotations: economic development, social culture, ecological environment, public services and residents' lives.

Quality of urban economic development. Cities are the bearers of social development, and the economy of a city drives the development of a city. The quality of the city's economic quality is mainly reflected in the optimization of the city's structure and power transformation, which is manifested in the contribution of the tertiary industry.

Meanwhile, Yunnan Province, as a tourist city, the development of its tourism industry drives part of the economic growth to a certain extent. The economic development of the city is reflected in the economic scale and spillover benefits generated by the city in the development process of spatial expansion and labor force upgrading, which makes the city's population size and per capita income level increase. The amount of actual utilized foreign capital can reflect the attractiveness of the city's open development policy and the convenience of the business environment. The total amount of import and export measures the city's foreign trade scale level, which comprehensively reflects the city's openness level.

The cultural quality of urban society. Cities are places where culture is nurtured, and urban development nurtures not only material culture but also spiritual culture. The quality of social culture mainly reflects the requirements of high-quality development for the transformation of urban dynamics, which is mainly manifested in the construction of books and literature.

Urban ecological quality. Cities are places where people live, and in the process of the continuous gathering of population and urban development, it is inevitable that pressure will be exerted on the limited natural resources, thus producing many negative effects. Therefore, the quality of urban ecology reflects the requirements for the green rise and high quality development of cities, emphasizing the harmonious coexistence of human beings and the environment, which is mainly manifested in the construction of cities in terms of the treatment of polluted wastes, comprehensive utilization, per capita green space area, greening area, and so on.

Quality of urban public services. Cities are places where services are provided, and one of the prerequisites for urban development is the provision of better services, improved market efficiency and the expansion of urban development potential. The quality of urban services is mainly reflected in an efficient urban market, emphasizing urban services for human and economic development, mainly in the provision of basic living resources, education and health care.

Quality of life of urban residents. Cities are places where citizens live, and the most primitive function of cities is to provide a place for people to live. High-quality development requires that it always be people-centered, requiring not only that people be able to live, but also that they live well. Therefore, the quality of urban life mainly reflects the requirements of high-quality development shared by the people of the city, which is mainly manifested in the construction of social security.

Based on the above analysis, and taking into account the actual situation in Yunnan Province, a comprehensive evaluation index system of urban quality is constructed, covering five secondary indicators and 33 specific indicators of economic development quality, social and cultural quality, ecological quality, public service quality and residents' quality of life, as shown in Table 1 below (The data used for the above indicators are obtained from Yunnan Provincial Statistical Yearbook, and statistical bulletins of national economic and social development of states and cities, etc.).

4. Determination of Evaluation Methods for Urban Quality in Yunnan Province

In this paper, principal component analysis (PCA) is used to study the empirical data of 16 cities and towns in Yunnan Province from 2017 to 2021. The principal component analysis method was originally introduced by Pearson, and Houghtaling has continuously improved it. The principle of the principal component analysis method is to use projection to reduce the dimensionality of the data, to transform multiple indicators into a few representative composite indicators under the premise of minimizing the loss of original data and information, and to use the transformed indicators to reflect the original information.

4.1. Standardization of evaluation indicators

Assuming that there are a total of j research objects (this paper refers to the 16 cities and towns in Yunnan Province), each object has i characteristics (33 indicator characteristics are selected in this paper), and the matrix X represents the collected data x_{ij} . Consistency of raw data. In the evaluation indicators, there are three indicators, namely, the emission intensity of major air pollutants from fixed pollution sources, the emission intensity of major water pollutants from fixed pollution sources, and the urban registered unemployment rate, which are negative indicators, and the rest are positive indicators. In this paper, we refer to Ye Zongyu's practice and use formula (1) to positively transform the reverse indicators.

$$x'_{ij} = \max\{x_{ij}\} - x_{ij} \quad (1)$$

The presence of excessive variance and differences in magnitude between the raw variables can have a serious effect, and to eliminate this effect between the data, all the raw data that have been normalized are standardized using Equation (2). Where \bar{x}_j and s_j are the mean and standard deviation of the first j mean and standard deviation of the variables.

$$x_{ij}^* = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (2)$$

4.2. Constructing the covariance matrix

KMO and Bartlett's test were performed on the standardized data and equation (3) was used to construct the covariance matrix R on the basis of the standardized matrix X , which reflects the relationship between the indicator data after the data were standardized.

$$R = X^*TX^*/(N - 1) \quad (3)$$

where X^* is the normalized data matrix, the eigenvalues $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_m$ of the correlation matrix R and the corresponding eigenvectors $\mu_1, \mu_2, \dots, \mu_m$ are obtained.

4.3. Determination of principal components and factor loadings

First, the variance contribution ratio was calculated using equation (4).

$$\eta_i = \lambda_i / \sum_i^p \lambda_i \quad (i=1,2,\dots,p) \quad (4)$$

The cumulative variance contribution was then calculated using equation (5).

$$\beta = \sum_{i=1}^m \lambda_i / \sum_{i=1}^p \lambda_i \quad (i=1,2,\dots,m,\dots,p) \quad (5)$$

Table 1. Comprehensive evaluation index system of urban quality

Tier 1 indicator level	Secondary indicator level	Three-tier indicator layer	notation	unit (of measure)	causality
Urban Quality	Quality of economic development	GDP per capita	X1	rmb	greater than zero
		Ratio of tertiary sector value added to total regional output value	X2	%	greater than zero
		General public income per capita	X3	rmb	greater than zero
		Real utilization of foreign capital per capita	X4	dollar	greater than zero
		Land utilization rate	X5	%	greater than zero
		Total labor productivity	X6	%	greater than zero
		Per capita income from tourism	X7	rmb	greater than zero
		Imports and exports per capita	X8	rmb	greater than zero
		Intensity of investment in research and experimental development	X9	%	greater than zero
	Socio-cultural quality	Number of libraries for 10,000 people	A1	classifier for volumes of books	greater than zero
		Mass Art and Cultural Centers	A2	classifier for individual things or people, general, catch-all classifier	greater than zero
		cultural center	A3	classifier for individual things or people, general, catch-all classifier	greater than zero
		public library	A4	classifier for individual things or people, general, catch-all classifier	greater than zero
		Per capita expenditure on cultural relics	A5	rmb	greater than zero
		museums	A6	classifier for individual things or people, general, catch-all classifier	greater than zero
	Ecological quality	Green space per capita in parks	B1	m2	greater than zero
		Greening coverage in built-up areas	B2	%	greater than zero
		Emission intensity of major air pollutants from stationary sources	B3	Tons/million	turn one's back on
		Emission intensity of major water pollutants from stationary sources	B4	Tons/million	turn one's back on
		Comprehensive utilization rate of general industrial solid waste	B5	%	greater than zero
		Urban sewage treatment rate	B6	%	greater than zero
	Quality of public services	General secondary school enrolment per 10,000 population	C1	man	greater than zero
		Number of elementary school students per 10,000 population	C2	man	greater than zero
		Number of hospital beds per 1,000 population	C3	sheet of paper	greater than zero
Number of health technicians per 1,000 population		C4	man	greater than zero	
Number of service enterprises above scale		C5	classifier for individual things or people, general, catch-all classifier	greater than zero	
Total postal operations per capita		C6	rmb	greater than zero	
Quality of life of the population	Urban unemployment registration rate	D1	%	turn one's back on	
	Per capita disposable income	D2	rmb	greater than zero	
	population density	D3	Persons/km2	greater than zero	
	Vehicle ownership per capita	D4	classifier for wheeled vehicles; such as cars, bicycles	greater than zero	
	Total social retail sales per capita	D5	the Yuan or Mongol dynasty (1279-1368)	greater than zero	
	Urbanization rate of resident population	D6	%	greater than zero	

The cumulative variance contribution rate calculated above determines the number of principal components, and the cumulative variance contribution rate is taken to be higher than 75% to 95% corresponding to the first m principal components, which covers most of the information that can be contained in the p original data, where m is the number of principal components. The factor loading matrix is established using the obtained data, and the correlation degree $R(Z_i, X_i)$ between the principal components and the original indicators is expressed by the factor loading.

4.4. Comprehensive Evaluation Score

For comprehensive evaluation, the linearly weighted expression for each principal component is first solved using Eq. (6), and the principal component score coefficients are the eigenvectors corresponding to the eigenroots of each principal component ε_i . The

$$F_i = \varepsilon_i Z_1 + \varepsilon_i Z_2 + \dots + \varepsilon_i Z_j \quad (i=1,2,\dots, m) \quad (6)$$

Equation (7) is then used to weight and sum the first m principal components to obtain the final evaluation value, and the weights are the variance contribution ratio of each principal component. η_i The weights are the variance contribution ratio of each principal component.

$$F = \sum_{i=1}^m \eta_i F_i \quad (7)$$

5. Evaluation Results and Analysis

5.1. Analysis of the results of the comprehensive evaluation of urban quality

Due to the fact that the states and cities in Yunnan Province involve more data in a wider range, this paper selects the time zone of the study as 2017-2021, and operates with spss

software, and the results show that the KMO value of the data collected in Yunnan Province reaches 0.80, and the significance test value of the Bartlett's test of sphericity is significantly 0, which indicates that there is a strong correlation between the variables, and the data are suitable for factor analysis. Table 2 shows the urban quality composite index of 16 cities and towns in Yunnan Province calculated according to the above principal component analysis. Among them, the values in the results produce negative values because of the standardization of the original data, which only indicates the deviation between the resultant values and the mean value, and the size of the composite score reflects the relative relationship between the years in the five-year period.

(1) As can be seen from Table 3 and Figure 1, the comprehensive index of urban quality in Yunnan Province shows a steady increase over time, with the average comprehensive score increasing from -0.5 in 2017 to 0.62 in 2021, and the overall situation of urban quality has improved relatively significantly, implying that Yunnan Province has achieved certain practical results in the past five years in all aspects of urban construction, planning and management. From Figure 1, it can be seen that the growth rate in 2017-2020 shows an upward trend, while the growth rate in 2020-2021 decreases significantly. This decline may be attributed to the challenges posed by the epidemic in late 2019 to economic development and other aspects of the country, as well as the fact that Yunnan Province was in a critical period of economic development during the time of the epidemic, which led to a slowdown in all aspects of urban development and construction in Yunnan Province. In conclusion, despite the decrease in growth rates from 2020 to 2021, the overall trend of the composite index of urban quality in Yunnan Province is still increasing. This suggests that the measures taken by the 16 cities and towns in Yunnan Province in terms of urban construction, planning and management are having a positive impact.

Table 2. Composite Urban Quality Score Index by State and City, 2017-2021

state (e.g. of US)	2017	2018	2019	2020	2021
Kunming, prefecture-level city and capital of Yunnan province in southwest China	4.01	4.09	4.33	4.45	4.74
Qujing prefecture level city in Yunnan	0.11	0.24	0.45	0.9	1.32
Yuxi prefecture level city in Yunnan	0.14	0.26	0.69	1.26	1.45
Baoshan prefecture level city in Yunnan	-0.94	-0.81	-0.54	0.27	0.31
Zhaotong prefecture level city in Yunnan	-0.78	-0.74	-0.43	-0.13	0.1
Lijiang prefecture level city in Yunnan	-1.05	-0.86	-0.72	-0.43	0.82
Pu'er prefecture level city in Yunnan	-1.1	-0.88	-0.62	-0.1	0.03
Lincang prefecture level city in Yunnan	-1.79	-1.21	-0.92	-0.61	-0.38
Chuxiong or Chuxiong county in Yunnan	-0.58	-0.55	-0.32	0.17	0.49
Honghe prefecture level city in Yunnan	0.3	0.41	0.66	1.19	1.53
Wenshan prefecture level city in Yunnan	-1.02	-0.99	-0.66	-0.19	0.01
Xishuangbanna prefecture level city in Yunnan	-0.96	-0.99	-0.6	-0.47	-0.32
Dali prefecture in Yunnan	-0.24	-0.23	0.03	0.56	0.7
Dehong prefecture in Yunnan	-0.74	-0.65	-0.14	0.3	0.18
Nujiang prefecture in Yunnan	-1.94	-1.72	-1.46	-0.75	-0.54
Diqing prefecture in Yunnan	-1.43	-1.59	-1.14	-0.71	-0.53

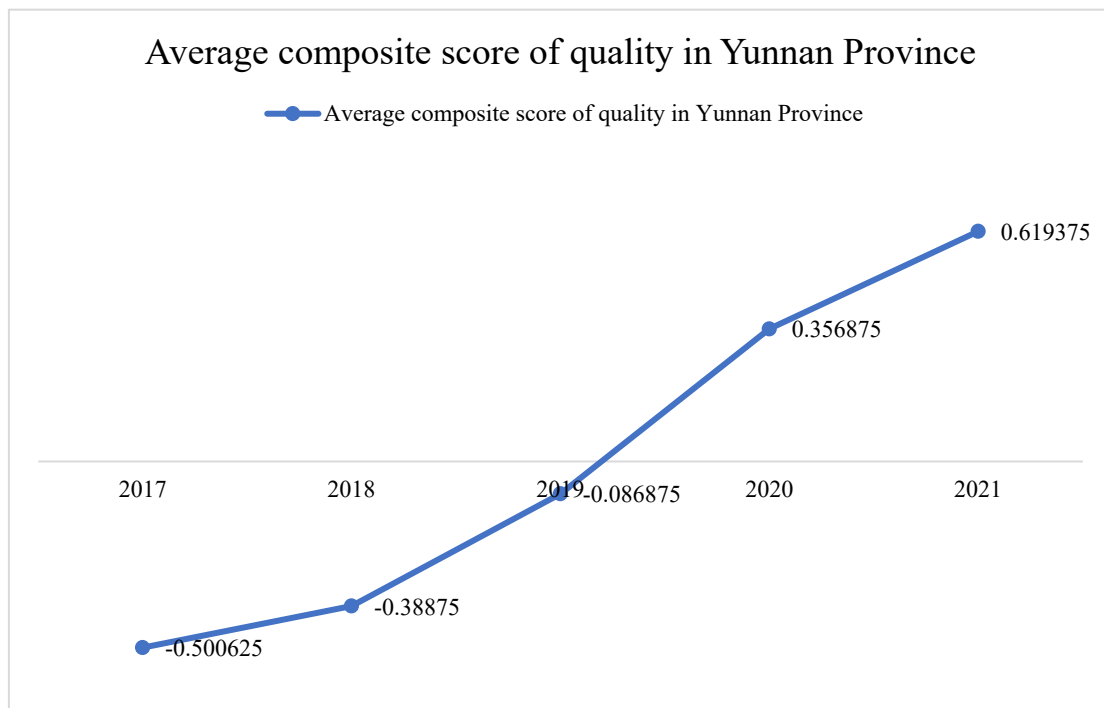


Figure 1. Average composite score of urban quality over the years

(2) In terms of the differences among the prefectures and cities, Kunming City shows a sustained growth trend over the five-year period, with the urban quality composite score index gradually increasing from 4.01 in 2017 to 4.74 in 2021. This indicates that Kunming City has achieved remarkable results in urban construction, planning and management. Qujing, Yuxi, and Honghezhou cities also show a relatively good growth trend over the five-year period, with a gradual increase in the urban quality composite score index. The improved scores of these cities and municipalities indicate that they have also achieved some tangible results in urban construction, planning and management.

Baoshan City, Zhaotong City, Lijiang City, Pu'er City, Lincang City, and Chuxiong Prefecture had relatively small changes in the urban quality composite score index over the five-year period, but were generally in a positive growth trend. These states still have some room for improvement in urban construction, planning and management. Xishuangbanna, Dehong, Nujiang and Diqing have relatively low urban quality composite score indices over the five-year period, with little change. These cities and municipalities need to make greater efforts to improve their urban quality in terms of urban construction, planning and management.

In conclusion, judging from the comprehensive score index of urban quality of each state and city, Kunming is in the leading position in Yunnan Province, and the urban quality of other states and cities has also improved to different degrees, but there is still some room for improvement. Each state and city needs to adapt to local conditions in terms of urban construction, planning and management.

5.2. Analysis of the results of the comprehensive evaluation of urban sub-quality

(1) Analyzing the changes of each state and city from 2017

to 2021 in terms of the quality of economic development, it can be seen from Figure 2 that the economic development of each state and city has been on a general upward trend over the five years. Kunming City has gradually improved its economic development quality score over the five-year period, from 2.65 in 2017 to 3.14 in 2021. This indicates that Kunming has achieved better results in economic development. Qujing and Yuxi cities also gradually improved their economic development quality scores over the five-year period, gradually increasing from negative values in 2017 to 0.68 and 2.4 in 2021. The improved scores of these cities and municipalities indicate that they have achieved some real results in economic development. Baoshan City, Zhaotong City, Lijiang City, Pu'er City, Lincang City, and Chuxiong Prefecture had smaller changes in their economic development quality scores over the five-year period, but were generally on a positive trend. These states and cities still have some room for improvement in economic development. Xishuangbanna, Dali, Dehong, Nujiang and Diqing have relatively low scores and little change in economic development quality over the five-year period. These cities and municipalities need to make greater efforts in economic development in order to improve the quality of their economic development.

To summarize, Kunming City has relatively high quality of economic development in Yunnan Province, and other states and cities have also improved to different degrees, but they still need to make further efforts to improve the quality of economic development. Each state and city should take effective measures to promote economic development and improve the quality of economic development according to its own actual situation in order to better meet the economic development needs of its residents.

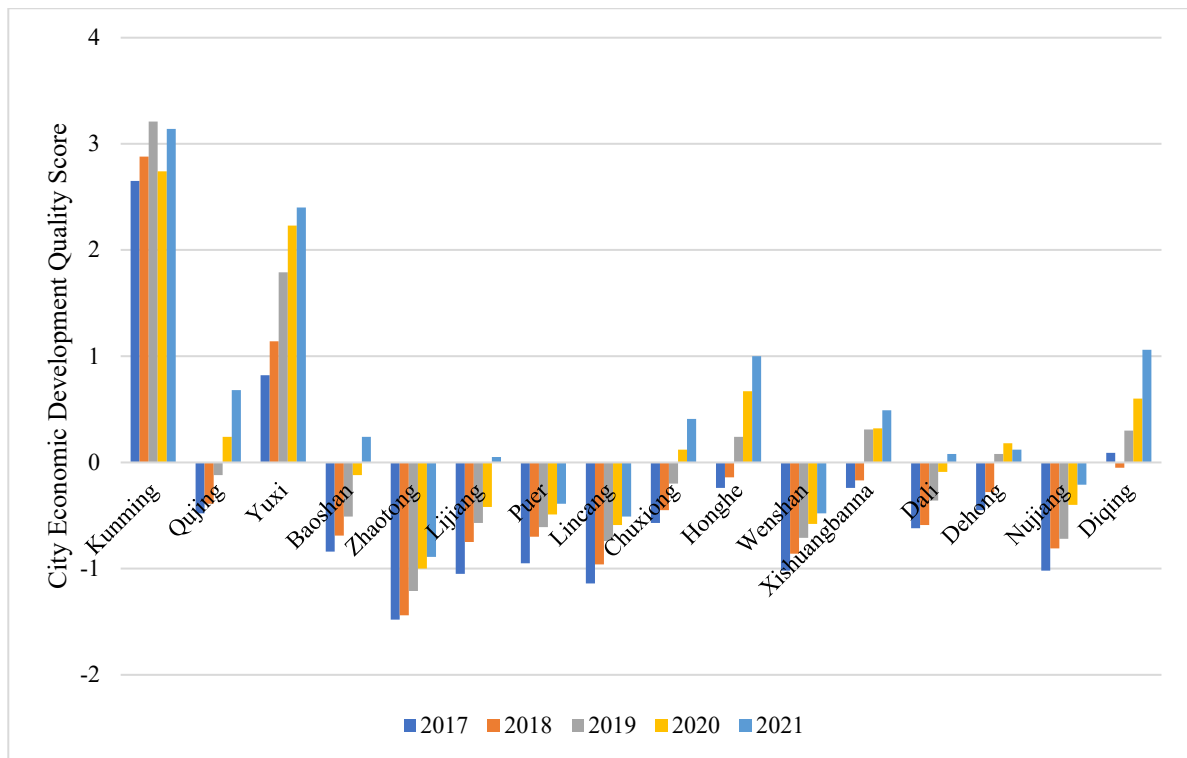


Figure 2. Composite Economic Development Quality Score by State and City, 2017-2021

(2) Analyzing the changes of each state and city from 2017 to 2021 in terms of socio-cultural quality, it can be seen from Figure 3 that the socio-cultural quality of each state and city in the five years is characterized by a decrease and then an increase. Kunming City shows a better growth trend in social and cultural quality, gradually increasing from 2.84 points in 2017 to 3.57 points in 2021. This indicates that Kunming City has achieved some real results in social culture. Qijiang and Yuxi have seen less change in their social and cultural quality scores over the five-year period, with Qijiang rising from 0.74 in 2017 to 1.24 in 2021, and Yuxi scoring lower in 2017 but then improving. These cities and municipalities still have some room for improvement in social culture. Baoshan City, Zhaotong City, Pu'er City, Lincang City, and Chuxiong Prefecture had smaller changes in their social and cultural quality scores over the five-year period, but were generally on a positive growth trend. These cities and municipalities still

have some room for improvement in social culture. Lijiang City's social and cultural quality score shows a decreasing trend over the five-year period, from -0.93 in 2017 to -0.97 in 2021. This indicates that Lijiang City needs to make more efforts to improve its social and cultural quality. Honghe Prefecture and Dali Prefecture have relatively high scores in social and cultural quality over the five-year period, increasing from 1.54 and 1.22 in 2017 to 1.77 and 1.4 in 2021, respectively. These cities and municipalities have achieved some tangible results in terms of social culture. Wenshan Prefecture, Xishuangbanna, Dehong Prefecture, Nuijiang Prefecture, and Diqing Municipality have relatively low scores and little change in social and cultural qualities over the five-year period. These cities and municipalities need to make greater efforts to improve their social and cultural quality.

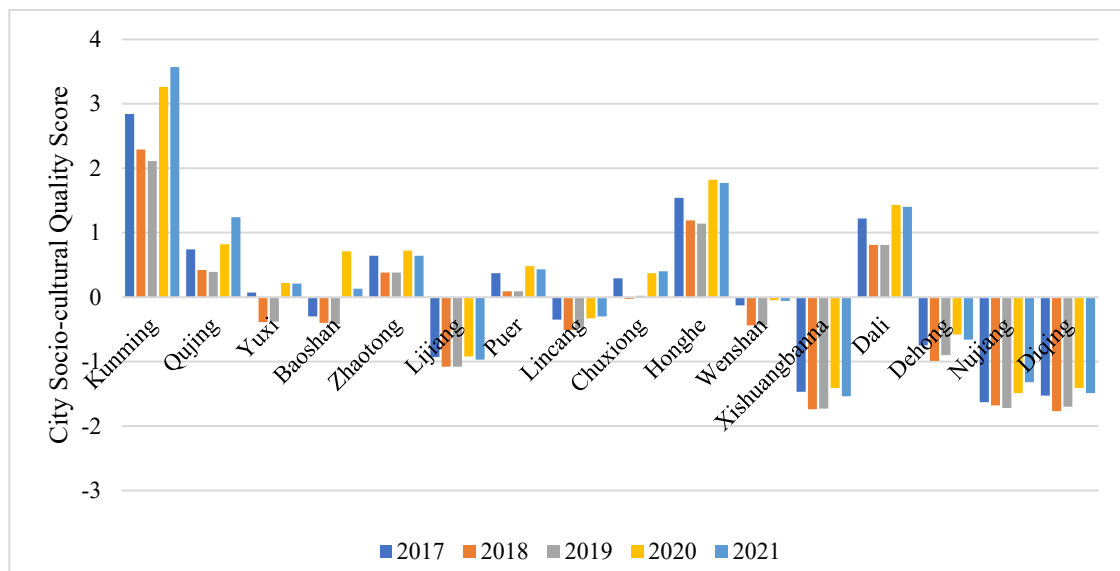


Figure 3. Composite score of socio-cultural quality by state and municipality, 2017-2021

Overall, Kunming performs relatively well in terms of socio-cultural quality, and other cities and towns have also improved to varying degrees, but further efforts are still

needed to enhance socio-cultural quality for the development of the city and to improve the quality of life of its residents.

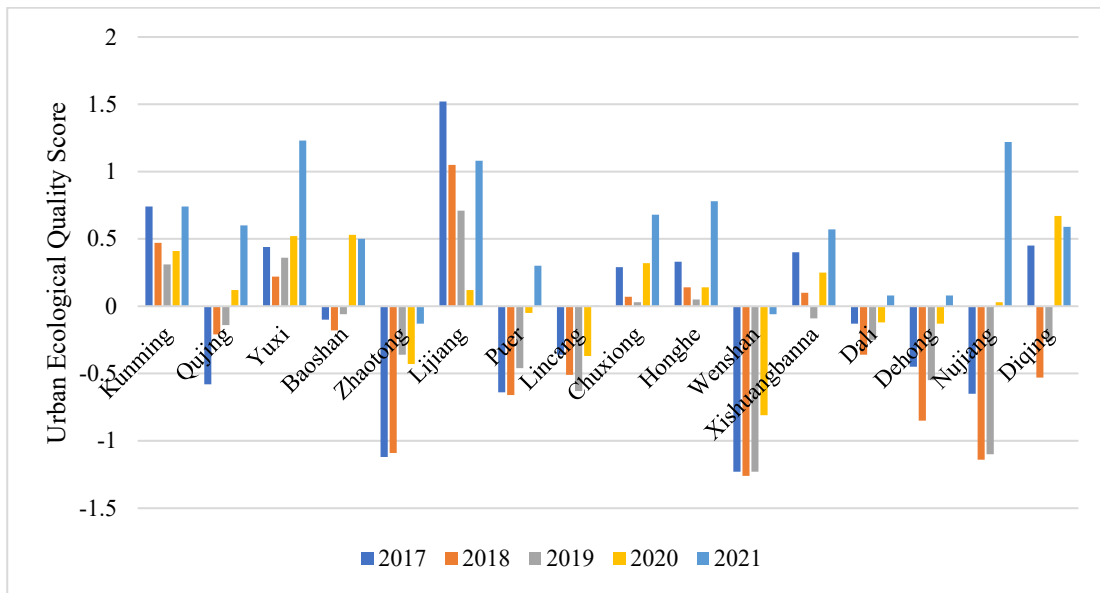


Figure 4. Composite Ecological Quality Score by State and City, 2017-2021

(3) From the ecological environmental quality to analyze the changes of each state and city in 2017-2021, it can be seen from Figure 4 that the development of the ecological environmental quality of each state and city is uncoordinated, with a clear upward and downward trend, and a great deal of scheduling. It shows that there is still some room for improvement in the development of the ecological environment in each state and city, and there are still some difficulties in resource allocation, which leads to the uncoordinated development of the ecological environment and causes the phenomenon of the environmental quality of each state and city to be high and low. The ecological environmental quality score of Kunming City is relatively high, but there is little change in the ecological environmental quality score from 2017-2021, indicating that the measures taken by Kunming City in ecological environmental protection are not strong enough and have not achieved significant improvement results. Qujing City, Yuxi City, Pu'er City, Lincang City, and Chuxiong Prefecture gradually improved their ecological environmental quality scores over the five-year period, gradually increasing from negative values to 0.6, 1.23, 0.3, 0.003, and 0.68 in 2021. The improvement of the ecological environment quality scores of these cities and towns indicates that they have achieved some practical results in ecological environment. Baoshan City, Zhaotong City, Lijiang City, Honghe Prefecture, and Dali Prefecture had smaller changes in their ecological environment quality scores during the five-year period, but were generally in a positive trend. These states and cities still have some room for improvement in ecological environment. Wenshan Prefecture, Xishuangbanna, Dehong Prefecture, Nujiang Prefecture and Diqing Municipality have relatively low ecological environment quality scores and little change over the five-year period. These states and municipalities need to make more efforts in ecological environment to improve the quality of ecological environment, promote the development of the cities and improve the quality of life of the residents.

Overall, the ecological environment quality scores of the states and cities in Yunnan Province are relatively low, and there is more room for improvement. All states and cities should take effective measures to increase ecological environmental protection and governance according to their own actual situation, in order to improve the quality of the ecological environment, promote the sustainable development of the city and enhance the quality of life of the residents.

(4) Analyzing the changes of each state and city from 2017 to 2021 in terms of the quality of public services, it can be seen from Figure 5 that the quality of public services in each state and city generally shows an upward trend. The public service quality score of Kunming is relatively high, gradually increasing from 2.61 in 2017 to 2.74 in 2021. This indicates that Kunming City has achieved some real results in public services. Qujing City, Yuxi City, Baoshan City, Zhaotong City, Pu'er City, Lincang City, and Chuxiong Prefecture gradually improved their public service quality scores over the five-year period, gradually increasing from negative values to 0.21, 0.15, 0.27, 0.12, 0.22, 0.05, and 0.3 in 2021. The improved scores of these states and municipalities indicate that they have achieved some tangible results in public services. Honghe Prefecture and Dali Prefecture have seen less change in their public service quality scores over the five-year period, but are generally on a positive growth trend. These states still have some room for improvement in public services. Wenshan Prefecture, Xishuangbanna, Dehong Prefecture, Nujiang Prefecture and Diqing Municipality have relatively low public service quality scores over the five-year period, with little change. These cities and municipalities need to make greater efforts to improve the quality of public services in order to promote urban development and enhance the quality of life of their residents.

Overall, the public service quality scores of the states and cities in Yunnan Province are relatively low, and there is more room for improvement. All states and cities should take effective measures to increase public service investment and

construction according to their own actual situation, in order to improve the quality of public services, promote the

sustainable development of cities and enhance the quality of life of residents.

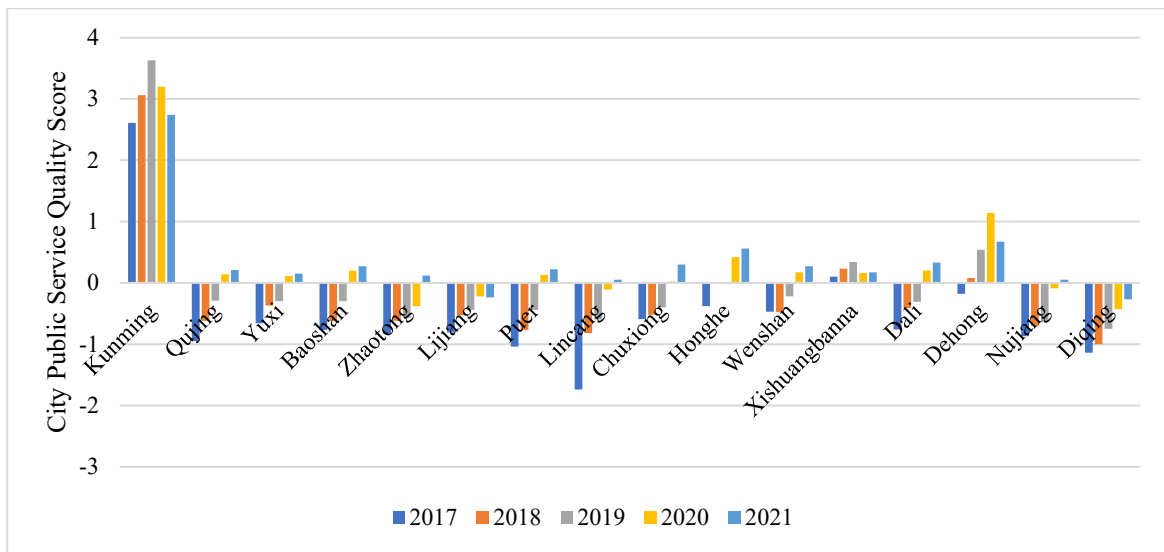


Figure 5. Public Service Quality Scores by State and City, 2017-2021

(5) From the quality of life of residents to analyze the changes in each state and city from 2017 to 2021, from Figure 6, it can be seen that compared with 2017, the quality of life of residents in each state and city in 2021 have improved. The quality of life score of residents in Kunming is relatively high, gradually increasing from 3.18 in 2017 to 3.76 in 2021. This indicates that Kunming has achieved some real results in terms of residents' life. Qujing City, Yuxi City, Pu'er City, Lincang City and Chuxiong Prefecture have gradually improved their residents' quality of life scores over the five-year period, gradually increasing from negative values to 0.35, 1.47, -0.55, -0.67 and 0.24 in 2021. The improvement in the scores of these cities and towns indicates that they have achieved some real results in the lives of their residents. Baoshan City, Zhaotong City, Lijiang City, Honghe Prefecture, Wenshan Prefecture, Xishuangbanna, Dali Prefecture, Dehong Prefecture, Nuijiang Prefecture, and Diqing Municipality have relatively low scores and little change in the quality of life of their residents over the five-year period. These states and municipalities need to make greater efforts to improve the quality of life of their residents in order to promote the development of their cities and

improve the quality of life of their residents. However, in terms of the development trend of these five years, it is not a steady growth, after the outbreak of the epidemic that is, at the end of 2019 the quality of life of the residents of the states and municipalities in 2020 and 2021 has declined to varying degrees, and the quality of life of the residents in 2021 compared to 2020 has declined significantly. This is due to the fact that from the beginning of the epidemic the various needs of the people were difficult to be met in all aspects, and Yunnan Province and even the whole country were in a state of tension and in the midst of fighting the epidemic. With slow economic development, the quality of life of the population naturally declines.

Overall, the scores of residents' quality of life in the states and cities of Yunnan Province are relatively low, and there is more room for improvement. All states and cities should take effective measures to increase public service investment and construction according to their own actual situation, in order to improve the quality of life of residents, promote the sustainable development of cities and improve the quality of life of residents.

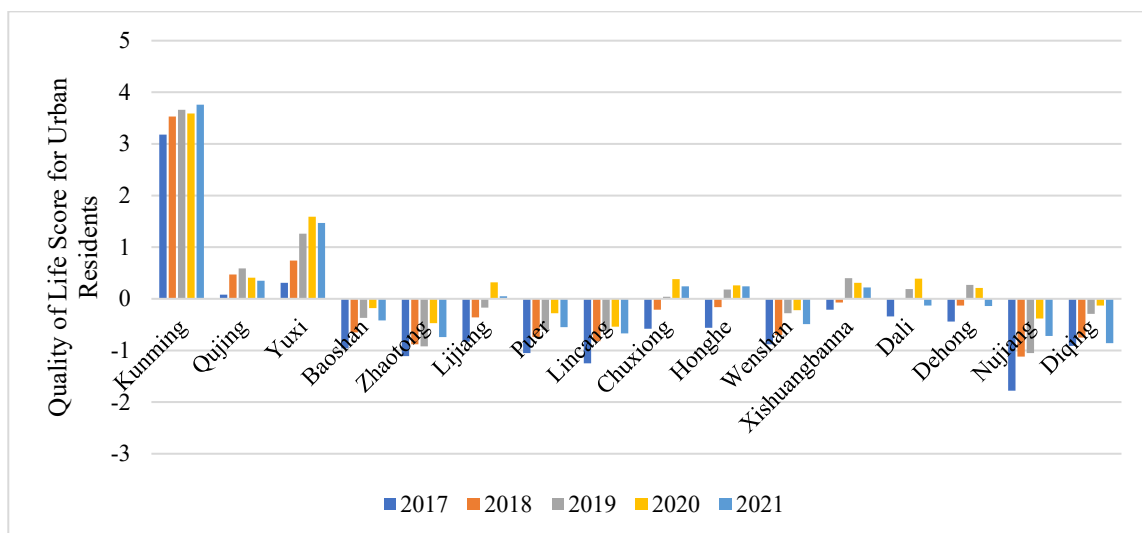


Figure 6. Composite Quality of Life Score for Residents by State and City, 2017-2021

In summary, the overall urban quality of the states and cities in Yunnan Province is at a moderately low level. From the perspective of the five major sub-qualities, there is an uneven development among the prefectures and cities. Although Kunming has relatively high comprehensive urban quality, its ecological environment quality is relatively low. Although Diqing Prefecture has a low comprehensive urban quality, its economic development and ecological environment quality are at a medium level. While a few city sub-qualities in Lincang, Nujiang, Zhaotong and other cities and towns have a more balanced development, the overall quality is still at a low level.

6. Conclusions and Responses

This paper constructs a comprehensive evaluation index of urban quality suitable for Yunnan Province from the connotation of five major urban qualities, and analyzes the current status of urban quality in 16 cities and towns in Yunnan Province using principal component analysis. The results show that the urban quality of each state and city in Yunnan Province is improving steadily over time, but the growth rate has slowed down since the outbreak of the epidemic. Kunming, Qujing, Yuxi, and Honghe, as the center cities of the central Yunnan urban agglomeration, have developed better urban quality. Nujiang, Diqing, Lincang and Xishuangbanna are at a low level of urban quality development. The overall urban quality level of the 16 cities and towns in Yunnan Province is on the low side, with almost half of the cities and towns at a low level, and the difference in urban quality level between regions is relatively large.

The empirical results of this paper point out the direction of urban planning and construction for the states and cities in Yunnan Province to a certain extent:

5.1 In terms of the quality of economic development, Yunnan Province also needs to continue to promote the establishment of a mechanism for coordinated regional development, and gradually form a regional economic layout with obvious main functions, complementary advantages and high-quality development. Specific recommendations are set out below:

(1) Responding to the national call to promote the transformation of the city's economy from a crude to an intensive one and from an incremental to a stock-based one. This includes improving the efficiency of resource allocation, optimizing industrial structure, upgrading technology, and strengthening enterprise management. Vigorously develop the tourism industry.

(2) As a tourist destination, Yunnan Province is blessed with natural resources and humanistic landscapes. By upgrading the quality of tourism services, creating a tourism brand with Yunnan style and attracting more tourists to stay, it can promote the economic growth of states and cities and improve the quality of cities.

(3) Optimizing the economic structure of cities and vigorously developing medium- and high-end industries. This can promote the industrial upgrading of states and cities, improve the competitiveness of cities, and continue to promote the healthy development of the economy. Grasp its own reality and unleash the charm and vitality of urban innovation.

(4) Strengthening regional coordinated development. Yunnan Province can establish an effective mechanism for regional coordinated development, giving full play to the

resource advantages and characteristics of each state and city to form a pattern of complementary advantages and synergistic development. This can be achieved by strengthening transportation links, promoting industrial transfer, and enhancing regional cooperation.

Through these measures, states and cities in Yunnan Province can improve the quality of economic development and promote the overall improvement of urban quality.

5.2 In terms of socio-cultural qualities, Yunnan Province is endowed with unique and rich tourism resources, which are an important part of its socio-cultural qualities. The following are some specific recommendations:

(1) Creating a good urban socialization atmosphere: All cities and municipalities in Yunnan Province should pay attention to creating a good urban socialization atmosphere. This includes protecting and restoring historical and cultural heritage, upgrading the quality of urban public space, improving the quality of life of citizens, and creating a safe, comfortable and inclusive urban environment.

(2) Cultivating a unique corporate culture: Enterprises should focus on cultivating a unique corporate culture in order to enhance their employees' sense of belonging and responsibility and to promote the sustainable development of the enterprise. This can be achieved by organizing regular corporate culture activities, promoting the spirit of enterprise and enhancing employees' sense of social responsibility.

(3) Developing a variety of experiential recreational activities: Communities need to vigorously develop a variety of experiential recreational activities in order to satisfy the intrinsic needs of citizens and enhance community cohesion. For example, special cultural festivals, concerts, painting exhibitions, theatrical performances, etc. can be organized.

(4) Vigorously developing cultural industries: Yunnan Province can utilize its rich cultural resources to vigorously develop cultural industries. For example, it can enhance the quality and added value of cultural industries through innovation and scientific and technological means, and promote the upgrading and development of cultural industries.

(5) Improving public cultural service guarantees: The Government, enterprises and communities should link up in a multi-party effort to improve public cultural service guarantees in order to promote the prosperity of cultural endeavors. For example, they can increase investment in cultural undertakings, improve the quality of public cultural facilities, provide diversified public cultural services, and promote outstanding cultural works.

Through the above measures, the social and cultural quality of Yunnan Province will be further improved, and it will be more attractive for domestic and foreign tourists to come and visit.

5.3 In terms of ecological quality, the following aspects can be addressed:

(1) Vigorously develop green and low-carbon industries: Yunnan Province should actively promote the application and popularization of renewable energy and clean energy, promote the optimization of energy structure and reduce carbon emissions. At the same time, it can guide and support green technological innovation and green industrial development, and promote the development of circular economy and low-carbon economy.

(2) Actively promoting urban pollution control: urban pollution control is one of the most important measures to improve the quality of the ecological environment. Cities in

Yunnan Province should adopt comprehensive pollution control measures, including the implementation of energy conservation and emission reduction, garbage classification and treatment, and water pollution control, to improve the quality of the urban environment.

(3) Accelerating the construction of infrastructure for the urban environment: urban environmental infrastructure is an important guarantee of the quality of the urban ecological environment. Cities in Yunnan Province should accelerate the construction of environmental infrastructure, including sewage treatment plants, garbage treatment plants, public greening facilities, etc., to improve the environmental carrying capacity of cities.

(4) Increasing the area of green space: Increasing the area of green space is one of the effective measures to improve the quality of urban ecological environment. Cities in Yunnan Province should rationally plan urban green space, increase the area of urban green space, and improve the urban greening coverage rate.

(5) Protection of urban forest resources: Urban forest resources are an important part of the urban ecological environment. Cities in Yunnan Province should strengthen the protection and management of urban forest resources and promote the sustainable growth of urban forest resources and the enhancement of ecological functions.

(6) Establishment of a systematic ecological environmental protection system: Cities in Yunnan Province should establish a sound ecological environmental protection and management system, including environmental monitoring, environmental impact assessment, and environmental law enforcement, in order to ensure the healthy and sustainable development of the urban ecological environment.

Through the implementation of the above measures, the ecological environment quality of Yunnan Province will be further improved, providing a solid ecological environment guarantee for building a beautiful Yunnan.

5.4 In terms of the quality of public services, Yunnan Province can take the following measures:

(1) Insisting on demand-oriented and precise supply of public services: Public services in Yunnan Province should start from the actual needs of citizens and, through surveys and analyses, determine the priority and demand for various types of public services. At the same time, accurate and personalized public services should be provided according to the characteristics of different regions and groups in order to meet the diversified needs of citizens.

(2) Providing financial support and striving for equalization of public services: The Yunnan Provincial Government should increase its investment in public services and improve the coverage and quality of public services through rational fiscal policies. At the same time, it should focus on balancing the level of public services between urban and rural areas, eliminating the gap between urban and rural areas, so that every citizen can enjoy equalized public services.

(3) Promoting technological innovation in the field of public services: using modern scientific and technological means to improve the quality of supply. Through technological innovation, public services can be personalized and intellectualized, and service quality and efficiency can be improved.

In implementing the above measures, Yunnan Province should also establish a sound mechanism for assessing and monitoring the quality of public services, and continuously optimize the content and quality of services through regular

assessment and feedback. At the same time, communication and interaction with the public should be strengthened, so as to enhance the public's sense of participation in and access to public services

5.5 In terms of the quality of life of the population, Yunnan Province can take the following measures:

(1) Actively developing the community service industry: Improving the comprehensive quality of service personnel is crucial to improving the quality of life of residents. Yunnan Province should strengthen the training and quality improvement of community service personnel, and improve their abilities in terms of professional ethics and business level. Regular training mechanisms can be established to improve the professional knowledge and service skills of service personnel to ensure that they can provide high-quality services to residents.

(2) Improvement of living quality: Yunnan Province should strengthen the rectification of rotten buildings and the adjustment of housing structure to improve the living quality of residents. Relevant policies can be formulated to encourage and support the renovation and upgrading of old neighborhoods to improve the living environment of residents. At the same time, the supervision of housing quality should be strengthened to ensure that the housing meets the relevant national standards and norms, so that residents can live in peace and comfort.

(3) Improving urban social security: Optimizing the allocation of medical and health-care resources and solving the problem of difficulty in accessing medical care, which has long plagued the majority of residents. Yunnan Province should increase its investment in medical and health care, improve the coverage and quality of medical facilities, and enable residents to enjoy high-quality medical services. At the same time, a sound social security system should be established to provide residents with a full range of social security and enhance their sense of security in life.

(4) Meeting the needs of the spiritual and cultural life of the elderly: For the elderly, Yunnan Province should endeavor to meet their spiritual and cultural needs. Facilities such as various kinds of cultural activity centers and universities for the elderly can be established to provide diversified cultural and recreational activities to enrich the lives of the elderly. At the same time, attention should be paid to the mental health and quality of life of the elderly, and the necessary services and support should be provided to enable them to spend a happy old age.

(5) Providing employment assistance to low-income groups that are willing to move to employment: Yunnan Province should establish a sound mechanism for employment assistance and provide employment guidance and support to low-income groups that are willing to move to employment. Employment training and skills upgrading courses can be provided to help them enhance their employ ability and competitiveness, and realize stable employment and increased income.

Through the implementation of the above measures, the quality of life of residents in Yunnan Province will be further improved, laying a solid foundation for building a harmonious society and livable cities.

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