

## Space and Temporal Analysis of Social Economic Vulnerability in Guizhou Province

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**Keywords:** Disaster-Bearing Body, Vulnerability, Social Economy, GIS.

**Abstract:** China is a country with multi-disaster risk, with large disaster risks and hidden dangers, and disaster resistance is different across the country. In order to find out the basic number of national disaster risks and hidden dangers, and objectively understand the comprehensive disaster risk level in the country and various regions, relevant departments issued a notice on the General Plan of the National Comprehensive Disaster Risk Survey in December 2019. Guizhou Province has formed the implementation plan of the provincial comprehensive disaster risk survey to actively implement the relevant national regulations and requirements. According to the implementation, the time and spatial location information assessment, analyze the vulnerability characteristics, not only provides disaster risk information and decision basis for the social and economic sustainable development, but also the important vulnerability evaluation methods of the upcoming population, housing, resources and environment and the comprehensive information of risk factors.

### 1. Introduction

There are many disasters in Guizhou Province, mainly including five major disasters: earthquake disasters, geological disasters, meteorological disasters, water and drought disasters, forest and grassland fires. For the objective understanding of the province comprehensive disaster risk level, to carry out the comprehensive disaster risk census is necessary, and the spatial location and quantity of all kinds of disaster carrier is an important input information of disaster loss assessment, the assessment of disaster vulnerability level as one of the main content is also very important.

Disaster-bearing body refers to all aspects of human itself and social development that are directly affected and damaged by disasters, involving industry and agriculture, transportation, culture, various disaster reduction engineering facilities and all kinds of wealth accumulated by people. By evaluating the social and economic vulnerability of nine prefectures and cities in Guizhou Province, it reveals their temporal and spatial distribution characteristics, objectively understands the vulnerability level of disaster carriers in each region, and provides decision-making and suggestion reference for the zoning and the prevention and control of disaster risks in Guizhou Province in the future.

### 2. Study Area

Guizhou province is located in southwest China, between 103°36' - 109°35' east longitude, 24°37' - 29°13' north latitude. The total land area of the province is 176,167 million km<sup>2</sup>, accounts for 1.80% of the country's land area, and the province is divided into nine prefectural cities.

With the support of national policy support, Guizhou province has achieved sustained growth rate for many years. The economic growth rate since 2010 has ranked among the top three in China, and the economic aggregate exceeded one trillion yuan in 2015<sup>[4]</sup>. In 2019, the province's gross regional product (GDP) reached 1.676.934 billion yuan, ranking 22 in China, with a growth rate of 8.3%,

ranking first in the country for three consecutive years<sup>[5]</sup>. In 2020, the province's gross regional product (GDP) reached 1,782.656 billion yuan, an increase of 4.5% over the previous year. Guizhou province is constantly transforming from an economically underdeveloped province with underdeveloped resources. It adheres to the main tone of "accelerating development, accelerating transformation and promoting leap-forward", and continues to catch up.



Figure 1 Location map of Guizhou Province.

### 3. Basic Data Sources

The study based on the socio-economic vulnerability of Guizhou Province in 2015 and 2019, Most of the data come from statistical Yearbook of Guizhou Province in 2020 and 2016. The 2019 fixed asset investment data came from the Statistical Bulletin of National Economic and Social Development in 9 prefectures and cities, Income is calculated based on the growth rate; The traffic network density data of nine prefectures have collected regional land area data on the websites of nine prefectures and municipal governments, The ratio of highway mileage data and regional land area is obtained. The basic geographic data are derived from the Guizhou Provincial Seismological Bureau, the Guizhou Provincial Department of Culture and Tourism and the Guizhou Provincial Department of Natural Resources.

In order to ensure the scientific and accurate accuracy of the research results, it is necessary to normally test the research data before the data analysis and evaluation, and determine whether the relevant data conform to the normal distribution. If not, the data need to be log transformed.

### 4. Index System and Evaluation Method

#### 4.1. Construction of the Index System

Through the reference of the existing vulnerability evaluation index system, based on the index selection, operability of scientific, pertinence, considering the accuracy of data and data collection, to the difficulty of the construction of social economic vulnerability target layer, index of social capital, social security and economic development index layer and index layer three levels index of 10 indicators system<sup>[1]</sup>.

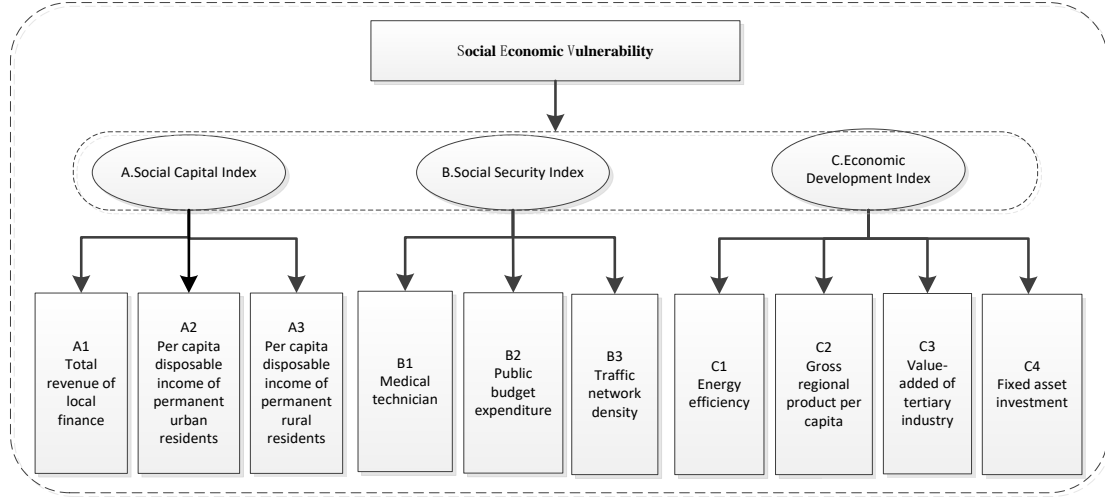


Figure 2 Evaluation index of social and economic disaster-bearing body vulnerability in Guizhou Province.

## 4.2. Weight

The nature of the information entropy is to quantify the importance of the indicator factors based on the variability and inhomogeneity of the data itself<sup>[6]</sup>. Entropy weight method to determine the weight mainly by the normalized index value information entropy calculation, according to the information entropy results and the number of indicators, calculate the output entropy, second, based on the output entropy results, finally, using the difference of the index results divided by the sum of the entropy power coefficient of the index<sup>[7]</sup>. The calculation steps are as follows:

$$(H(Y_j)) = -\sum_{i=1}^m y_{ij} \ln y_{ij}, \quad y_{ij} = \frac{v_{ij}}{\sum_{i=1}^m v_{ij}} \quad (1)$$

Equation (1) is used to calculate the information entropy of the indicators.

$$E_j = \frac{H(Y_j)}{\ln m} \quad (2)$$

Equation (2) is used to calculate the output entropy of the index.

$$G_j = 1 - E_j (1 \leq j \leq n) \quad (3)$$

Formula (3) is used to calculate the index difference.

$$a_j = \frac{G_j}{\sum_{i=1}^n G_i} \quad (4)$$

Formula (4) to calculate the entropy coefficient of the index is the final weight value of an index.

## 4.3. Evaluation Method

This paper selects the fuzzy comprehensive evaluation method for calculation, takes the generalized objective function as the evaluation model, and calculates the sum of the evaluation index value after all levels of standardized processing, thus obtaining the vulnerability results of the evaluation area. Generalized objective function evaluation model<sup>[8]</sup> as follows:

$$Z = \sum_{i=1}^n z_i = \sum_{i=1}^n \sum_{k=1}^{k_i} K_{i00} \times K_{ij0} \times K_{ij0s} \quad (5)$$

In the formula: Z is the evaluation of regional vulnerability result; ZiIs the state layer. The total value of the i index in the evaluation index; i is the number of the state level evaluation index; j is

the subj factor of the i index in the state level evaluation index;  $K_i$  For Number of factors affect in gitem i of the state layer index;  $K_{i0}$  It is the subfactor weight of the state layer index;  $K_{ij}$  Secondary index j is the subfactor weight;  $K_{ij0}$  Data for the standardized processing of subfactor j of the secondary index.

In this paper, all the index raw data are standardized separately, so that their index values are between 0-1. The positive index was calculated according to the higher the index value and the higher the index value, the smaller the social vulnerability.

## 5. Result Of Analysis And Evaluation

### 5.1. Index Weight Value

Calculate the weight values of 3 state layer indicators and 10 indicators according to the information entropy formula (1), (2), (3), and (4) to obtain the following results:

Table 1 Distribution table of index weight values.

State layer	weighted value	Index layer	weighted value
A. Social Capital Index	0.3353	A1 Local total fiscal revenue	0.1030
		A2 The per capita disposable income of permanent urban residents	0.1017
		A3 Per capita disposable income of permanent rural residents	0.1134
B The Social Security Index	0.2643	B1 Medical technicians	0.1060
		B2 Public Budget Expenditure	0.0865
		B3 Traffic network density	0.0756
C. Economic Development Index	0.4004	C1 Energy utilization efficiency	0.1046
		C2 GDP per capita	0.0992
		C3 Third industry added value	0.1109
		C4 Fixed asset investment	0.0991

### 5.2. The characteristics of Temporal and Spatial

Based on the weight value of each index, after standardizing the index data, the results of the vulnerability of the evaluation area. The final value is divided into four levels according to the natural break point classification method. Level 1 is low vulnerability, grade 2, high grade 3 and high grade 4. The higher the value, the greater the vulnerability and the lower the bearing capacity. The specific division scope is listed in the following table:

Table 2 Table of vulnerability classification.

C	$\leq 0.0592$	0.0593-0.4243	0.4244-0.8060	0.8061-0.8900
Level of coordination	Low vulnerability	Medium vulnerability	High vulnerability	High vulnerability

Table 3 Assessment table of social and economic disaster bearing vulnerability in 9 prefectures and prefectures of Guizhou Province.

City state	Value Review in 2015	grade	Value Review in 2019	grade
Guiyang City	0.0311	Low vulnerability	0.0872	Low vulnerability
Liupanshui city	0.7368	High vulnerability	0.8599	High vulnerability
Zunyi City	0.4473	High vulnerability	0.4013	Medium vulnerability
Anshun City	0.8494	High vulnerability	0.8668	High vulnerability
Bijie city	0.6898	High vulnerability	0.6893	High vulnerability
Tongren city	0.7915	High vulnerability	0.7970	High vulnerability
Qianxinan Buyi and Miao Autonomous Prefecture	0.8518	High vulnerability	0.8900	High vulnerability
Qiandongnan Miao and Dong Autonomous Prefecture	0.7728	High vulnerability	0.8802	High vulnerability
Qiannan Buyi and Miao Autonomous Prefecture	0.7906	High vulnerability	0.8205	High vulnerability

According to the classification standard of Table 2, the results of social and economic damage vulnerability in 2019 in 2015 and Guizhou Province were graded, and the results of Table 3 are as follows.

It can be seen that in 2015, there were 2 cities and states with high vulnerability, 6 cities and states with high vulnerability, and 0 cities and states with medium vulnerability. As cities and states adopt different development models and roads, 2019 was changed to five high vulnerability, two high vulnerability, one medium vulnerability and one low vulnerability in China. On the whole, in 2019, the social and economic carrying capacity of all cities and prefectures in Guizhou Province was slow from low to high, and the phenomenon of reducing the social and economic carrying capacity was relatively obvious. There is still a long way to go to improve the social and economic carrying capacity of their own region.

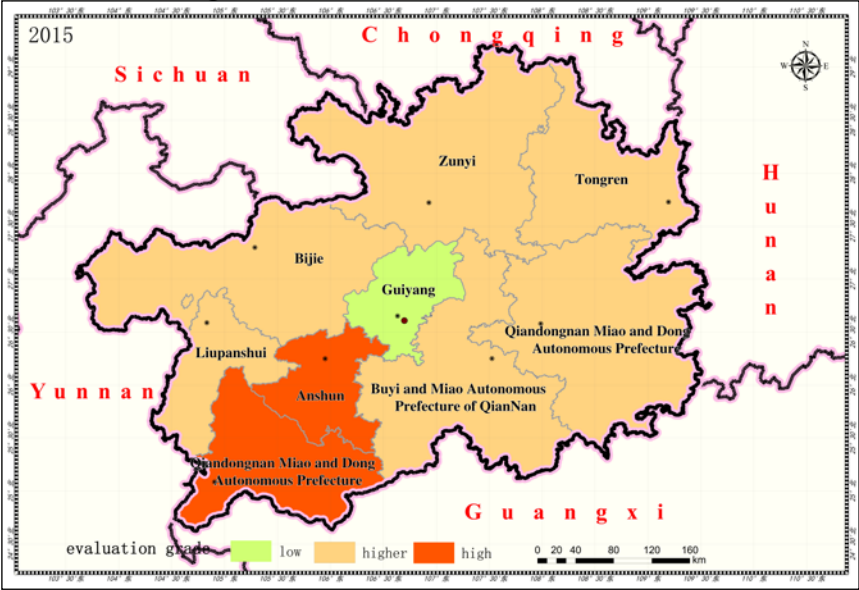


Figure 3 Distribution of Social and Economic Vulnerability Assessment in Guizhou Province in 2015.

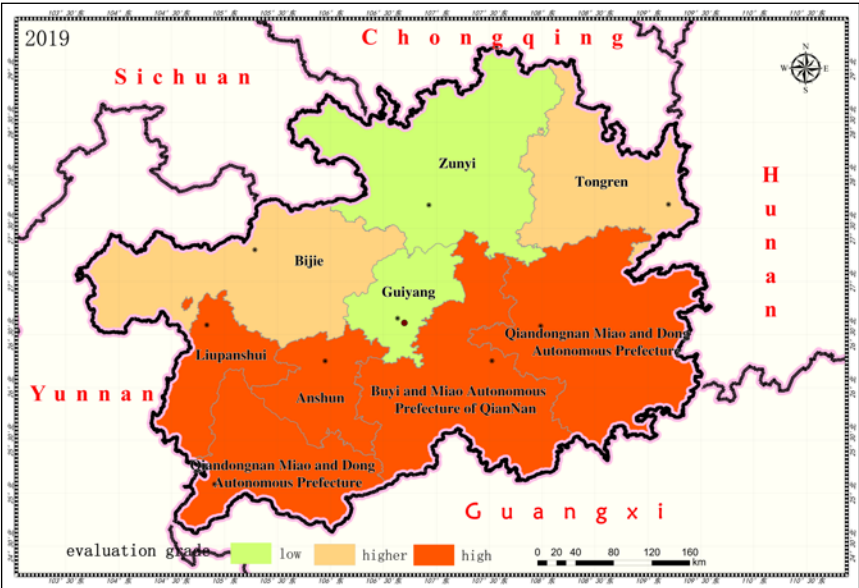


Figure 4 Distribution of Social and economic vulnerability Assessment in 9 cities in Guizhou Province in 2019.

### 6. Conclusion

Through the evaluation of the social and economic carrying capacity of 9 prefectures in Guizhou

Province, the conclusion that the overall carrying capacity of Guizhou Province can be low. From the perspective of time, from 2015 to 2019, the development process of the social and economic vulnerability carrying capacity improvement in Guizhou Province was slow, and 9 prefectures and cities have two characteristics of changes from low to lowest change and low to high change. From the perspective of space, with Guiyang as the center, the south, southwest and southeast cities have high vulnerability and the lowest carrying capacity, the west and northeast, the north and Guiyang have the best and the highest carrying capacity.

Overall view, the higher the economic development, social infrastructure construction modernization and improvement, the higher the people's living standard, the better the social economic carrier bearing capacity, the stronger the emergency state to disaster resistance, the faster the recovery speed. The results of social and economic development indirectly affect people's ability to deal with it after the disaster. The nine prefectures in Guizhou cities in addition to Guiyang and Zunyi, the rest of the city should constantly improve social infrastructure construction, increase people's economic income, Strengthen economic development under the background of ecological protection and green development stability, improve the regional social and economic carrier vulnerability, improve the carrying capacity, improve the ability to cope with disasters, to achieve sustainable long-term development in the future.

## Acknowledgment

This article is in the Teaching research project "Guizhou Science and Technology Plan Project-Liupanshui Active Fault Detection Project", (No.4Y053[2020]). And "Research of GIS-Based Earthquake Emergency Information Exhibition Platform Take Weining Yi, Hui and Miao Autonomous County" of Guizhou Earthquake Bureau, Guizhou Province.

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