Research on Intensity of Mining Environmental Regulation in Different Regions Based on Entropy Method

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Abstract: In this paper, six mining environmental regulation intensity indicators are selected to construct mining environmental regulation index system, and the entropy method is used to measure the intensity of mining environmental regulation in different regions from 2008 to 2017. The results show that the regulation intensity of mining environment is on the rise in all four regions, but the regulation intensity of mining environment is in an unbalanced state of high in the east and low in the west. On this basis, some suggestions are put forward to optimize the mining environmental regulation under the consideration of regional balance.

1. Introduction

The exploitation and utilization of mineral resources will bring about a series of environmental problems and environmental regulation comes into being[1]. Environmental regulation is to regulate individual or organization behavior related to environmental protection through binding tangible system or intangible consciousness for the purpose of protecting the environment. At present, the specific environmental regulation measures adopted in the mining field include: special legislation to protect the geological environment of mines, the formulation of standards to regulate the environmental protection behavior of mines, the establishment of the mine environmental treatment and restoration fund and the levy of environmental protection tax[2]. These measures protect the ecological environment to some extent and promote the green development of mining industry[3]. However, with vast territory, some areas of mining environment regulation measures are weak, and the effect of mining ecological environment control is not obvious. In view of this, it is of great significance for Chinese government to optimize mining environmental regulation measures, improve environmental quality and promote the development of mining industry to clarify the intensity of mining environmental regulation in different regions and different years.

2. Index system construction

2.1. Division of economic regions

With the steady progress of coordinated development of regional economy, coordinated adjustment of environmental regulation level in different regions has become an important content of ecological and environmental governance[4]. According to the Several Opinions of the CPC Central Committee and The State Council on Promoting the Rise of the Central Region and the Opinions of The State Council on the Implementation of Several Policies and Measures for the Development of the Western Region, this paper divides the country into four economic regions for research (see Table 1).

<table>
<thead>
<tr>
<th>Region</th>
<th>Inclusive province</th>
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<tbody>
<tr>
<td>Eastern region</td>
<td>Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan</td>
</tr>
<tr>
<td>Central region</td>
<td>Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan</td>
</tr>
<tr>
<td>Western region</td>
<td>Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Liaoning, Jilin and Heilongjiang</td>
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2.2. Index Selection

The measurement of environmental regulation intensity is the premise of objectively evaluating the implementation effect of environmental regulation measures, and it is a new focus in the field of environmental regulation research in recent years[5]. At present, the common method is to set certain indicators to measure the intensity of environmental regulations, which can be divided into single index method and comprehensive index method.

3. Research Methods

The entropy method is used to measure the comprehensive intensity of environmental regulation. The entropy method determines the weight of each index according to the amount of information contained in it[8]. If the larger the amount of information contained, the smaller the entropy value, the larger the information utility value of the index, and the greater the influence of the index on the comprehensive evaluation. Compared with other methods, the entropy method is more objective and can explain the results better[9]. The specific calculation steps are as follows:

(1) Dimensionless processing of original data:
   - For the positive index, \( y_{ij} = \frac{x_{ij} - \min_x}{\max_x - \min_x} \) \( i=1,2,3,...31; j=1,2,3,4,5,6; y_{ij} \) is the standardized value of the JTH indicator of the i province, and \( x_{ij} \) is the original value of the JTH indicator of the i province.
   - For the negative index, \( y_{ij} = \frac{x_{ij} - \min_x}{\max_x - \min_x} \)

(2) Calculate the proportion of the i province in the j-th index:
   \( p_{ij} = \frac{x_{ij}}{\sum x_{ij}} \) \( (3) \)

(3) Calculate the entropy value of the JTH index \( (e_j) \) :
   \( e_j = \frac{1}{\ln n} \sum_{i=1}^{n} p_{ij} \ln p_{ij} \) \( (4) \)

(4) Calculate the weight of the j-th index:
   \( w_j = \frac{1-e_j}{\sum_{j=1}^{3} 1-e_j} \) \( (5) \)

(5) Calculate the comprehensive index:
   \( w_j = \sum_{j=1}^{6} w_j p_{ij} \) \( (6) \)

4. Calculation results of mining environmental regulation intensity in different regions

The entropy method is used to measure the intensity of mining environmental regulation in different regions. The results show that the intensity of mining environmental regulation in eastern, central, western and northeastern regions is on the rise from 2008 to 2017. The possible reason is that the country attaches great importance to environmental protection in recent years, and the requirements for ecological and environmental protection are gradually increasing. As an industry that has a certain negative impact on the ecological environment, the development of mining industry is restricted by relevant environmental protection policies issued by relevant ministries and local governments. The protection of mine ecological environment and the development of green mining are required in various regions, and the intensity of mining environmental regulations in different regions has been improved to a certain extent.
The results also show that the intensity of mining environmental regulation is higher in the east and lower in the west. The intensity of mining environmental regulation in eastern China leads the whole country, with an average value of 0.1324 during the study period. The intensity of mining environmental regulation in central and northeast China is the second, with an average value of 0.0802 and 0.0711 respectively. The intensity of mining environmental regulation in western China is the weakest, with an average value of 0.0623. This spatial situation is mainly caused by the following two reasons: On the one hand, regional economic development levels are different, and regional economic development determines the intensity of mining environmental regulations to a certain extent. The eastern region of our country, due to a superior geographical position, rich human capital, early start of economic development, high degree of marketization, the financial expenditure of environmental pollution control is more advanced, related techniques to reduce pollution are more advanced, the popular concepts of green consumption, green production and green life, thus the intensity of mining environment regulation is relatively high. In the western region, the economy is underdeveloped, the level of urbanization is low, and the public's awareness of environmental protection is relatively low, so the intensity of mining environmental regulation is weak. On the other hand, regional environmental regulation policies are different. The eastern region has low dependence on mining for economic development, high environmental protection requirements and high environmental management standards. However, the development of the western region is heavily dependent on the mining industry. Based on the consideration of economic development, the environmental management standards are relatively loose and the tolerance of high-polluting industries is relatively high, resulting in the weak effect of the environmental regulation of the mining industry.

### 5.1. Research Conclusions

The intensity of mining environmental regulation in different regions of China presents an upward trend on the whole, and the intensity of mining environmental regulation in China has been developing well. The ecological environment of mines continues to improve, and the green development of mining industry has made new progress.

There is a spatial pattern change in the intensity of mining environmental regulation from the east to the central, northeast and west. There is not a big gap in the intensity of environmental regulation in the central, northeast and west areas, but there is a obvious gap with the eastern area. In other regions, further efforts should be made to alleviate the spatial imbalance in the intensity of mining environmental regulations.

### 5.2. Revelation

The investment in mining environmental governance should pay attention to regional balance. On the premise of ensuring that the investment in environmental governance in the eastern region is not reduced, the investment in mining environmental governance in the northeast and central and western regions should be increased, and emphasis should be placed on the training of environmental protection personnel and the equipping of technical equipment in the mining sector. For areas where mining environmental regulation measures are not perfect, measures should be formulated according to local conditions and targeted to control the mine environment, so as to achieve accurate and practical policies.

More market-oriented means should be used to regulate mining environment. On the one hand, we should innovate and optimize market-oriented environmental regulation tools. For example, we should provide tax incentives, investment and financing incentives and return pollution charges to mining enterprises, especially mining enterprises in western China, and adopt more market-oriented regulatory measures such as emission trading and environmental tax. On the other hand, it is necessary to improve the efficiency of micro-enterprises in using market means such as emission rights trading and environmental tax, so that enterprises can become the main body of trade, and encourage enterprises to unconsciously participate in promoting environmental governance and industrial restructuring.

**Improve the depth and breadth of public participation in mine environmental protection.** Public participation in mine environmental regulation can enable
the government to supervise mining enterprises at a lower cost, and also alleviate the tension between mining enterprises and the government. Therefore, it is necessary to improve the information disclosure mechanism of mine environment\textsuperscript{[11]}. All kinds of environmental information related to stakeholders should be disclosed at all stages from the establishment of mining rights to mine closure, and attention should be paid to transforming professional mine environmental information into information that can be understood by the general public. In addition, it is also necessary to enhance the awareness of public participation in mine environmental protection, and let the public, especially stakeholders, realize the relationship between mine environment and themselves through publicity, so as to take responsibility for preventing environmental harm and protecting mine environment.

References