Analysis of Environmental Impact Assessment Indexes of Oil and Gas Resources

Xingyuan Zhang
School of Management, Tianjin University of Technology, Tianjin 300384, China
zhangxingyuan@tjut.edu.cn

Abstract. Environmental impact assessment is one of the important tasks that oil companies need to complete in the exploration and development of oil and gas resources. In order to explore the related issues of the environmental impact assessment of oil and gas resources exploration, based on the analytic hierarchy process, the index weights of the environmental impact of oil and gas resources exploration and development are determined, and triangular fuzzy is used. Calculate the environmental impact index value of onshore oil and gas resource exploration and development with the number of language variables, and finally conduct an evaluation analysis through a comprehensive evaluation model, which is conducive to identifying and evaluating the environmental impact of oil and gas resources.

Key Words: Resource exploration, Environmental impact, Oil and gas resources.

1. Introduction
With the improvement of the level of social development, it is necessary to increase the exploitation of mineral resources and solve the problem of shortage of mineral resources, otherwise it will hinder social and economic development. Compared with developed countries such as Europe and the United States, my country's geological exploration technology has not been applied for a long time, and it needs to be explored and developed [1]. With the development of resource exploration, the environmental impact assessment of oil and gas resource exploration and development has gradually attracted attention.

At present, China’s environmental impact assessment mainly focuses on planning environmental impact assessment and construction project environmental impact assessment [2]. However, there are not many studies focusing on environmental impact assessment of China’s oil and gas resource exploration and development, especially on land oil and gas resources. The research is mainly carried out from the perspectives of environmental protection, environmental risk, environmental performance and environmental laws [3]. The research on the environmental impact evaluation index system and evaluation technical methods for the exploration and development of onshore oil and gas resources is relatively lacking, and there is a lack of systemicity and evaluation [4]. Factors are not comprehensive and other issues. In this case, how to study the environmental impact assessment of onshore oil and gas resource exploration and development in a more systematic and targeted manner is particularly important.
2. Evaluation index system
The environmental impact evaluation index system for the exploration and development of onshore oil and gas resources should start from the entire exploration and development process, and consider various influencing factors at multiple levels and dimensions, so as to enhance the comprehensive evaluation effect of the index system. With reference to the literature on environmental impact assessment of onshore oil and gas resources exploration and development at home and abroad in recent years, construct an onshore oil and gas resource exploration and development environmental impact assessment index system. Starting from the three levels of pressure, state and response, indicators including 18 secondary indicators are determined in the system, the pressure level includes 8 indicators, which reflect the pressure on the environment caused by onshore oil and gas resource exploration and development activities in terms of resource occupation per unit of industrial output value, energy consumption, and three wastes emissions; the state level includes 4 indicators, respectively Vegetation, air, soil, and water bodies are used to reflect the impact of onshore oil and gas resource exploration and development on the environment; the response level includes six indicators, including pollutant reduction, three waste utilization rates, energy-saving and consumption-reducing measures, and accident prevention measures. Environmental protection investment ratio and environmental protection technology innovation intensity and other aspects reflect the response to the negative impact of the exploration and development of onshore oil and gas resources. As shown in Table 1.

Table 1. Environmental Impact Assessment Index System for Oil and Gas Resources Exploration and Development

| Serial number | First-level index         | Secondary indicators                               | unit         |
|---------------|---------------------------|----------------------------------------------------|--------------|
| 1             | Corresponding indicators A | Pollutant reduction                                 | \( A_{11} \) |
|               | A1                        | Three wastes utilization rate                       | \( A_{12} \) |
|               | A2                        | Energy saving and consumption reduction measures    | \( A_{13} \) |
|               | A3                        | Accident prevention measures                        | \( A_{14} \) |
|               | A4                        | Environmental protection investment ratio            | \( A_{15} \) |
|               | A5                        | Environmental technology innovation                 | \( A_{16} \) |
|               | A6                        | Vegetation status                                   | \( A_{21} \) |
| 2             | Status indicator A2       | Air quality compliance rate                         | \( A_{22} \) |
|               | A2                        | Soil quality compliance rate                        | \( A_{23} \) |
|               | A3                        | Water function zone compliance rate                 | \( A_{34} \) |
|               | A4                        | Oil and gas production                              | \( A_{31} \) |
|               | A5                        | Land occupation area                                | \( A_{32} \) |
|               | A6                        | Energy consumption per unit of GDP                  | \( A_{33} \) |
|               | A7                        | Water consumption per unit of GDP                   | \( A_{34} \) |
| 3             | Stress indicator A3       | Raw material consumption per unit GDP               | \( A_{35} \) |
|               | A3                        | Exhaust emissions                                   | \( A_{36} \) |
|               | A4                        | Wastewater discharge                                | \( A_{37} \) |
|               | A5                        | Solid waste discharge                               | \( A_{38} \) |

3. Evaluation model and evaluation process
Step 1: Calculate the weights of indicators at all levels.

Use the Analytic Hierarchy Process (AHP) to determine the weights of the primary and secondary indicators of the environmental impact of the exploration and development of onshore oil and gas resources to be evaluated:

\[
V_i = (V_{i1}, V_{i2}, \ldots, V_{ip}), \quad i = 1, 2, \ldots, m
\]

Step 2: Determine the environmental impact evaluation index value of onshore oil and gas resource exploration and development.
(1) Employ evaluation experts and set \( n \) first-level indicators, which are represented by \( C_i \) \((i = 1, 2, \ldots, n)\); \( m \) second-level indicators, which are represented by \( A_{ij} \) \((j = 1, 2, \ldots, m)\), \( p \) review experts, which are represented by \( E_k \) \((k = 1, 2, \ldots, p)\).

(2) Define linguistic variables and corresponding triangular fuzzy numbers.

Linguistic variables are used to determine the evaluation values under different indicators, and triangular fuzzy numbers are used as sets \( C = (b_1, b_2, b_3) \), among them \( b_1 < b_2 < b_3 \). Use the interval \([0, 10]\) to determine the environmental impact language variables of onshore oil and gas resources exploration and development and the corresponding triangular fuzzy numbers, as shown in Table 2.

**Table 2. Linguistic variables and corresponding triangular fuzzy numbers**

| Linguistic variables | Triangular fuzzy number |
|----------------------|------------------------|
| VB                   | (0, 0.25)              |
| B                    | (0.25, 5)              |
| M                    | (2.5, 5.75)            |
| G                    | (5.75, 10)             |
| VG                   | (7.5, 10, 10)          |

(3) Using the central value method to defuzzify the fuzzy decision matrix of the secondary index of the environmental impact of onshore oil and gas resources exploration and development: 

\[
M(x) = \frac{a + 2b + c}{4}
\]

Through the above calculations, the qualitative indicators of the environmental impact of onshore oil and gas resource exploration and development can be quantified, so as to conduct quantitative evaluation research on the environmental impact of onshore oil and gas resource exploration and development.

Step 3: Determine the range of environmental impact assessment values for the exploration and development of onshore oil and gas resources-node domain and classic domain.

Step 4: Use the correlation function to calculate the degree of correlation.

Step 5: Rating, the formula is:

\[
K_j = \max K_j(P_0)
\]

4. Summary

The calculation results show that the environmental impact of the onshore oil and gas resource exploration and development is mainly affected by the low level of the state index. The pressure index and response index are relatively good, but they still have not reached a good level. Therefore, further targeted measures are needed. Implement measures to reduce the environmental impact of the exploration and development of onshore oil and gas resources.

The environmental impact assessment index system for the exploration and development of onshore oil and gas resources is composed of three major indicators including pressure indicators, and 18 secondary indicators such as oil and gas production volume and land occupation area. This indicator system includes quantitative and qualitative indicators of the environmental impact of onshore oil and gas resource exploration and development, which can better reflect the environmental impact of onshore oil and gas resource exploration and development.

Using the linguistic variables of the triangular fuzzy number to calculate the index value, the qualitative index is quantified, and the multi-level extension evaluation method is adopted for comprehensive evaluation, which overcomes the difficulty of quantifying the environmental impact and provides an environment for the exploration and development of onshore oil and gas resources. The impact evaluation provides the basis.

Through the evaluation, it is possible to clarify the weak links that exist in the environmental impact of onshore oil and gas resource exploration and development.

It provides a basis for further improving the environmental impact of onshore oil and gas resource exploration and development.
5. References

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