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Coal mine environment evaluation based on fuzzy comprehensive evaluation method

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ABSTRACT

This paper firstly analyses the influence of coal mining on the environmental factors; and then selected recovery ratio, waste water rate, air pollution degree, reclamation rate of subsidence land and other indexes according to the influence of coal mining on the water, air, land and other environmental factors; secondly, this paper divides the indexes into five classes with scores in export scoring method, lastly, combining specific cases and based on fuzzy comprehensive evaluation method, it gets coal mine environmental score through operation of index weight matrix and fuzzy evaluation matrix.

KEYWORDS

Coal mine; Environment; Fuzzy comprehensive evaluation.

INTRODUCTION

Coal resource mining mainly involves the following environmental problems, referring to TABLE 1, according to the classification of environmental factors, this paper selected a total of 18 indexes including reserve-production ratio, recovery ratio, discharge standard of waste water, mechanism degree, waste residue rate for one million tons, greening rate, mine drainage application rate, residue application rate, fly ash application rate, water environmental pollution degree, air environment pollution degree, noise environmental pollution degree, solid waste pollution degree, heavy metal pollution degree, surface landscape pollution and damage degree, reclamation rate of subsidence land in the mining area, treatment rate of municipal solid waste and industrial "three-waste" treatment rate to evaluate comprehensive coal mining environment.

FUZZY COMPREHENSIVE EVALUATION METHOD

Fuzzy comprehensive evaluation totally includes three factors: single-factor evaluation, comment and factor set and multiple-factor comprehensive evaluation based on single-factor evaluation.

TABLE 1 : Environmental problems for coal resources development

Stage	Environmental factors	Specific factors	Reasons	Environmental damage
Coal mining	Land subsidence and damage	Surface subsidence and fissure	Mining damages the internal mechanics balance of rock mass	Damages surface facilities and vegetation, change the landform
	Air pollution	SO_2, NO, NO_2, CO, CO_2, CH_4 and H_2S, etc.	Earth-moving, demolition of explosives, material transport, coal gangue spontaneous combustion, gas drainage and boiler emission, etc.	Directly damage human health and cause various diseases; generate acid rain and damage surface facilities, soil and pollute water resources; gas accumulation can cause asphyxia, explosion and safety accident.
	Water pollution	Coal powder, sand, mud, sulfide, suspended solids, suspended oil, flocculant and magnetic material, etc.	Mine drainage, industrial wastewater, coal-washing wastewater and coking wastewater are discharged in the production	Decrease farmland yield, pollute the rivers and groundwater, and get illnesses, etc.
	Solid drainage pollution	Coal residue, tailing, sludge, fly ash, surface soil in opencast mining and municipal solid waste	Accompaniments is inevitable in the process of coal resources mining.	Take too many lands;. Spontaneous combustion of coal residue can generate smoke and harmful gas and pollute the air; pollute the soil and groundwater through leaching of the rainwater.
	Noise pollution	Noises	Drilling, blasting, coal mining machines and equipments, ventilator, elevator and blower.	Affect operators' health; mask all safety warning signs and cause the accidents.
	Damage of ecological environment	Comprehensive	Coal mining	Damage landform, soil formation, hydrology and climate; result in water and soil loss, desertification, damage the natural landscape and ecological balance

Multiple-factor comprehensive evaluation shall refer to resulted of single-factor evaluation set, namely: we can establish a gross evaluation matrix R for multiple-factor evaluation set.

$$\mathbf{R} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \quad (1)$$

If we have determined evaluation matrix R and factor weight set W, then we can determine fuzzy comprehensive evaluation set E by adopting multiplication operation according to fuzzy matrix, it can be expressed as follows:

$$\mathbf{E} = \mathbf{W} \times \mathbf{R} = (\mathbf{w}_1, \mathbf{w}_2, ..., \mathbf{w}_m) \times \begin{bmatrix} \mathbf{r}_{11} & \mathbf{r}_{12} & ... & \mathbf{r}_{1n} \\ \mathbf{r}_{21} & \mathbf{r}_{22} & ... & \mathbf{r}_{2n} \\ ... & ... & ... & ... \\ \mathbf{r}_{m1} & \mathbf{r}_{m2} & ... & \mathbf{r}_{mn} \end{bmatrix} \qquad (2)$$

Take e_j as the weight, and obtain the evaluation results by equal-weighted value of comment set v_j :

$$\mathbf{V} = \frac{\sum_{j=1}^{n} \mathbf{e}_j \mathbf{v}_j}{\sum_{j=1}^{n} \mathbf{e}_j} \qquad (3)$$

CASE ANALYSIS

Adopt 10 experts for safety evaluation according to real situation of the coal mine safety production management. We classify the comments of the experts into five classes, namely, comment set is as follows:

$V = \{v_1, v_2, v_3, v_4, v_5\} = \{$excellent, very good, good, poor, very poor$\}$

Evaluation of the single-factor 3rd index refers to TABLE 2:

TABLE 2 : Expert Scoring

Index layer	Excellent	Very good	Good	Poor	Very poor
D111 Reserve-production ratio	0.8	0.2	0	0	0
D112 Recovery ratio	0.6	0.4	0	0	0
D121 Discharge standard of waste water	0.6	0.2	0.2	0	0
D122 Mechanism degree	0.6	0.4	0	0	0
D123 Waste residue rate for one million tons	0.6	0.2	0.2	0	0
D124 Greening rate	0.4	0.4	0.2	0	0
C131 Mine drainage application rate	0.6	0.2	0.2	0	0
C132 Residue application rate	0.4	0.4	0.2	0	0
C133 Fly ash application rate	0.6	0.4	0	0	0
C211 Water environmental pollution degree	0.6	0.2	0.2	0	0
C212 Air environment pollution degree	0.8	0.2	0	0	0
C213 Noise environmental pollution degree	0.4	0.4	0.2	0	0
C214 Solid waste pollution degree	0.6	0.2	0.2	0	0
C215 Heavy metal pollution degree	0.6	0.4	0	0	0
C216 Surface landscape pollution and damage degree	0.6	0.2	0.2	0	0
C221 Reclamation rate of subsidence land in the mining area	0.8	0.2	0	0	0
C222 Treatment rate of municipal solid waste	0.4	0.4	0.2	0	0
C223Industrial three-waste" treatment rate	0.4	0.4	0.2	0	0

We can get single-factor fuzzy comprehensive evaluation matrix and make compound operation for the index layer combined weights of all indexes as follows:

$$\mathbf{E31=[0.333\ 0.667]\times\begin{bmatrix}0.8 & 0.2 & 0 & 0 & 0\\ 0.6 & 0.4 & 0 & 0 & 0\end{bmatrix}=[0.6666\ 0.3334\ 0\ 0\ 0]} \quad (4)$$

$$\mathbf{E32=[0.276\ 0.109\ 0.124\ 0.491]\times\begin{bmatrix}0.6 & 0.2 & 0.2 & 0 & 0\\ 0.6 & 0.4 & 0 & 0 & 0\\ 0.6 & 0.2 & 0.2 & 0 & 0\\ 0.4 & 0.4 & 0.2 & 0 & 0\end{bmatrix}=[0.5018\ 0.320\ 0.1782\ 0\ 0]} \quad (5)$$

$$\mathbf{E33=[0.363\ 0.206\ 0.431]\times\begin{bmatrix}0.6 & 0.2 & 0.2 & 0 & 0\\ 0.4 & 0.4 & 0.2 & 0 & 0\\ 0.6 & 0.4 & 0 & 0 & 0\end{bmatrix}=[0.5588\ 0.3274\ 0.1138\ 0\ 0]} \quad (6)$$

$$\mathbf{E34=[0.243\ 0.376\ 0.087\ 0.087\ 0.043\ 0.164]\times\begin{bmatrix}0.6 & 0.2 & 0.2 & 0 & 0\\ 0.8 & 0.2 & 0 & 0 & 0\\ 0.4 & 0.4 & 0.2 & 0 & 0\\ 0.6 & 0.2 & 0.2 & 0 & 0\\ 0.6 & 0.4 & 0 & 0 & 0\\ 0.6 & 0.2 & 0.2 & 0 & 0\end{bmatrix}=[0.6578\ 0.226\ 0.1162\ 0\ 0]} \quad (7)$$

$$\mathbf{E35=[0.164\ 0.301\ 0.535]\times\begin{bmatrix}0.8 & 0.2 & 0 & 0 & 0\\ 0.4 & 0.4 & 0.2 & 0 & 0\\ 0.4 & 0.4 & 0.2 & 0 & 0\end{bmatrix}=[0.4656\ 0.3672\ 0.1672\ 0\ 0]} \quad (8)$$

Make compound operation for the indexes at the factor layer and get fuzzy evaluation matrix of the indexes at the factor layer by operation for the indexes at the index layer, and then multiply the weights of the indexes at the factor layer and fuzzy evaluation matrix of the indexes at the factor layer to get fuzzy evaluation matrix of the index at the standard layer in the same method as compound operation of the indexes at the index layer.

$$\mathbf{E21=[0.163\ 0.304\ 0.533]\times\begin{bmatrix}0.6666 & 0.3334 & 0 & 0 & 0\\ 0.5018 & 0.320 & 0.1782 & 0 & 0\\ 0.5588 & 0.3274 & 0.1138 & 0 & 0\end{bmatrix}=[0.5590\ 0.3261\ 0.1149\ 0\ 0]} \quad (9)$$

$$\mathbf{E22=[0.667\ 0.333]\times\begin{bmatrix}0.6578 & 0.226 & 0.1162 & 0 & 0\\ 0.4656 & 0.3672 & 0.1672 & 0 & 0\end{bmatrix}=[0.5938\ 0.2730\ 0.1332\ 0\ 0]} \quad (10)$$

Take compound operation for the indexes at the standard layer, and get fuzzy evaluation matrix of the indexes at the standard layer and then multiply the weights of the indexes at the standard layer and fuzzy evaluation matrix of the indexes at the standard layer to get compound operation result E in the same method as compound operation of the indexes at the index layer and the indexes at the factor layer.

$$\mathbf{E=[0.500\ 0.500]\times\begin{bmatrix}0.5590 & 0.3261 & 0.1149 & 0 & 0\\ 0.5938 & 0.2730 & 0.1332 & 0 & 0\end{bmatrix}=[0.5764\ 0.2996\ 0.1240\ 0\ 0]} \quad (11)$$

The operation results mentioned above E can only reflect the proportion of environmental evaluation degree of the coal mine enterprises rather than a specific score. In order to get an intuitive score and make comparative study easily, we set the specific score for each evaluation degree, referring to TABLE 3, and make them consist of a column vector $C = (c_1, c_2, ..., c_m)^T$.

TABLE 3 : Comparative table of evaluation result and evaluation degree

Comment degree	Excellent	Very good	Good	Poor	Very poor
Score	100-80	80-60	60-40	40-20	20-0

Take the middle one from the degree score scope, namely $C=(90,70,50,30,10)^T$, then we can get the score for environmental evaluation of the coal mine enterprise:

$$M=[0.5764\ 0.2996\ 0.1240\ 0\ 0]\times\begin{bmatrix}90\\70\\50\\30\\10\end{bmatrix}=79.048$$, the evaluation degree shall be very good.

CONCLUSION

Fuzzy comprehensive evaluation score can reflect evaluation result of coal mine environmental evaluation indexes, dimensions and factors, and comparing the scores of all indexes can get a clear idea on the conditions at all aspects from intuitive comparison and find out the advantages and disadvantages so as to measure the environmental level of the coal mine comprehensively.

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REFERENCES

[1] Zhou Yongkang; About Resources and Environment [M]. Beijing: Geological Publishing House, **(2000)**.
[2] CIAC; Environment Stewardship [J]. Management, Accountability and the Role of chartered Accountants, **12(9)**, 67-70 **(2008)**.
[3] Cao Xueling, Liu Dameng; Environment pollution during coal development and control measures [J]. Coal Science and Technology, **33(5)**, 67-69 **(2005)**.
[4] Zhang Zengfeng, Ding Huixian, Zhao Yanhong; Reasons Causing Environmental Pollution in Coal Mines Areas in China and Precautions and Measures against Pollution [J]. China Mining Magazine, **11(4)**, 45-48 **(2002)**.
[5] Liu Wei; Application of Fuzzy Comprehensive Evaluation in Coal Industry [J] Journal of Safety and Environment, **5(1)**, 89-91 **(2005)**.