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Ecological Environment Management and Applicable Resource Conditions for Open-pit Mining

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Abstract: The development of mineral resources is the core industry of the national economy. The development, processing and use of mineral resources not only promotes social and economic development, but also brings many ecological and environmental problems. Therefore, it is of great practical significance to choose the ecological environment protection management and restoration measures through the study of the ecological environment impact assessment of mining mountains. The purpose of this paper is to study the ecological environment management and applicable resource conditions of open-pit mining mines, taking calcite as the research object, to analyze the impact of mine ecological environment protection and restoration on the mine ecological environment, and first establish the mine ecological environment protection and restoration management. Evaluation index system, using expert rating method and analytic hierarchy process to analyze the indicators. The evaluation index system of mine ecological environment protection and restoration management with 4 indicators was obtained. The hierarchical weight results show that the weight of production wastewater treatment and utilization rate is 0.3428, the weight of pollution water body treatment and restoration rate is 0.1572, the weight of damaged landscape restoration rate is 0.3148, and the weight of land reclamation rate in mining area is 0.1852, so the ecological restoration and governance status is the most important factor affecting mines. The main reasons for the status of ecological environment protection and restoration.

1. Introduction

Mineral resources play an important role in the development and progress of human civilization and are widely used in all aspects of daily production and life. At the same time, mineral resources are also the foundation of metallurgy, chemical industry, heavy industry and other industries, which guarantees the sustainable development of the national economy and promotes the progress of human civilization [1]. Calcite processing, 1200 mesh, 95% whiteness, 55% calcium oxide, with the

rapid growth of the population and the continuous development of society, the demand for mineral resources continues to increase, and the development speed and scale of mineral resource mining are also expanding. However, due to the rough and radical mining methods and the lack of necessary labor protection measures and geological protection measures, a large number of mine geological environment problems have been generated. Therefore, it is an important topic for the open-pit mining industry to scientifically evaluate the ecological and environmental impacts of open-pit mining and strengthen the ecological protection and restoration of open-pit mining [2].

Many economists have specially discussed the ecological environment governance and applicable resource conditions of open-pit mining mines. A D W developed a method to optimise the design of the open pit mine, while addressing transition issues and taking into account the need for a top column with a prescribed shape. Optimizing the design of an open pit mine based on existing methods, framed by the maximum graph closure problem. Introduces non-trivial strongly connected subgraphs (NSCS) of graphs, a complexity that previous authors on the maximum graph closure problem did not seem to cover. To avoid checking each method for compatibility with NSCS, the problem is reduced to its equivalent without them. This has the additional advantage of reducing the overall processing time when the number of NSCSs is large [3]. Gholamnejad J proposed a chance-constrained integer programming method based on a linear method to solve the long-term open pit mine production scheduling problem. Specifically, based on the availability of processing capacity and possible future processing, a single inventory has been resolved to store excess low-grade material. The proposed scheduling model maximizes project NPV while respecting a range of physical and economic constraints. Unlike the usual practice of using a deterministic model to calculate the average grade of material in inventory, in this work, a stochastic approach is performed starting from a planned time before inventory is realized. Probabilistic analysis of two case studies (iron ore and gold ore) demonstrates that inventory attributes can be treated as normally distributed random variables [4]. Loring P A reports research aimed at understanding how people prioritize marine ecosystem management outcomes. Using the Q method, residents were asked to rank outcomes such as food security, trustworthy governance, opportunities for harvest and recreation, education and employment in order of importance to the well-being of the community. They were also asked to discuss the strategies they used when faced with difficult tradeoffs, and how they felt throughout the classification process. Four strategies were identified that people use to address trade-offs, as well as four social discourses that can inform participants' categorization: Prioritization strategies reflect people's moral positions and whether they are thinking in the short or long term. These discourses reflect a desire for state-based governance, local self-governance, and people to participate in and connect with the marine environment [5]. Currently, the main focus is on bioremediation of contaminated soils, with the aim of restoring and rebuilding the health and environmental safety of mining ecosystems.

This paper mainly discusses the development of mining industry and its effect on the natural ecological environment from the aspects of natural resource endowment, natural environment, economic and social development conditions, etc., through the discussion of environmental restoration, mineral resource system development, and rational development of open pit mines. The environmental protection and environmental development of the project site has great scientific research value and practicability, and can be used for environmental assessment and environmental protection research of open-pit mining. Restoration and governance of mine geological environment Environmental governance is of significance to the restoration of natural landscapes and the construction of human settlements. The improvement of the natural ecological environment of mines has obvious ecological and economic benefits, and it is of significance to improve the living environment of human beings and the harmony and stability of society.

2. Research on Ecological Environment Management and Applicable Resource Conditions for Open-pit Mining

2.1. Basic Overview of the Mine

The calcite mining field is located 41 kilometers away from the north of the city, and the traffic is relatively convenient. The geographical coordinates of the center of the mining area are: east longitude 123°18′22″, north latitude 40°37′25″. The mining area is 0.1000km2, and the mining area is composed of 4 inflection points. The designed mining elevation of the development and utilization plan is from +472m to +325m. The underground mining method is adopted. The designed production capacity is 10,000 t/a, which is a small mine. The ore body in this mining area has a large burial depth and a medium-thickness ore body. The ore body is vein-like and is produced in the NE direction. The ore body is strictly controlled by faults, with a dip of 120 ° and a dip of 57 °.

2.2. Environmental Treatment Technology of Open-pit Mines

2.2.1. Engineering Governance Technology

This type of technology is produced by the evolution of related technologies in civil engineering and geological engineering, such as foundation treatment technology in civil engineering and slope treatment technology in geological engineering. Its main purpose is to change or strengthen the geological structure, thereby enhancing the stability of the geological environment. The main control objects are the unstable geological bodies in the mining environment, including the instability of natural and artificial slopes, the deformation of shallow rock and soil on the surface, and the damage of hydrogeological structures. The object of governance involves almost all parts of the open-pit mine[6-7].

2.2.2. Ecological Restoration Technology

The main object of this protection technology is the vegetation, landscape and natural habitat on the land destroyed by mining production, and the main purpose is to repair the environmental damage. Damaged ecosystems must be repaired through technical means, and the restoration of the ecosystem itself must be given full attention. Relevant environmental problems include: exposed rocks, land desertification, topographic changes, dust pollution, etc. [8-9].

2.2.3. Bioremediation Technology

The engineering treatment technology and ecological restoration technology mentioned above both achieve the purpose of geological and ecological environment treatment by changing the external structure or form of the mine, but such treatment technologies are different, and their role lies in the internal pollution of environmental problems., to reduce or remove the pollutants, such as the washing process of metal mines will cause the surrounding water, rock and soil to be polluted by heavy metals, and the removal of pollutants through specific plant absorption is the scope of bioremediation technology [10-11].

2.3. Principles of Selection of Evaluation Indicators

2.3.1. Comprehensiveness of Evaluation Indicators

The indicators of ecological restoration effect evaluation of open-pit mines should be able to

fully reflect all mine geological environmental problems and the impact of vegetation hydrological effects, and all indicators can evaluate all aspects of open-pit mine ecological restoration. In order to ensure that the evaluation results are consistent with the actual situation and avoid the repetition of the contents of each index[12-13], the structure and function of the mine ecosystem should be combined, and the limitations of environmental factors should be considered to screen out comprehensive coverage of the mine geological environment issues and vegetation hydrological effects and representative indicators [14-15].

2.3.2. The Operability of Evaluation Indicators

The indicators of the ecological restoration effect evaluation system of open-pit mines should try to ensure that the selection of indicators is simple, easy to obtain and typical. At the same time, it is also necessary to fully consider the operability of the indicators to ensure that they are easy to obtain and graded to be feasible. When constructing an evaluation system, attention should be paid to whether the practical operation and theoretical methods can be effectively combined, so as to avoid the inaccurate and unreasonable calculation of the evaluation system caused by the acquisition of indicators[16-17].

2.3.3. The Dynamics of Evaluation Indicators.

The ecological restoration effect of open-pit mines is affected by the climate, topography, vegetation growth and time of the mining area, and it often takes a certain amount of time to reflect the restoration effect. Therefore, the selection of indicators should fully consider the dynamic nature of ecological restoration, extend the time line as much as possible, and collect data at different time points to ensure that the calculation results of the evaluation system are consistent with the actual situation [18].

3. Investigation and Research on Ecological Environment Management and Applicable Resource Conditions of Open-pit Mining Mines

3.1. Overview of the Study Area

The project area is located in Xiuyan County, the territory is mountainous, the terrain is high in the north and low in the south, with an average elevation of 79.6 meters. The terrain is dominated by mountains and hills, with small alluvial plains and basins in between. The low mountains account for more than 78% of the total area of the county. The main mountain range is the Changbai Mountains. From north to south, there are the Maokui Mountain branch, the Yaoshan branch, the Yishuling branch, the Brother Mountain branch, the Dadingzi Mountain branch, and the Camelpo. There are 6 branches in the sub-branch, and many branches of each branch are spread throughout the county. There are more than 500 named mountains. The highest peak, Maokui Mountain, is 1141.5 meters above sea level, which is also the highest peak in southern Liaoning.

3.2. Investigation Method

Collect past governance data, compare the current governance effect, and form a field reference; UAV cooperates with high-precision GPS (RTK) to conduct aerial surveys to form high-definition aerial photos of mining areas and three-dimensional geological model DOM; on-site investigations use a combination of recourse and intersection methods. Investigate geological conditions, topography, etc., find out the current state of damage in the mining area, and form a three-dimensional and in-depth understanding and grasp.

3.3. Calculation of the Weight of the Evaluation Index System

The evaluation index system is a multi-level evaluation structure that integrates many index factors. Each index in the evaluation structure needs to calculate the weight of the index through the analytic hierarchy process. CI can be derived from the formula:

$$CI = \lambda_{max} - \frac{n}{n-1} \tag{1}$$

Among them, λ is the characteristic root, and n is the number of variables in the ecological environment governance evaluation system.

Calculate the maximum eigenroot λmax of the matrix according to the formula.

$$\lambda_{max} = (\sum (BW)_i / W_i) / n \tag{2}$$

Among them, λ is the characteristic root, and n is the number of variables in the ecological environment governance evaluation system.

4. Analysis and Research on Ecological Environment Management and Applicable Resource Conditions for Open-pit Mining Mines

4.1. Analysis of the Impact Range of the Open-pit Coal Mining Ecological Environment

In this paper, the remote sensing ecological index (RSEI) is chosen to determine the ecological impact range of open pit mining. RSEI includes four components: greenness index, dryness index, humidity index, and heat index. Using RSEI can more intuitively monitor and compare the temporal and spatial changes in the quality of the regional ecological environment, and identify the impact of coal resource mining on the surrounding ecological environment.. Selecting the Landsat remote sensing images of the vegetation growing season in 2019 and 2020, the buffer zone analysis was carried out on the 2km, 3km, 4km, 6km, and 9km boundaries of the mining area, and the RSEI values were calculated, as shown in Table 1.

Table 1: SEI index of buffer zone at different distances from the mine boundary

	0km	2km	3km	4km	6km	9km
2019	0.84	0.41	0.56	0.42	0.55	0.48
2020	0.54	0.34	0.36	0.37	0.44	0.46

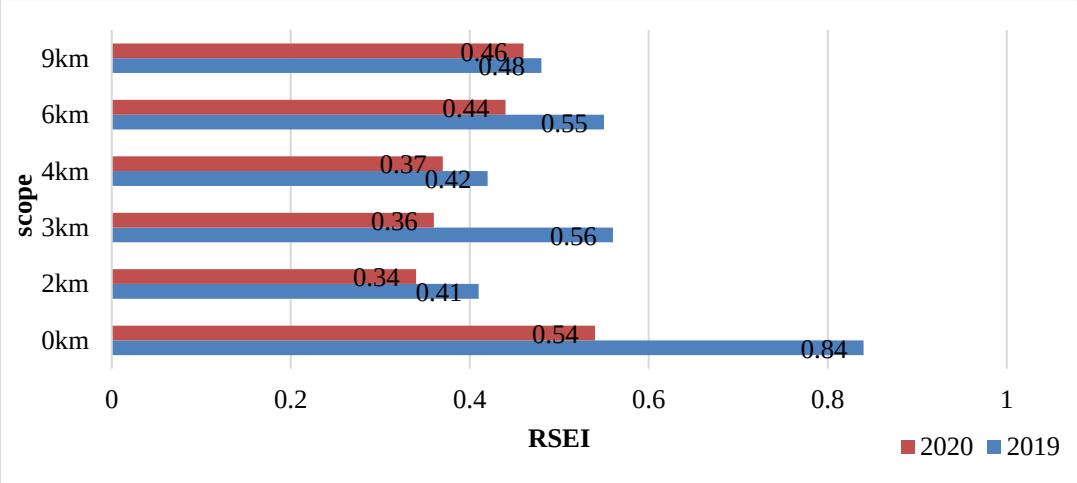

Figure 1: SEI variation trend in 2019 and 2020

The trend analysis of the RSEI index of the buffer zone that has been obtained is shown in Figure 1. It can be seen that the average RSEI value of the ecological background before mining (2019) first decreases and then increases with the expansion of the buffer zone. The overall value of the average RESI in 2020 is smaller than that in 2019, and the fluctuation is relatively gentle. It can be seen that when the buffer range is 4km-9km, the difference between the average RSEI values in 2019 and 2020 is small, and the change trend is consistent. Within the 0-3km buffer zone, the average RSEI values in 2019 and 2020 are quite different, and the value changes show the opposite trend. Therefore, it can be seen that the ecological environment within the range of 3km to 6km from the mining area is greatly affected by mining, and At 3km, the regional average RSEI value has the largest difference, so the 3km buffer zone at the boundary of the mining area is selected as the study area.

4.2. AHP to Determine Weights

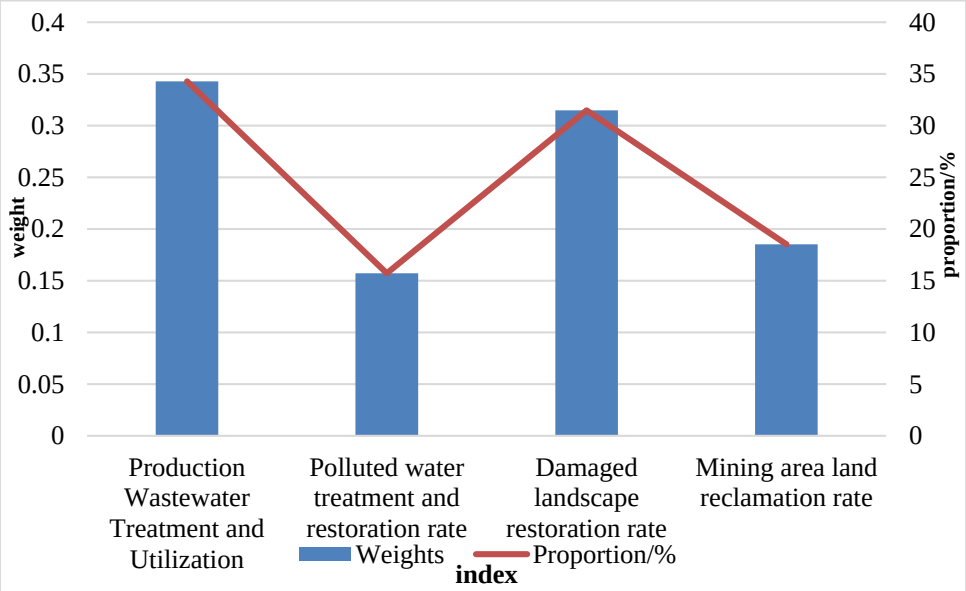

Figure 2: Results of weights at each level

Applying the analytic hierarchy process in the third chapter, according to the analysis of the status quo of ecological environment protection and restoration management of a coal mine, by sending a questionnaire to 20 experts in mine ecological environment in the expert database of the Mine Ecology Association, combined with the actual collection of 15 experts The scoring results are used to determine the weights for the evaluation index system. The weight results of each level are shown in Figure 2.

It can be seen from the above analysis that the weight of production wastewater treatment and utilization rate is 0.3428, the weight of pollution water body treatment and restoration rate is 0.1572, the weight of landscape restoration rate of damaged land is 0.3148, the weight of land reclamation rate of mining area is 0.1852, the ecological restoration and management status It is the main reason that affects the ecological protection, restoration and management of mines. Therefore, in order to improve the quality of mine ecological environmental protection and restoration, it is necessary to take effective measures to improve the quality of ecological restoration.

5. Conclusions

From the perspective of ecology, this paper takes open-pit mining as the research object, takes

the overall evaluation of environmental impact and ecological restoration as the research content, conducts a comprehensive study on the impact of open-pit mines, constructs an index weight system and calculates the weights, based on the investigation and evaluation, Using scientific means, adapting measures to local conditions and using the terrain skillfully to carry out economical and efficient mine restoration and management, take the road of "green mines", protect and improve the environment on which survival depends, and obtain the greatest social benefits at the least cost. The improvement of the natural ecological environment of mines has obvious ecological and economic benefits, and it is of great significance to improve the human living environment and social harmony and stability.

References

[1] Teck G. A. Perspective on Social-Ecological System Framework and New Institutional Economics Theories in Explaining Public Open Spaces (POS) Governance and Quality Issues [J]. Journal of Design and Built Environment, 2019, 19(2):1-13.

[2] Lisboa A C, Souza F, Ribeiro C M, et al. On Modelling and Simulating Open Pit Mine Through Stochastic Timed Petri Nets [J]. IEEE Access, 2019, (99):1-1.

[3] A D W, B M B, A P A G, et al. Combined optimisation of an open-pit mine outline and the transition depth to underground mining – Science Direct [J]. European Journal of Operational Research, 2018, 268(2):624-634.

[4] Gholamnejad J, Azimi A, Lotfian R, et al. The application of a stockpile stochastic model into long-term open pit mine production scheduling to improve the feed grade for the processing plant [J]. Rudarsko Geolosko Naftni Zbornik, 2020, 35(4):115-129.

[5] Loring P A, Hinzman M S. "They're All Really Important, But": Unpacking How People Prioritize Values for the Marine Environment in Haida Gwaii, British Columbia [J]. Ecological Economics, 2018, 152(oct.):367-377.

[6] Ruiz-Frau A, Krause T, Marba N. In the blind-spot of governance - Stakeholder perceptions on seagrasses to guide the management of an important ecosystem services provider [J]. The Science of the Total Environment, 2019, 688(Oct.20):1081-1091.

[7] Adjei R, Addaney M, Danquah L. The ecological footprint and environmental sustainability of students of a public university in Ghana: developing ecologically sustainable practices [J]. International Journal of Sustainability in Higher Education, 2021, 22(7):1552-1572.

[8] Castellanos-Navarrete A. Oil palm dispersal into protected wetlands: Human–environment dichotomies and the limits to governance in southern Mexico [J]. Land Use Policy, 2021, 103(3–4):105304.

[9] Dutra L, Sporne I, Haward M, et al. Governance mapping: A framework for assessing the adaptive capacity of marine resource governance to environmental change [J]. Marine Policy, 2019, 106(AUG.):103392.1-103392.13.

[10] Andrew, Flynn, Li, et al. The Protean Environmental State in Dongguan: Reconceptualising the local state and ecological development in China: [J]. Environment and Planning C: Politics and Space, 2019, 38(3):443-463.

[11] Kelani G, Alimi T, Amujoyegbe B J, et al. Gender Differentials and Optimal Combination of Crop Enterprises under Limited Resource Conditions in South Western Nigeria: A Case Study of Cocoa-based Farming Systems[J]. Asian Research Journal of Agriculture, 2020, 12(2):27-38.

[12] Antonenko V, Khutkyi V. Museums as a Tourist Resource in the Conditions of the COVID-19 Pandemic: Challenges and New Opportunities [J]. Bulletin of Kyiv National University of Culture and Arts Series in Tourism, 2021, 4(1):54-73.

[13] Alidou S, Gundogdu K S, Traore F, et al. Estimating in-season actual evapotranspiration over a large-scale irrigation scheme in resource-limited conditions [J]. Comptes rendus de l'Académie bulgare des sciences: sciences mathématiques et naturelles, 2020, 73(10):1473-1480.

[14] Byelozyerova Y, Lebedeva Y. The Possibility of Using Alternative Intangible Resources to Motivate Staff in the Conditions Resource Constraints [J]. Management of the personnel and intellectual resources in Russia, 2020, 9(2):26-30.

[15] Savelieva A D, Milyaev D V, Dushenin D I. Determining the Conditions for the Resource and Economic Assets Emergence Using Threshold Analysis Algorithms[J]. World of Economics and Management, 2021, 21(1):59-71.

[16] Kuznecov S, Kaschenko M. Robotization in Modern Conditions of Human Resource Management [J]. Actual directions of scientific researches of the XXI century theory and practice, 2020, 8(2):90-94.

[17] Belan I A, Rosseeva L P, Blokhina N P, et al. Resource potential of soft spring wheat varieties for the conditions of Western Siberia and Omsk region (analytical review)[J]. Agricultural science Euro-North-East, 2021, 22(4):449-465.

[18] Kononets N, Novopismenny S. Resource-Based Learning of the Discipline "Higher School Pedagogy" in the Conditions of Distance Education [J]. The Sources Of Pedagogical Skills, 2021(26):107-114.