Scholar Publishing Group
Nature Environmental Protection
https://doi.org/10.38007/NEP.2020.010201
ISSN 2790-2684 Vol. 1, Issue 2: 1-8

Building an Environmental Protection Assessment System Based on Fuzzy Mathematical Algorithm

Shania Pesik*

Wave Theory Department, Marine Hydrophysical Institute, Russian Academy of Sciences, 2 Kapitanskaya St., Sevastopol 299011, Russia

**corresponding author*

Keywords: Fuzzy Mathematical Algorithm, Environmental Protection, Mine Geology, Assessment System

Abstract: With the rapid development of China's economy, environmental protection (EP) has attracted much attention. The geological environment management in mining areas is one of the important elements, however, the effectiveness of geological environment management in many mining areas is far from the national standard. Therefore, this paper takes mining geological EP as an example, establishes an evaluation system to assess the geology of mining areas, and calculates the index weights of the system by fuzzy mathematical algorithm (FMA), and analyzes the current situation of mining geology from multiple levels, such as greening coverage rate, land reclamation rate, and land planning and management, in order to propose strategies to protect the geological environment of mining areas. The results show that the geological EP of mining areas can be realized only from scientific exploitation of mineral resources, control of water resources utilization of mining activities, and construction of green mining areas.

1. Introduction

Mineral extraction is an indispensable part of human economic income generation. In recent years, many mining cities have emerged in China and the mining industry has developed rapidly, but due to the ongoing mining activities, the mines and their surrounding environment have suffered heavy environmental damage. Although mineral extraction has greatly contributed to economic development, the increasing environmental pollution not only threatens the safety of life and property of mine residents, but also limits the national economic and social development to a large extent [1]. Therefore, this paper needs to implement a management and protection program for the mining environment, and it is necessary to assess the current situation of environmental pollution in mining areas first.

At present, many scholars have achieved very excellent research results in the assessment of EP and environmental management in mining areas. For example, some scholars, after comparing and studying the EP system in foreign mining areas, combined with the current situation of mining geological environment in China, put forward many opinions to improve the geological EP system in China's mines, such as using incentives and economic means to guide mining enterprises to be more involved in geological environmental management [2]. Some scholars have mapped out specific methods to evaluate the geological environment of mining areas and found that the empirical value method can be used to evaluate the condition of the geological environment of mining areas, which is the basis for more detailed differentiation of geological damage [3]. Some scholars have used the gray clustering method in assessing the environmental conditions of mining sites, and this method has also provided a reference for the environmental assessment of mining sites [4]. Some people have also analyzed the assessment factors of the mining geological environment in the process of the induced geohazards and the impact and destruction of aquifers, and found that the mineral geological environmental problems are dominated by the destruction of water and soil, and in the activities of mining, land suppression and destruction can occur, leading to the reduction of the extent of forests, grasslands, and arable land [5]. In conclusion, many studies have established mining geological environment evaluation systems based on the classification of different mining environments in order to propose targeted protection countermeasures and treatment recommendations.

In this paper, we first introduce the concept of fuzzy mathematics, then analyze the current situation of environmental pollution such as water loss and ground collapse of mine geology, then establish the indicators of mine geological EP evaluation system and calculate the weights of indicators, then evaluate the mine geological environment with this system, and finally give suggestions to manage environmental pollution in order to achieve the effect of protecting mine geology.

2. Basic Overview

2.1. The Concept of Fuzzy Mathematics

Fuzzy mathematics is a mathematical discipline and effective method for studying and dealing with uncertain and fuzzy phenomena. The basic idea of fuzzy mathematics is to describe and model real-life vagueness using accurate mathematical methods in order to clarify vague things [6]. On a technical level, one of the missions of fuzzy mathematics is to enable computers to imitate the human brain to recognize and judge complex systems to accomplish the judgmental thinking ability of the human brain and to achieve a higher level of automation and intelligence in modern production and management [7]. Fuzzy comprehensive judgment is one of the most commonly used fuzzy mathematical methods to consider multiple factors or indicators in the face of fuzzy things [8].

The relationship between things in our daily life does not simply belong or not belong, but has a certain complexity, uncertainty and fuzziness, thus the concept of fuzzy mathematics is proposed [9]. In recent years, the relevant theories of fuzzy mathematics have been developed and improved, and fuzzy mathematics can also be widely used in all aspects of our life. At present, fuzzy mathematics has achieved many specific applications in the fields of computers, biology, agriculture, education, etc.

2.2. Problems and Analysis of Geological Environment in Mining Areas

(1) Serious soil and water erosion

Not only most of the land in the mining area will be directly damaged by the open-pit mining behavior, the waste ballast and waste rock generated by the mining behavior will also damage the ecological environment and vegetation, raising the possibility of land sanding and soil erosion, and occupying a large part of the land area [10].

(2) The environmental pollution situation in mining areas is severe

The coal gangue, tailings and mining waste rock generated from mining activities are not deposited in a reasonable way, and the beneficiation wastewater and pit water are usually discharged into nearby rivers and valleys [11]. In order to ensure the successful completion of mining activities, the encroachment of part of the land area for the fixing of shafts, the construction of necessary amenities and dumps, and the construction of roads are necessary for all mining activities. Humans and other organisms living in the mine site are adversely affected to varying degrees by harmful atmospheric pollutants. Usually, some of the harmful gases and dust in the atmosphere can be absorbed or adsorbed by most plants, but if the dust and harmful gases in the atmosphere exceed certain limits, the growth and development of plants will be adversely affected to a large extent, and in some cases, a large number of plants will wither and die out [12, 13].

(3) Frequent ground collapse in mining areas

Steep hills, rainfall, excavation of the foot of the slope, weathering, mining ore, blasting, earthquakes or slopes on the proverbial surface are among the basic triggers for the emergence of collapse situations, while the artificial mining of ore is prone to collapse in the area. The mine area has been damaged for a long time, and the damaged area of the land surface continues to expand, involving a wide range of areas, because the long-term operation of the mine area has caused the original topography to change, so that local areas have also collapsed [14, 15].

3. Establishment and Analysis of GeoEP Assessment System in Mining Areas

3.1. Index Establishment

Summarizing information on changes in the mine geological environment, characteristics of changes in the geological environment, and trends in global changes has a positive effect on optimizing the accuracy and comprehensiveness of mine geoEP evaluation [16]. In the process of constructing the index system, it is the premise, core, guarantee and mining target as the primary indicators, and the greening coverage rate, soil pollution situation, land reclamation rate, land planning and treatment situation as the secondary indicators to realize the hierarchical division of the index system.

3.2. Calculation of Index Weights Based on FMA

After specifying the indicators, the analysis using FMA needs to be analyzed in terms of evaluation model application, system evaluation, etc., as a way to achieve quantitative analysis of the evaluation work.

In the analysis of the indicator weighting ratio and overall evaluation, etc., the analysis needs to be carried out in terms of weight determination, indicator analysis, and data processing, etc. Under the premise of clarifying the research object, the analysis needs to be carried out in terms of data processing and indicator weighting processing, which is the key work to achieve effective analysis and implementation of indicators [17, 18]. In the construction of the evaluation model, the formula for calculating the comprehensive index of the FMA is as follows.

$$R=\sum_{j-1}^{m} R_j=\sum_{i,j}^{N,m} w_j R_i \tag{1}$$

$$R_i = \sum_{i-1}^{n} X_i w_i \tag{2}$$

Where R is the comprehensive evaluation index, Rj is the index sum of the jth evaluation layer, wj is the weight of the kth evaluation layer, Ri is the evaluation index of the ith index, Xi is the standardized value of the ith index, and wi is the weight of the ith index.

3.3. Evaluation of Geological EP on Mining Areas

In the process of determining the weight indicators, it is using FMA to analyze the validity of the data as well as the parameters, etc. The weight determination is from the perspective of the first level indicators. In the process of calculating the weights of the first-level indicators of the guideline layer, the combined raw data scores of the evaluation guideline prerequisite, core, guarantee, target, support and comprehensive score are 0.03675, 0.038, 0.042, 0.036 and 0.04325, respectively, and the calculation results of their first-level indicator scores in 2016-2020 are shown in Figure 1.

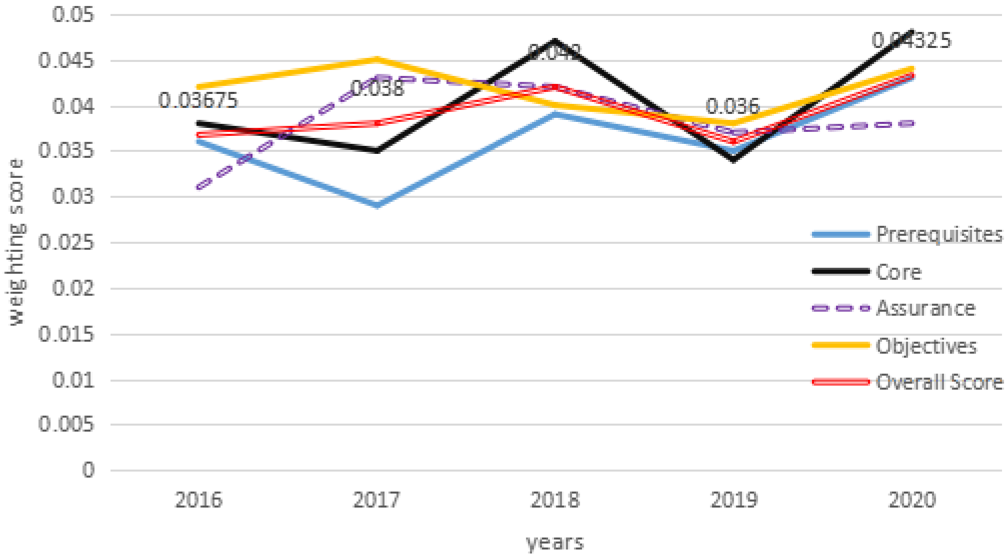

Figure 1. Score of primary indicators

In the process of analysis on the aspect of green cover, the comparison was made from the proportion of grass area, and the green cover of the mine area was 32.67%, 44.83%, 49.72%, 36.64% and 53.62% from 2016 to 2020, respectively. in the process of analysis on the aspect of green cover, the change of cover has a direct impact on the aspect of green mine construction. The changes of forest and grass cover are shown in Table 1.

Table 1. Forest and grass cover

	2016	2017	2018	2019	2020
Forest and grass cover(%)	32.67	44.83	49.72	36.64	53.62

Under the premise of analyzing the forest and grass coverage of the mine area, the analysis should be carried out from the perspective of "three waste" emission rate, and under the premise of analyzing the situation of pollutants, the implementation should be carried out from the aspects of pollutant sampling and soil sampling, etc. The soil sampling of the mine area is carried out by random selection, and after sampling the soil, the situation of inorganic pollutants in the soil is shown in Figure 2.

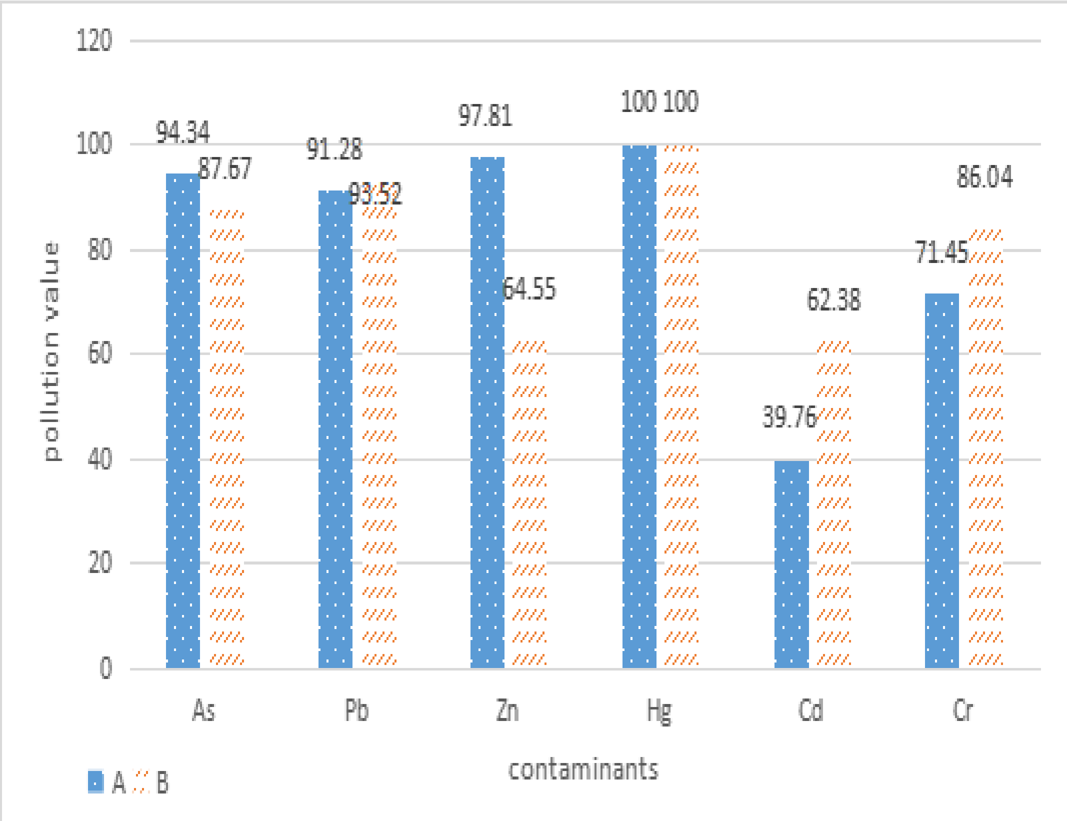

Figure 2. Inorganic soil contamination in mining areas

In the process of analyzing the aspect of soil inorganic pollutants, the Hg in soil inorganic pollutants completely exceeds the standard, and the content of As, Pb, Zn and other aspects need to achieve effective control, and in the analysis of the pollution situation in the industrial site, the surrounding pollutants are obviously lower than the industrial site. When green mine construction is carried out, adjustments need to be made in terms of pollution treatment, pollution diffusion and migration, which are the basic conditions for circumventing pollution treatment and adjustment.

In the process of analyzing the land reclamation rate aspect of the mine site, the sub-accounting is done from the perspective of land reclamation rate, and the accounting results are shown in Table 2.

Table 2. Land reclamation rate of the mine site

	2016	2017	2018	2019	2020
Destroyed land	1243.12	1372.35	1945.63	2138.94	2456.88
Reclaimed land	314.06	498.57	873.76	1513.29	1740.34
Temporary land	433.74	862.71	1346.52	1437.68	1621.43
Land reclamation rate	21.87%	28.94%	67.34%	71.50%	74.98%
Land Reclamation Rate	48.69%	41.54%	66.85%	69.74%	71.62%

By analyzing the above information data, in the process of analyzing and adjusting the land reclamation rate aspect, the difference of land reclamation potential is not obvious, and the land reclamation space is relatively saturated, so it is necessary to further strengthen the reclamation effect and to restore the environment as the basis, so as to realize the comprehensive construction of green mine.

In the process of analyzing the aspect of land command, the analysis is made from the perspective of arable area, forestable area, grassable area, treatment area and land treatment rate, whose specific data table is shown in Table 3.

Table 3. Land planning and treatment in the mine area

	2016	2017	2018	2019	2020
Arable area	716.82	733.93	765.27	724.06	813.35
Forestable area	68.94	70.25	73.41	79.65	87.48
Area suitable for grass	296.38	327.44	331.52	367.30	425.17
Sum of governance areas	1082.14	1131.62	1170.20	1170.01	1326
Land management rate	93.64	95.87	97.59	98.63	98.82

In summary, in the process of analyzing the ecological industry and green mine construction, the analysis is conducted from the aspects of greening mine construction and industrial planning, and it is found that the overall greening effect of the green mine area is relatively good in the process of comprehensive construction, and the greening coverage rate and land reclamation effect show a yearly increase, and in the process of analyzing the land planning and governance, the land governance This indicates that the overall situation of mine development has an upward trend.

4. Suggestions for Geo-EP in Mining Areas

4.1. Enhance Soil and Water Conservation in Mining Areas

Introduce corresponding system to guarantee the effectiveness of corresponding management, control the water resources disaster caused by mining activities, and develop and utilize water resources. Strengthen the control of pollution emission from surrounding enterprises, strictly implement energy saving and emission reduction, reduce pollution in mining areas, and improve the survival rate of forest and grass. This will ensure the effect of afforestation and achieve the effect of soil and water conservation. Environmental pollution of water and soil in mining areas is mainly caused by the unreasonable accumulation of mining waste rock such as coal gangue and tailings slag produced in mining activities. In response to this problem, mining waste wastes are reasonably handled, and EP measures of mining enterprises are improved to regulate mining activities of open-pit coal mines, reduce internal discharge and promote external discharge.

4.2. Manage Slope Mining to Prevent Ground Collapse

Restoring the original vegetation and completing greening are of great significance to substantially manage the slopes of mining areas and reduce ground collapse. The drought tolerance and pollution resistance characteristics of the vegetation in the mining area need to be taken into consideration, and drought-tolerant shrubs are set as the main tree species of the slope. To reduce the collapse of mine remediation land, in the process of actual management, water sand can be used to fill the hollow area, and for the medium-thick mine area, high-pressure human mud injection technology is used to reduce as well as minimize the subsidence of the ground surface. In addition, to promote the value of land resources utilization by mining enterprises, the compensation price should be increased so that they can reduce the degree of damage as much as possible and cut down the damage area, or choose to stop mining work for certain mining areas where the compensation price is similar to the value of mined minerals.

4.3. Land Resource Management

Reasonable management of coal gangue, in the process of mining, coal sludge still exists, in the process of management of coal gangue, ash slag can be applied to brick making, as far as possible to mine waste slag, waste rock for backfill, reduce waste rock, waste slag land resources occupation, save reclamation funds, to achieve comprehensive improvement of the geological environment of the mine.

5. Conclusion

In the new period of rapid economic development, mining resources have become a strategic resource, the role of mining resources on economic development is becoming more and more obvious, and the exploration, exploitation and use of mining resources have become the core topic of social concern in the new period. This paper combines mining and economic conditions, uses FMAs to establish a mine geological environment assessment system, accurately assesses the geological environment of mines, avoids the occurrence of geological disasters in the mining process, effectively formulates mining mining plans, and achieves the new era mining goals of safe mining, EP, energy conservation and EP, and high quality and efficiency.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Mahdi A, Siamak T. Improved Arithmetic Optimization Algorithm for Design Optimization of Fuzzy Controllers in Steel Building Structures with Nonlinear Behavior Considering Near Fault Ground Motion Effects. Artif. Intell. Rev. (2020) 55(5): 4041-4075.

[2] Cuong T, Bao H, Moazam B, Amir M R, Mehdi H, Mohammad M. Optimized Fuzzy Clustering Using Moth-Flame Optimization Algorithm in wireless Sensor Networks. Artif. Intell. Rev. (2020) 55(3): 1915-1945.

[3] Tobias E, Martin P, Doreen T. Automation of Maritime Shipping for More Safety and EP. Autom. (2020) 70(5): 406-410. https://doi.org/10.1515/auto-2020-0003

[4] Simona P, Pedro S A, Daniel P M. A Discriminant Analysis of High and Low-Innovative Firms: The Role of IT, Human Resources, Innovation Strategy, Intellectual Capital and Environmental Dynamism. J. Knowl. Manag. (2020) 26 (6): 1615-1632.

[5] Mikaeel A , Mohammed E. L, Ryuto S, Abdul M H, Tomonobu S. Optimal Sizing of Multiple Renewable Energy Resources and PV Inverter Reactive Power Control Encompassing Environmental, Technical, and Economic Issues. IEEE Syst. J. (2019) 13 (3): 3026-3037. https://doi.org/10.1109/JSYST.2019.2918185

[6] Kurt V, Chandrani B, Fabio M, Jon W. Teaching Algebraic Model Construction: A Tutoring System, Lessons Learned and an Evaluation. Int. J. Artif. Intell. Educ. (2020) 30(3): 459-480. https://doi.org/10.1007/s40593-020-00205-3

[7] Srecko S, Nenad J, Pinaki C. Evaluation of Simulation Systems Suitable For Teaching Compiler Construction Courses. Comput. Appl. Eng. Educ. (2020) 28(3): 606-625. https://doi.org/10.1002/cae.22231
[8] Akihisa O, Andante H P, Daiki Y, Hiroshi O. Environmental and Economic Evaluation of a Mechanical Biological Treatment System for a Small and Medium-Sized Waste Treatment Facility Considering the Karatsu Smart Disaster-Resilience Base Construction Project. Int. J. Autom. Technol. (2020) 14(6): 984-998. https://doi.org/10.20965/ijat.2020.p0984
[9] Dacheng X, Theodore S. R. Construction on Teaching Evaluation Index System of Track And Field General Course for Physical Education Major in Light of Wireless Network Technology. J. Intell. Fuzzy Syst. (2019) 37(3): 3435-3443. https://doi.org/10.3233/JIFS-179147
[10] Utsav P, Sanjeet S. Data Envelopment Analysis in Hierarchical Category Structure with Fuzzy Boundaries. Ann. Oper. Res. (2020) 315(2): 1517-1549. https://doi.org/10.1007/s10479-020-03854-8
[11] Thara A, Jitimon A. FLORA: A Hierarchical Fuzzy System for Online Accommodation Review Analysis. J. Syst. Inf. Technol. (2019) 21(3): 347-367. https://doi.org/10.1108/JSIT-03-2018-0046
[12] Laura A, Ruo C L, Rajiv K, Hejamadi R Rao. Effects of Structural and Trait Competitiveness Stimulated by Points and Leaderboards on User Engagement and Performance Growth: A Natural Experiment with Gamification in an Informal Learning Environment. Eur. J. Inf. Syst. (2020) 29(6): 704-730. https://doi.org/10.1080/0960085X.2020.1808540
[13] Yuta Y, Kenji T, Tadashi W, Toshitake T. Durability Evaluation of an Additive Manufactured Biodegradable Composite with Continuous Natural Fiber in Various Conditions Reproducing Usage Environment. Int. J. Autom. Technol. (2020) 14(6): 959-965. https://doi.org/10.20965/ijat.2020.p0959
[14] Ali A, Roger S, Roozbeh J, Bobak J. M. Using Intelligent Personal Annotations to Improve Human Activity Recognition for Movements in Natural Environments. IEE J. Biomed. Health Informatics (2020) 24(9): 2639-2650. https://doi.org/10.1109/JBHI.2020.2966151
[15] Gabor K, Yasuharu K, Takao M, Hideki H. Saliency and Spatial Information-Based Landmark Selection for Mobile Robot Navigation in Natural Environments. Adv. Robotics (2019) 33(10): 520-535. https://doi.org/10.1080/01691864.2019.1602564
[16] Alice C, Andrea G. When Virtual Feels Real: Comparing Emotional Responses and Presence in Virtual and Natural Environments. Cyberpsychology Behav. Soc. Netw. (2019) 22(3): 220-226. https://doi.org/10.1089/cyber.2018.0393
[17] Euisung J, Eun J J. Service-Oriented Architecture of Environmental Information Systems to Forecast the Impacts of Natural Disasters in South Korea. J. Enterp. Inf. Manag. (2015) 32 (1): 16-35. https://doi.org/10.1108/JEIM-03-2015-0022
[18] Dina K, Suzan A, Birsen D, Martina R, Joyita C. Using Naturalistic Vehicle-Based Data to Predict Distraction and Environmental Demand. Int. J. Mob. Hum. Comput. Interact. (2019) 11(3): 59-70. https://doi.org/10.4018/IJMHCI.2019070104